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Research Center

Billie H. Hix
BILLIE H. HIX
Chief, Technical Systems Branch
The Albert F. Simpson Historical
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THE DEVELOPMENT OF GUIDED MISSILES

APPENDIX B

AAF Missiles Documents

VOL. I

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FILE NO. 201-76
V3

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Auth: C.G. AMC
Initials: CWT
Date: 14 JUNE 1946

Downgraded to Unclassified in accordance with letter from AMC, dated 17 November 1959, Sub: "Declassification of Histories (U)"

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App. B, Vol. I
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Initials: CMT
Date: 14 June 1946

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App. B, Vol. I

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Summary

of

POWER DRIVEN WEAPONS

developed by

Special Weapons Branch

Equipment Laboratory

20 November 1943

No. of pages - 8.

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"Summary of Power Driven Weapons."

A. INTRODUCTION.

1. This report is intended to give a brief summary of the history of the development of power driven weapons, the means of control now available or being developed for them, the tactical uses contemplated for these weapons, and the types and stage of development of the present power driven weapons.

B. HISTORY.

1. The Army Air Corps became interested in the development of power driven weapons, or the "torpedo plane" as it was then known, in 1917 shortly after this country entered the World War. Tests of pre-set "flying bombs" were conducted by the Army Air Corps in 1918 and again in September, 1919, in non-man-carrying aircraft. As a result of these tests, it was recommended by the Chief, Engineering Division, that future tests be conducted in man-carrying aircraft so that adjustments, corrections, and observations could be made in flight under remote control. Mr. C. F. Kettering of the Dayton Metal Products Company, Mr. Orville Wright of the Dayton Wright Airplane Company, Mr. E. A. Sperry of the Sperry Gyroscope Company, Mr. S. E. Votey of the Aeolian Company, designer of the pneumatic controls, and Mr. C. H. Wills, engine designer, were cooperating with the Air Corps at that time in the development of the "flying bomb."

2. Development of the aerial torpedo then continued using man-carrying aircraft. About 1923, the Chief of the Engineering Division recommended the development of radio control apparatus for the aerial torpedoes and in 1924 funds were allotted for this development. According to a letter dated 14 August 1924 from the Chief, Airplane Section, to the Chief Engineer, actual pre-set flights had been made hitting targets as far as thirty miles distant, and radio controlled aerial torpedoes had been controlled by another airplane and actual hits made at distances of 30, 60, and 90 miles, i.e., the torpedoes actually flew those distances to the target accompanied by the control airplane.

3. On 10 October 1928, the Acting Chief of Engineering Division, in a letter to the Chief of the Air Corps, stated that plans were contemplated to investigate the possibilities of adapting commercial airplanes of various sizes to carry different

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bomb loads from 300 pounds to 2000 pounds, thus facilitating the production of aerial torpedoes by commercial firms in war time at very short notice. "The complete program would provide for purchasing one airplane in each of the above bomb size classes (300, 600, 1100, 2000) (selecting the airplane with the most suitable flying qualities in each case), installing the controls, and testing the airplanes for automatic flight, making any necessary modifications to the airplanes, and then filing away the data for use in case of war."

4. In October, 1928, it was decided to buy a Curtiss Robin and early in 1929 flight tests and stability studies of a Curtiss Robin and a Stinson Junior were made. In August, 1930, no satisfactory airplane had been tested. On 13 May 1932, the project was closed out due to insufficient funds.

5. In 1938 the Army Air Corps successfully flew a completely radio and automatically controlled airplane, including landing, and in August, 1938, the Chief of the Air Corps directed that the development of the radio controlled bomb-carrying aerial torpedo should be reopened and, as a result of this action, military characteristics were prepared for the approval of the Adjutant General. These military characteristics called for a range of 20 to 50 miles, no crew, 200 pounds of explosive or a standard 300-pound bomb, and such instruments and equipment as are necessary to permit the aircraft to hit a predetermined target not greater than 2 square miles at a distance of 20 miles. On 29 August 1938 authority was granted by the Chief of the Air Corps for design competition for aerial torpedoes and a request for data was issued in April, 1939. No satisfactory designs were submitted. On 15 January 1940, more rigid military characteristics for an aerial torpedo were submitted for approval by the Secretary of War and these were approved 26 February 1940. These military characteristics called for the torpedo to fly to and strike a predetermined target consisting of a circle 1/2 mile in diameter at a range of 20 miles. The aerial torpedo should lend itself to an extension of range to distances up to 100 miles.

6. In 1941 a contract for the development and delivery of ten (10) non-man-carrying aerial torpedoes and related control and launching equipment was signed with General Motors and later in 1941 the nomenclature was changed from Aerial Torpedo to Controllable Bomb, Power Driven.

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"Summary of Power Driven Weapons."

7. Shortly after 7 December 1941 it was decided that in order to have a controllable bomb, power driven, ground launched, available in the shortest possible time, action would be taken to have the largest possible bombs installed in the radio controlled targets then under procurement, which were the PQ-9, PQ-10, PQ-11, and PQ-12 aircraft.

8. Upon investigation, it was ascertained that the PQ-9 aircraft was too small to carry a bomb and flight tests of the PQ-11, as revised to carry a 1000-pound bomb, proved it to have unsatisfactory flight characteristics, which resulted in cancellation of contract. The Fleetwings PQ-12 was revised to carry a 500-pound bomb and procurement continued. Remote control tests were conducted on this aircraft and it was found suitable for remote flight. However, since the time of procurement, the tactical missions to be performed by these aircraft are considered to have changed to such an extent that the performance of the PQ type aircraft is insufficient to warrant their use tactically. In other words, the Materiel Command wishes to have an aircraft capable of flying with a B-17 or similar type airplane and with a bomb load sufficient to warrant the use of a power driven weapon. The PQ type aircraft is not believed to possess these characteristics.

9. In March, 1942, upon the request of the Chief, Equipment Laboratory, proposals were invited from Fleetwings, Inc., for two types of ground launched, power driven, controllable bombs, one capable of carrying a 2000-pound bomb and the other a 4000-pound bomb, and from Fairchild Aviation Corporation for modification of the AT-14 aircraft, then flying, to provide a new fuselage capable of carrying a pilot, navigator, necessary remote control equipment, and either two 2000-pound bombs, one 4000-pound bomb, or two 2000-pound torpedoes. These proposals were submitted to the Materiel Command and, after examination, Fleetwings was given a contract, dated 10 July 1942, for two controllable bombs capable of carrying one 2000-pound bomb and Fairchild was given a contract, dated 1 October 1942, for two aircraft capable of carrying a 4000-pound bomb load and which have been designated type XBQ-3. In the Fleetwings procurement, changes in engines have since been made on one article which give different characteristics to the two aircraft. They are, therefore, designated as types XBQ-1 and XBQ-2A.

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"Summary of Power Driven Weapons."

10. In a letter dated 16 September 1942, the Chief, Experimental Engineering Section, requested the Assistant Chief of Staff (E), Army Air Forces Materiel Command, Washington, D. C., to obtain two each of the Navy's XTDR-1 and XTD2R-1 controllable bombs. These aircraft are being procured and are to be delivered to the Materiel Command where modifications will be made to provide for installation of Army Air Forces type control equipment and other necessary changes. These aircraft are designated as the XBQ-4 (Navy XTDR-1) and XBQ-5 or XBQ-6 (Navy XTD2R-1 or XTD3R-1). The Navy may install a Wright R-975 engine in lieu of the 12-cylinder Franklin intended for the XTD2R-1 due to considerable difficulties with the Franklin engine, in which event the designation will be XBQ-6 (XTD3R-1).

11. On 16 February, 1943, Technical Instructions, Serial No. CTI-1102, directed "Continue the intensive development of power driven bombs, including various methods of remote control."

12. In a letter dated 24 August 1943 from the Materiel Command to the Commanding General, Army Air Forces, Washington 25, D. C., Attention: Assistant Chief of the Air Staff, Materiel, Maintenance, and Distribution, subject: "Controllable Bomb, Power Driven, General Motors, Type A-1," it was recommended that the General Motors "Bug" project "be discontinued in favor of the man-carrying bomb developments which show more promise."

13. On 10 October 1943 a power driven controllable bomb demonstration was conducted at the Materiel Command Flight Test Base, Muroc, California, using type PQ-12A radio airplane targets as facsimiles of BQ type power driven bombs, in accordance with Materiel Command Technical Instructions, Serial No. CTI-1102, Addendum No. 1, dated 5 July 1943. A television camera transmitter was installed on the wing of each type of PQ-12A aircraft and a 500-pound bomb was mounted in the fuselage. A television receiver was installed in the type AT-7 airplane and the radio control pilot controlled the PQ-12A from the AT-7 using the television picture as reference for the attitude and proximity of the PQ-12A to the target.

14. The first demonstration was an "air-to-air" explosion. Two radio airplane targets, a type PQ-8 and a type PQ-12A, on different radio frequencies were used. The PQ-8 was controlled visually from the type UC-78 airplane and the PQ-12A was controlled by reference to the television screen in the control airplane. The

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"Summary of Power Driven Weapons."

control airplanes were at least one mile off the right wing of the target airplanes. The bomb was armed remotely while on course. When the PQ-8 airplane was centered in the television screen of the control airplane and appeared to be of a size to indicate a reasonably close range, the explode circuit was actuated remotely. Later, ground estimates placed this range at approximately 75 feet. The PQ-12A airplane completely disintegrated with the main force of the explosion appearing to be concentrated around the fore and aft axis of the PQ-12A and with minimum force to the front and rear. From the ground, the belly of the PQ-8 airplane appeared to be crushed and the tail group appeared to be only loosely attached. No radio control of the target was possible after the burst and it hit the ground in a steep right spiral. As a side light to the actual explosion, maneuverability of both remotely controlled airplanes was demonstrated in setting the courses to intersect over safe territory as close as practicable to the spectators. Three courses were necessary to bring both airplanes over the desired spot together for the actual explosion. The pilotless time on each airplane was approximately 25 minutes.

15. The second demonstration consisted of flying a type PQ-12A radio airplane target into a target by means of television, with receiver and screen being located on control airplane 3 to 5 miles from the PQ-12A and camera transmitter being located in the PQ-12A. Take-off and climb to an altitude of about 1000 feet was accomplished by visual reference to the PQ-12A airplane. Control was then established using the television screen as reference. Once the target was located on the screen it did not drift off. With the PQ-12A at full throttle in a shallow dive, the target was held at least one minute on the television screen, appearing to grow larger and larger with a decrease in distance between the target and the PQ-12A. At the last instant, the 30-foot square target filled the whole screen. The actual impact occurred approximately 30 feet to the right of the 30-foot square target. It is believed that, due to the increased speed of the dive, the directional trim of the PQ-12A was slightly off, causing the television camera to point to the left of the line of flight. Corrections for this factor can be made in the future. No single piece of the type PQ-12A airplane could be found weighing more than 15 pounds, and some pieces were found at least 1000 feet away from the blast.

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"Summary of Power Driven Weapons."

16. At the present time there are five types of power driven bombs, all bi-motored, under procurement. One TDR aircraft is scheduled for delivery to Wright Field in November, 1943, (not received as of 20 November 1943) and one in January, 1944. Delivery of the TD2R or TD3R aircraft, whichever it may be, will be one in December, 1943, and one in February, 1944. The XBQ-1 is scheduled for delivery in February, 1944, the XBQ-2A in December, 1943, and the XBQ-3's in February, 1944, and April, 1944.

C. MEANS OF CONTROL.

1. Control equipment now available or in the process of development for power driven weapons consists of the servo unit, a compact, single unit, remotely controlled automatic pilot which is directly connected to the controls of the aircraft, and the directing equipment which includes the radio link and television or target seekers.

a. Servo - One servo, hydraulic, type A-3, is now standard Army Air Forces equipment. However, at an early date an improved servo unit, the A-4, will be in production and available for the BQ's. This is ready for use on the power driven controllable bombs.

b. Radio - This control link is used to control the controllable bombs in accordance with television or direct visual observations. It has a proven range of 10 to 20 miles and in 1944 more secure link will have been developed. This is ready for use on the power driven controllable bombs.

c. Television - Successful tests have been made using television mounted on controllable bombs and an operating range (radio link) of 10 to 20 miles has been attained. This is ready for use on the power driven controllable bombs.

d. Target Seeking Equipment - This equipment consists of heat, light, and radar detecting and directing equipment which will be connected directly to the servo mechanism of the power driven weapon and is designed to direct the bomb to the source of the radiation. In case of heat it is inherent in a warm target; in case of light it requires daylight operation against a visible target or a brilliant source of light at night; in case of radar it requires illumination by a source of radar energy.

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"Summary of Power Driven Weapons."

Device	Range	Date of Completion
Heat	3 - 7 miles	One type in November, 1943, another in June, 1944.
Light	3 - 5 miles	Three types December, 1943.
Sound	Unsatisfactory	Discontinued.
Radar Homing Bomb	10 - 15 miles	November, 1943.
Radar Send-Receive Bomb	7 - 10 miles	December, 1944.

D. TACTICAL USES.

1. The power driven controllable bomb when controlled by the various target seeking devices would be of most value against strongly protected "pin-point" targets such as power plants, dams, harbor installations, submarine pens, or similar important targets, and against ships, radar installations, or strongly protected targets for which glide bombs would be unsuitable.

E. TYPES OF POWER DRIVEN CONTROLLABLE BOMBS UNDER DEVELOPMENT.

1. There are now five models of power driven bombs under procurement, all of which are bi-motored. These power driven bombs and some of their design characteristics are as follows:

Model	Mfr.	Speed MPH	Range Miles	Bomb Load Pounds	Scheduled Delivery First Article	Quantity Under Procurement
XBQ-1	Fleetwings	222	1717	2000	Feb. 1944	1
XBQ-2A	Fleetwings	210	1654	2000	Dec. 1943	1
XBQ-3	Fairchild	220	1500	4000	Feb. 1944	2
XBQ-4	Interstate	162	400	1950	Nov. 1943	2
XBQ-5	Interstate	212	996	1950	Dec. 1943	2

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Auth: C.G.,Mat.Com.
Date: 6/23/42
Initial: H.F.B.

Present Status and Future Development of Controlled Missiles.

OVH:hc:54:350

1st Ind.

Experimental Engineering Section, Wright Field. June 30, 1942.
To: Assistant Chief of Staff (E) AAF Materiel Command, Washington, D.C.

1. Reference is made to basic communication requesting information on the status of controllable bomb projects of this Office.

2. The special weapons program was initiated many years ago but special impetus was given this work during the spring of 1941 at which time an extensive program of development and test was prepared. (See Appendix 1). Development work on a few of the items has not been accelerated due to the pressure of other more promising projects listed on the program.

3. Attention is invited to the attached 1st Indorsement dated May 19, 1942 to your Office (copy attached) prepared concerning the same program, marked Exhibit 2. It will be noted in this report that a complete summary has been made of the status of all development work in connection with controllable bombs and allied equipment such as radio controlled land, water or air borne targets, as well as various types of special weapons. The status of these projects has not materially changed from that outlined in Appendix 2. Development continues at expected rates. It will be noted that in Appendix 2 there are mentioned only those projects actually under development. It will also be noted in Appendix 2 that an endeavor has been made to avoid unnecessary duplication of effort by dividing the development program between the Army, Navy and National Defense Research Council and through cooperation of these Activities. Only in the case of the flat trajectory controllable glide bomb are both the National Defense Research Council and the Army currently engaged in development work.

4. Listed below are projects which are believed to be desirable for development but which have not been to date specifically initiated by this Office:

a. Controllable towed glider bomb carrying four 2,000 pound bombs or two 4,000 pound bombs, or explosive loads of even greater amounts. The design, development and manufacture of experimental items of this type has not been allocated to aircraft manufacturers since it was considered more desirable to demonstrate feasibility of controllable glider bomb operation with smaller and more readily procurable models prior to obligating a substantial portion of the industrial effort to this project.

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1st Ind. to Assistant Chief of Staff (E)
AAF Materiel Command, Washington, D. C.
Present Status and Future Development of
Controlled Missiles.
June 30, 1942.

b. Controllable Power Driven Bombs, carrying four 2,000 pound bombs or two 4,000 pound bombs, or even greater explosive loads. Negotiations for bombs of this size and category have not been accomplished for reasons similar to those mentioned in paragraph 4 a above.

c. Air launched versions of controllable power driven bombs. A proposal from the Research Laboratories Division of the General Motors Corporation for one variation of this item is now under consideration although a formal contract has not yet been processed.

d. Gun carrying radio controlled airplane in which the sighting would be accomplished by means of television. This version of the controllable weapon program is visualized to be of utility in defensive fighter operations against bombardment aircraft to permit close range attack by the radio controlled airplane while the controlling airplane remains at a safe distance. Due to the pressure of more advanced projects, the development of this gun bearing version of a radio controlled airplane has not been expedited.

F. O. CARROLL,
Colonel, Army Air Forces,
Chief, Experimental
Engineering Section.

4 Incls.
Incl. #3 added -
Appendix 1 (List of Projects)
Incl. #4 added - Cy. IOM dated
May 16, 1942 w/1st Ind. dated
May 19, 1942 and 3 Incls.
(Appendix 2)

cc - Col ...

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Signature ____________

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May 21, 1942.

MEMORANDUM FOR: Colonel [illegible] S. [illegible],
G-4 Section,
General Staff.

SUBJECT: Controlled Missiles.

1. Attached hereto is a copy of Materiel Center [illegible] covering historical resume of the Air Force Special Weapons program, as requested in your memorandum of May 15, 1942, and the Joint Chiefs of Staff memorandum of May 1[illegible], 1942, same subject, copies attached. This report is being transmitted in the first indorsement form, in which it was received from the Materiel Center, and by special messenger in order to comply with the date set in your memorandum.

2. It might be noted that some of the projects are [illegible] listed in exact accordance with the [illegible] previously submitted by Dr. Bush, nor, likewise, are the Air Force [illegible] in exact agreement with those brought out in [illegible]'s report.

Inclosures -
Memo. 5/1[illegible]/42 fr. G-4;
Memo. 5/1[illegible]/42 fr. Jt. [illegible];
Course, 5/1[illegible]/42 fr. [illegible],
[illegible], (11 pgs.)

[illegible] P. [illegible],
Major General, [illegible],
Commanding General,
Materiel Center.

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Directive from Joint Chiefs of Staff Reference
Report on Controlled Missiles Projects.

1st Ind. RPW:hc:54

Experimental Engineering Section, Wright Field. May 19, 1942.
To: Commanding General, AAF Materiel Command, Washington, D. C.

1. Reference is made to basic communication. The following report covering the items outlined in paragraph 2 a, b, c, d and e of directive memorandum is submitted:

a. Historical Resume -

(1) For several years the Materiel Center has been engaged in research and development leading to automatic flight and landing equipment, radio airplane targets, land borne and water borne remotely controlled bombing targets. These devices involved gyro stabilizing mechanisms and servo control equipment developed in the Instrument & Navigation and Special Weapons Units, Equipment Laboratory of this Office and radio controls developed by the Aircraft Radio Laboratory of this Office.

(2) The application of the radio controlled target as an offensive weapon has long been recognized. In 1918 Mr. Kettering experimented with such a non-man-carrying airplane with appreciable success. In 1941 ten articles of an improved version of this weapon were contracted for by the Materiel Center with the Research Laboratories Division of the General Motors Corp., of which Mr. Kettering is the President. This weapon will be described later.

(3) In the spring of 1941 the Materiel Center entered into a greatly expanded program of development and procurement of remotely controlled targets and weapons. This program was carefully coordinated with the United States Navy and Sections D-3 and Division A of the National Defense Research Committee, with a view to the elimination of duplication of effort and mutual assistance through exchange of information. A proper classification was determined for the various forms of controllable weapons. This nomenclature has been standardized and in use for over a year.

b. Special Weapons Program -

(1) Attached hereto, marked Exhibit "A", is the program of special weapons approved by the Commanding General, Army Air Forces to be developed for use by the Air Forces. Since this program was

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1st Ind. to Commanding General,
AAF Materiel Command
Directive from Joint Chiefs of Staff Reference
Report on Controlled Missiles Projects
May 19, 1942.

approved controlled glider bombs (explosive carrying gliders to be towed by controlling aircraft and released for attack against bombardment objectives) have been added to the special weapons projects. The nomenclature used in Exhibit "A" is that standardized in 1941 by the War and Navy Departments.

(2) At a conference held in the spring of 1941 between representatives of the Army and Navy, it was decided that the development of the glide torpedoes referred to in Exhibit "A" would be the responsibility of the Navy, although the wing structure of the glide bomb under Army development might be utilized by the Navy for glide torpedoes.

(3) In order to accelerate development the Materiel Center had previously requested Section D-3 of the National Defense Research Committee to investigate and develop the high angle controllable bomb referred to in Exhibit "A". To avoid duplication the Materiel Center has refrained from activity in this development other than to assist Section D-3 of the National Defense Research Committee in various ways, including flight testing the practice models.

c. Status of Army Program -

(1) Targets (Robot planes with motors)

(a) The type OQ-2A target is a 12 foot monoplane non-man-carrying designed for small arms antiaircraft firing practice. It has been standardized and is in production. This target is launched by catapult and landed by parachute. It attains an airspeed of approximately eighty-five miles per hour at 5,000 feet. It is controlled by radio and does not employ gyro stabilization. The performance characteristics of this item have been favorably received by the using Services. Actual firing has been conducted on this target by ground forces. Although standardized and in production minor changes are currently in progress to improve reliability.

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1st Ind. to Commanding General,
AAF Material Command
Directive from Joint Chiefs of Staff Reference
Report on Controlled Missiles Projects.
May 19, 1942.

(b) The type PQ-8 target is a commercial monoplane adapted to target use by the installation of servo assemblies with three axis gyro stabilization and radio control equipment. This target operates at 116 M.P.H. at 13,500 feet and can be airchecked by a safety pilot. This target has been standardized and is in production. The control system has been simplified in operation to minimize the time of student pilot training. This target has been fired on by C.A.C. antiaircraft and has been found satisfactory with respect to controls. Its performance characteristics are less than desired insofar as speed and altitude are concerned, and for this reason service test quantities of improved types are being procured, designed as follows:

(1) 50 ea. PQ-9, capable of 200 MPH at 17000 ft.
(2) 50 " PQ-10, " " 275 " " " "
(3) 50 " PQ-11, " " 160 " " " "
(4) 50 " PQ-12, " " 165 " " " "

It is estimated that a radio controlled target capable of sufficient speed and altitude will be standardized during the current calendar year after completion of the service test of the above equipment.

(c) Control airplanes for the man-carrying targets are obtained through conversion of standard military aircraft.

(2) Controllable Bombs (High Angle)

(a) This type of equipment has been developed by Section D-3, National Defense Research Committee with the cooperation of the Special Weapons Unit, Equipment Laboratory of this Office. Numerous flight tests have been conducted at Eglin Field, Florida, to obtain data necessary for proper control. The information requested in basic communication should be obtained directly from Section D-3, National Defense Research Committee. During flight tests conducted at Eglin Field, Florida, usable control modifying the normal trajectory of the bombs was attained. It is understood that the next flight tests will incorporate the use of radio controls. The principal advantages of this form of special weapon are that it may be carried in the bomb bay of standard bombardment aircraft, and is practically immune to defensive fire during descent.

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1st Ind. to Commanding General,
AAF Materiel Command
Directive from Joint Chiefs of Staff Reference
Report on Controlled Missiles Projects
May 19, 1942.

(5) Procurement has been initiated with Fleetwings, Inc. for two power driven bombs capable of carrying a 2000 pound bomb 1700 miles at 215 MPH at 17,000 feet. This bomb can carry one man for aircheck and is capable of being ferried minus explosive during daylight hours. Delivery of the first article can be expected within nine months from date of contract.

(6) Negotiations are in progress with Fairchild Aviation Corp. for two power driven bombs capable of carrying two 2000 pound or one 4000 pound bomb 1700 miles at 250 MPH at 15,000 feet. This bomb will carry one or two men for aircheck and ferrying. Delivery of the first article can be expected within six months of date of contract.

(7) It will be seen that the field of bomb loads from 500 to 4000 pounds and ranges from 400 to 1700 miles is spread by existing contracts or initiated procurement and negotiations. This has been done to cover the variations in tactical requirements in various theatres. It is planned to extend the bomb load to 8000 pounds or more as soon as possible.

(8) Controllable Bombs, Power Driven, Air Launched.

(a) These bombs, described in Items 17 and 18, Exhibit "A", can likewise be equipped with television and radio controls, or target seeking devices. The feasibility of this item has not been demonstrated. It is visualized for use against enemy aircraft. Development studies as to the aerodynamic structure, engine and control components have been in progress in the Laboratories of this Office for several months. Test models are planned for procurement during this calendar year.

(9) Radio Control Equipment.

(a) The development of many different types of radio control equipment has been carried on by the Aircraft Radio Laboratory of this Office since 1937. For the small radio targets this equipment is in production. This same type of equipment will be used for radio controlled glide bombs. Radio control equipment for large airplane targets is also in production. This type will be used in all versions of power driven bombs. Development continues with many different radio equipments with a view to increasing performance at lessened cost.

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1st Ind. to Commanding General,
AAF Materiel Command
Directive from Joint Chiefs of Staff Reference
Report on Controlled Missiles Projects
May 19, 1942.

(10) Television Equipment.

(a) A joint development program has been conducted by the Army and Navy with the RCA to obtain a suitable television equipment. Testing at Wright Field and recent tests by the Navy indicate the equipment to be well suited for the purpose intended. Seventeen transmitters with necessary receiving and monitoring equipment are on hand and will be tested in special weapons in the near future. An order has been placed for eighty additional equipments. To accelerate the production program a joint contract between the Army and the Navy has been initiated with RCA to tool the industry for a production rate of 250 equipments per month starting approximately January 1, 1943. Expansion of this program is understood to be capable of being readily effected by the RCA.

(11) Target Seeking Devices.

(a) These devices assume one of four forms, employing heat, sound, light or Radar methods. Progress on these items is as follows:

(1) Heat - Several versions have been constructed at the Materiel Center and are under test at Wright Field. These equipments are still in the experimental stage. Cooperating with the Materiel Center on these items are the Eppley Laboratories, Offner Laboratories, Edgerton Laboratories, Harvard University, Weston Electrical Instrument Co., Massachusetts Institute of Technology and numerous individuals. An additional research program on this type of equipment is being conducted by the Research Laboratories Division of General Motors Corp. Models have been built and tested on surface craft with promising results. Tests on aircraft will be initiated in the near future.

(2) Light - Versions of light sensitive devices are being developed experimentally at Wright Field. Cooperation is being furnished by scientific centers. One item developed by the Hammond Instrument Co. has been flight tested. Under favorable conditions this device has operated for a distance of eleven miles. Considerable work will be required before the apparatus could be practically applied to bombing. Contracts have been let to the Delco-Remy Corporation for experimental quantities of light sensitive equipment. Ground and flight testing has been accomplished on the latter during the past few months. Although the equipment warrants continued development its utility has not yet been proven.

[redacted]

260

Carbon Copy
Cont. Missiles
AC-30 - 53 (10) 184?
? L. DLB

[redacted]

1st Ind. to Commanding General,
AAF Materiel Command
Directive from Joint Chiefs of Staff Reference
Report on Controlled Missiles Projects
May 19, 1942.

(3) Sound - Of many sound sensitive devices presented, only one item, proposed by the Pioneer Instrument Division of Bendix Aviation Corp. has warranted development. A contract has been let for five articles.

(4) Radar - At a recent conference with representatives of the Radiation Laboratories of the Massachusetts Institute of Technology, which includes members of Section D-1, National Defense Research Committee, this Office was informed that the Radar developments being carried on by that Laboratory had sufficiently advanced to warrant their immediate application to special weapons. To accelerate the program it is planned to make available on Type PQ-8 airplane for test and to request Section D-1, National Defense Research Committee to expedite the development. Equipment suitable for flight test is expected to be available within thirty days.

2. Summarizing the progress to date:

a. Controllable glide bombs for mass stabilized flight attack should be standardized in August 1942.

b. Controllable glide bombs, radio and television controlled for precision bombing should be standardized during the present calendar year.

c. Controllable glider bombs are in the experimental flight stage. Further flights will be necessary to determine the feasibility of towing remotely controlled gliders.

d. Power driven controllable bombs, delivered, or in process of development, are of two types, single and bimotored, and vary in loads and range from 400 to 4000 pounds and from 400 to 1700 miles. A single engine version should be standardized for production if such is desired by the end of the calendar year. Bimotored experimental types will be delivered by the winter of 1942 - 1943. These bombs are designed to use controls similar to the other special weapons.

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Carbon Copy
Cont. Missiles
3C-36-53 (11/18pp)
RL, DEB

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1st Ind. to Commanding General,
AAF Materiel Command
Directive from Joint Chiefs of Staff Reference
Report on Controlled Missiles Projects
May 19, 1942

e. Radio and television equipment is well developed. Target seeking devices are promising in some instances, but require further technical development and flight testing to determine tactical utility.

F. O. CARROLL,
Colonel, Air Corps,
Chief, Experimental
Engineering Section.

4 Incls.
Incl. #4 added -
Program - Exhibit "A"
(in dup)

[redacted]

 Signature _______________

MDAC-5 9-12-40-75M

TELETYPE MESSAGE

DATE: [illegible] 194[illegible]

FROM [illegible]

ATTENTION: [illegible]

[illegible]

THIS PAGE IS DECLASSIFIED IAW EO 13526

Cent F MX 53 (1/14) MX 53888

[redacted]

Commanding General
Air Materiel Command
Wright Field, Dayton, Ohio.

920

Wright Field, Dayton, Ohio
24 AUG 1943

Controllable Bomb, Power Driven,
General Motors, Type A-1.

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Assistant Chief of the Air Staff,
Materiel, Maintenance, and Distribution.

1. The following summary of the entire project of the General Motors power driven bomb has been prepared for your information and for decision by your Office and the Assistant Chief of the Air Staff, Operations, Commitments, and Requirements, as to whether or not this project should be closed out.

2. The Research Laboratories Division of the General Motors Corporation should not be discredited in any way as the result of a decision to drop this project as they have done everything in their power to bring this project to a successful conclusion. They have succeeded in developing a new type of power plant and several novel types of airframe construction which might be used on future projects.

3. Summary:

August 8, 1938

The aerial torpedo development was reopened by direction of the Office, Chief of Air Corps.

August 29, 1938

A design competition for Aerial Torpedoes was authorized.

October 1, 1938

Specification was issued for Aircraft, Aerial Torpedo. Military Characteristics called for a range of 20 to 50 miles, no crew, 200 pounds of explosive or a standard 300 pound bomb, and such instruments and equipment as are necessary to permit the aircraft to hit a pre-determined target not greater than 1 square miles at a distance of 20 miles.

Classification cancelled or changed to
AUTH: CP 334
By
Signature and Grade
Date 11-1-45

[redacted]

T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff

C-8-383

CENTRAL FILES

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(2/14)

[redacted]

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.
24 AUG 1943

October 12, 1938

The Aerial Torpedo was reclassified from Secret to Confidential.

April 26, 1939

The Vega Airplane Company was the only bidder on the design competition. It was decided that their design was of doubtful military value and that no equipment would be procured from this source.

September 7, 1939

Letter from C. F. Kettering to General Arnold - "I believe that a plane of 150 h.p., complete with controls and radio to receive its explosive load, could be built in the neighborhood of twelve to fifteen hundred pounds and I don't believe should cost, in reasonable quantities more than that many dollars."

November 3, 1939

Letter from General Arnold to C. F. Kettering - "I have stated in some detail the aerial torpedo problem as it appears to me in the hopes that you may be able to interest activities under your control to a degree that we could receive a definite proposal for the continuation of the development of this project along lines I have indicated." (Cost $700.00, high production).

November 28, 1939

Letter from C. F. Kettering to General Arnold - "I am quite sure that in quantities of 10,000 or more, a quite satisfactory cost figure could be attained and we are absolutely in sympathy with your point of view that it must be good and low priced. If we can be of any assistance in carrying this matter forward kindly let us know."

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MI-53

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(3/14)

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.

24 AUG 1943

February 26, 1940

Revised military characteristics were approved which called for the torpedo to fly to and strike a predetermined target consisting of a circle 1/2 mile in diameter at a range of 20 miles. The aerial torpedo should lend itself to an extension of range to distances up to 100 miles.

September 11, 1940

CTI-98 - "The Chief of the Air Corps desires that immediate steps be taken to enter into contract with the Cessna Aircraft Company for the procurement of an experimental quantity of aerial torpedoes."

September 13, 1940

Letter from C. F. Kettering to Captain Holloman - "After this meeting with yourself and the Cessna Aircraft, we can then submit a proposal for a development contract with the Army Aircraft Division."

September 27, 1940

At a conference attended by representatives of the Materiel Center, Cessna Aircraft, and General Motors Corporation, Mr. Kettering stated that he felt that any contract made should be between the Government and the Research Laboratories Division of General Motors Corporation, and that the latter corporation would subcontract with the Cessna Aircraft Corporation.

October 12, 1940

Power Driven Aerial Torpedo project M-24-38 was combined with project MX-53 and all data were marked accordingly.

January 4, 1941

The Power Plant Laboratory agreed to run a type test of the General Motors 2 cycle Aircraft engine if one could be made available.

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891 [redacted] 142

(4/14)

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.

24 AUG 1943

February 14, 1941

Contract 16396 with the General Motors Corporation was signed. It called for the development and delivery of 10 aerial torpedoes and related control and launching equipment.

April 30, 1941

It was decided that radio control equipment would be installed in the General Motors Aerial Torpedoes as it was felt that radio control would increase the probability of successful launching. It was also felt that by use of radio control several simulated bombing runs could be made in each flight.

May 21, 1941

Nomenclature was changed from Aerial Torpedo to Controllable Bomb, Power Driven, as a result of the recommendations of the joint Army-Navy conference on 16 April 1941.

July 16, 1941

The General Motors Power Driven Bomb, Type A-1 was tested at Langley Field in the full scale tunnel. Data indicated that rudder and elevator surfaces were adequate to control the torpedo in normal flight attitudes at cruising speed.

November 15, 1941

The first unit was tested at Muroc Lake, Muroc, California. This unit was launched from a carriage on a special track. The unit was attached to the carriage with a spring release mechanism so that it would release automatically as soon as it had 175 pounds excess lift. The take-off occurred at a speed of 91 MPH and the unit settled immediately and struck the ground as the take-off had occurred before the bomb had attained sufficient flying speed. It was decided to modify the launching carriage so that the units would be released mechanically after a 1500 foot accelerating

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MX-53

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(5/14) [redacted] 143

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.
24 AUG 1943

run on the track.

December 5, 1941.

The second unit was tested at Muroc Lake. Take-off was at approximately 100 MPH. The bomb went into a steep climbing right turn after take-off. The turn was stopped by radio control. Elevator control by radio was difficult and the bomb was switched to the automatic controls. The bomb then went into a sharp left turn and dived into the ground before recovery could be made by radio. This failure was caused by over control of the automatic controls. Flight time was 2-1/2 minutes. It was decided to reduce the limits on control surface movements to help the over control condition.

December 7, 1941

The third unit was tested at Muroc Lake. The only changes from the second flight were in the limit settings of control movement. Left rudder was reduced from 16 to 6 degrees, right rudder was reduced from 6-1/2 to 3 degrees. This bomb showed over control by both radio and automatic controls. The radio transmitter was accidentally disconnected after 10 minutes of flight and the bomb crashed five minutes later.

December 8, 1941

The fourth unit was tested at Muroc Lake. The rudder limit settings were reduced to 1-1/2 degrees both right and left. Elevator limits were reduced to 2 degrees up and 1 degree down. Rate of control movement was reduced from 17 to 8 minutes of angle per radio impulse. This bomb showed a tendency toward over control by radio and over controlled very badly with the automatic controls. It was crashed in landing after a flight lasting one hour and thirty-five minutes.

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RI-33

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.

24 AUG 1943

January 7, 1942

A conference was held at Wright Field with representatives of the Research Laboratories Division, General Motors Corporation. It was decided that a power driven launching car would be built as the track and carriage were unsafe and too cumbersome to be of military value. It was also decided to install gyros on pitch and roll to stabilize the flight. It was agreed that the roll gyros would control spoilers as the construction of the wing does not lend itself to the installation of ailerons.

January 23, 1942

The barometric altitude control was modified to obtain follow-up and was brought to Wright Field for tests. Tests showed that a greater follow-up ratio was needed and the control was returned to Detroit for modification.

January 29, 1942

The altitude control was again tested and it was found that it would operate satisfactorily at any given altitude but that action in climbing or diving to the pre-set altitude was of dangerous violence. The altitude control was returned to Detroit for the addition of a device to limit the rate of climb.

February 24, 1942

One unit was shipped from Detroit to Wright Field for the installation of Television equipment. It was believed that the utility of the weapon could be increased by adding television to assist in directing the bomb to a point target by radio.

March 10, 1942

The fifth unit was tested at Eglin Field, Florida. This was equipped with two axis gyro stabilization. Since the automatic controls were not perfected it was decided that

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.
24 AUG 1943

they would not be installed and all further efforts would be confined to the development of this weapon as a radio controlled bomb only. This unit was launched from the power driven launching car. The unit crashed when launched due to a side wind and a faulty control hook-up. It was decided that future launchings would be made without side wind.

March 19, 1942

The sixth unit was tested at Eglin Field, Florida. This unit also had two axis gyro stabilisation acting on spoilers and elevators. Provision was also made so that manual radio control without the gyros could be obtained. The bomb was launched successfully and a run was made at a target with manual control of the rudder and gyro control of the elevators. In rough air the bomb was continually bumped to a new heading, so it was pulled out of its dive and another run made at the target with the spoiler gyro acting also. On this run the rough air also bumped the bomb off course, but not as bad as before. As the bomb neared the target it became unstable in pitch and finally dumped the gyros and rolled over. It was recovered on the manual control position and was finally dived into the ground after a flight of one hour and fifty-five minutes. It was believed that the pitch instability was caused by improper follow-up ratios for the increased speed encountered in the dive.

April 2, 1942

The seventh unit was tested at Eglin Field, Florida. As a result of the previous tests the roll gyro in this ship was arranged so that it could be made to control either the rudder or the spoilers. The elevator follow-up ratio was also changed from 2 to 1 to 1 to 1. Pitch control in dives was much better, but directional control was still poor. After one hour and forty minutes of flight the bomb refused to answer radio signals and it crashed ten minutes later. It was believed that the generator was not charging, thus letting the voltage drop to such a low value that the radio receiver and servo quit operating.

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(8/14)

April 16, 1942

Letter from Mr. E. V. Rippingille of General Motors Corporation to Lt. Colonel G. V. Holloman - "We do not believe that the catapult type of launching gear is practical for these ships for obvious reasons but there is a possibility that a short track with a rocket assist on the take-off carriage is worth investigating; this is in hand, also the tricycle gear."

April 24, 1942

Letter from Colonel Grandison Gardner to General Arnold - "Everyone with whom I have talked agrees that a 500 pound load is inadequate. Recommendations: 1. I would recommend against any quantity production of these weapons unless we can simultaneously train pilot-engineer operators in proportion. I should think we would have to have the pilots of eight or ten bombardment groups trained to fly these weapons, in addition to their regular bombardment aircraft. 2. If you think the last half of 1943 and 1944 is soon enough, I would say--start production now. 3. I am more favorably inclined toward producing automatic pilots and radio equipment and diverting training airplanes if we think we see a definite need for this weapon later this year. 4. We should carry on uninterruptedly with the development of these weapons whether we produce them in quantity or not."

April 30, 1942

At a conference attended by representatives of the General Motors Corporation, it was decided that in the absence of adequate pre-set controls and in view of the poor results from attempts to target the bombs visually, the control equipment should include television and three axis gyro stabilization. It was also decided that five additional units would be procured. These additional units were to have tricycle

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C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.

24 AUG 1943

landing gear so that the bombs could be landed after test flights in order that follow-up ratios for the gyros could be worked out with the minimum expenditure of bombs. In addition it was decided that a monorail catapult accelerated by jet propulsion, and a droppable tricycle launching gear would also be procured.

June 16, 1942

Letter from Mr. Frank Rippingille of the General Motors Corporation to Colonel G. F. Holloman - "I feel that if steps are taken to try this method of operation (air launching) as soon as possible we will be able to throw a new light on the present "Bugs" as far as a piece of equipment goes. I feel further that one or two of the present "Bugs" be set aside for this experiment and that every possible effort should be made to adapt a control ship at the earliest possible moment."

July 17, 1942

The eighth unit was tested at Eglin Field, Florida. It was equipped with television and three axis gyro stabilization and was launched from the power driven launching car. The bomb took off in a very steep climb but did not respond to the radio control and crashed after a flight of two minutes. It was decided that the failure of the control radio was probably caused by moisture inside the set as the test was made following a long period of heavy rain and fog, and that subsequent tests should be made at the Muroc Army Air Base pending the redesign of the radio control equipment to eliminate trouble caused by high humidity and salt air.

September 6, 1942

The wings of the ninth unit were destroyed when it went out of control while it was being taxied to

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(10/18)

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.
24 AUG 1943

determine the proper follow-up ratio for the steerable nose wheel of the tricycle landing gear.

September 22, 1942

The ninth unit was taxied successfully at 75 MPH. During the taxi runs the bomb stayed within ten feet of a straight line which was marked on the lake bed to simulate a runway. In order to cool the engine while taxiing at slow speed it was necessary to remove the engine cowling and install an oversize radiator. It was decided that the preliminary tests were satisfactory so the small radiator was reinstalled and the cowling put back on and the bomb prepared for flight.

September 25, 1942

The ninth unit was destroyed during a final taxi test prior to an attempted take-off. It was taxied successfully to about 50 MPH at part throttle. When the throttle was cut and the brakes applied, the bomb swerved off course to the right, dumping the directional gyro and giving full left rudder and nose wheel. The taxi test was made with full down elevator to increase the pressure on the nose wheel for better steering and it was believed at that time that the right brake seized and caused the initial swerve to the right that resulted in the crash. Therefore, the brake pressure on the next unit was greatly reduced, but all other settings were kept the same.

September 30, 1942

The tenth unit was destroyed during an attempted take-off. The bomb veered slightly to the left when the throttle was opened and then went parallel to the line for about one thousand feet. At that point it veered sharply about twenty degrees to the right and continued for approximately one thousand feet more when it banked and turned sharply to the left and then rolled over. Full down elevator was used on this run also and examination of the tracks showed that only

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(11/14) 149

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.

24 AUG 1943

the nose wheel was touching the ground during the last one thousand feet of travel. It is now believed that this condition was the cause of these crashes.

October 26, 1942

A conference was held with personnel of the Research Laboratories Division, General Motors Corporation. It was decided that in view of the targets against which it can economically be used, the bomb will be useful only as an air launched weapon due to its short range and low weight carrying capacity, and that if air launched, the bomb could carry a 500 pound bomb and radio and television equipment for 15 minutes at a speed of 185 MPH. It was decided to drop the tests with the tricycle gear due to the improbability of being able to launch and land the bomb successfully by this means. It was also decided that the bomb should be ground launched from the power driven launching car under full gyro control to prove the control system prior to any launching attempts from an airplane.

January 7, 1943

Four units were inspected at Detroit, Michigan prior to shipment. The operation of the directional gyros was unsatisfactory and it was decided to delay shipment until the gyros were modified to give more satisfactory and consistent operation.

February 15, 1943

Four units were shipped from Detroit, Michigan and were stored at the Materiel Center Test Base, Muroc, California pending drying of Muroc Lake which was flooded due to heavy rains.

February 16, 1943

CTI-1102 "Continue the intensive development of power driven bombs, including various methods of remote control." [redacted] 5, 1943, five types

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MX-55

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(12/14) [redacted] 150

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.

24 AUG 1943

of man carrying power driven bombs were being procured with load carrying capacities up to 4,000 pounds and ferry ranges without bombs up to 3,000 miles, and ranges with bombs as high as 1,500 miles.

March 19, 1943

The Power Plant Laboratory reported on the type test of the General Motors GM-250-1 two-cycle engine which failed after 95 hours of endurance running on an attempted type test. The test was stopped because of a fatigue crack in the crankcase.

March 29, 1943

The gyros in the units stored at the Materiel Center Test Base were returned to General Motors for inspection. It was found that four gyros out of the twelve returned had deteriorated sufficiently in storage as to be unsatisfactory. These gyros were rebuilt.

May 24, 1943

The eleventh unit was tested at Muroc Lake. The unit was equipped with three axis gyro stabilization and television and was launched from the power driven launching car with the roll gyro inoperative and the spoilers centered. When launched the bomb lifted about six feet at once and then skidded to the left. It dropped to within about four feet of the ground and finally started climbing on a course approximately 60 degrees to the left of the course of the launching car. Its action in flight indicated that the follow-up ratio on the directional gyro was too large. The unit was unstable in turns and control was sluggish, but the unit was crashed 75 feet from the target by means of television. It was decided that flight characteristics under gyro control could be improved by reducing the rudder follow-up from 6 to 1 to 5 to 1 and reducing the spoiler follow-up ratio from 1 to 1 to .75 to 1.

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C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.

May 27, 1943

The twelfth unit was tested at Muroc Lake. It was launched from the power driven launching car under full three axis control. After release from the launching car the unit went into a steady climb of approximately 2000 feet per minute on very nearly the same course as the launching car. After approximately 30 seconds of flight, a combined rolling and yawing oscillation built up. During the flight various combinations of controls were tried and it was found that comparatively stable straight flight could be obtained with the roll gyro inoperative and the spoilers centered. It was impossible to find any control combination with which stable flight could be obtained in turns. After a flight of one hour and twenty minutes, the unit rolled over and crashed while making a turn. It is believed that it will be necessary to expend a large number of these bombs to determine follow-up ratios which will give satisfactory flight characteristics for air launching. In view of the large expenditure involved and the questionable utility of this weapon even though successful air launching and flight were attained, it has been recommended that this phase of the power driven bomb development be discontinued in favor of the man-carrying bomb developments which show much more promise.

4. Results of tests on this project, results of tests on the Glide Bomb project, and results of tests made in the past on this and other similar developments in which no provision has been made for a safety pilot, have shown it can reasonably be expected that at least one hundred units must be expended in order to work out a satisfactory control system to obtain accurate flight to a point target. This weapon would still be of doubtful value due to the inability to flight test the equipment before bombing missions as no pilot can be carried, thus making it necessary to have highly trained technicians service these weapons in the field. It is estimated that this development would involve the expenditure of $700,000.00 and would require at least 18 months for completion. The alternative, redesign of the

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(14/14)

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C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
Controllable Bomb, Power Driven,
General Motors, Type A-1.

bomb to provide for a safety pilot, would require an expenditure of approximately $200,000.00 and would take at least two years for its completion. Successful completion of this project would result in a weapon of questionable value due to its bomb capacity of only 500 pounds and range of only 200 miles. In comparison, the type PQ-12A radio airplane target has a bomb capacity of 500 pounds and a range of 670 miles. This airplane is now at Wright Field for tests. In addition, five other types of power driven bombs with much larger bomb capacity and much greater range are being procured. The first of these is scheduled for delivery to Wright Field in October, 1943.

5. In accordance with a recent directive from your Office that projects showing little promise be dropped, this summary is presented for consideration by your Office and the Assistant Chief of the Air Staff, Operations, Commitments, and Requirements, as to whether or not this project should be discontinued. The results of this study are requested.

T. A. SIMS,
Colonel, Air Corps
Deputy, Chief of Staff

27 AUG 1943

ENGINEERING DIVISION
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MX-53

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MDAC-5-WF-9-12-40-75M

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TELETYPE MESSAGE

RPW:dh:54:3747
8:45 A.M.

DATE: May 1, 1941.

FROM P.O.CARROLL,Lt.Colonel,A.C.

ATTENTION: CHIEF, ENGINEERING SECTION

REMOVE FROM RECORDS

EXP-T-390 RETELETYPE Ex-230 dated 4-24-41 and EX-245 DATED 4-30-41 AND BUREAU OF AERONAUTICS' LETTER DATED APRIL 18, 1941, PERTAINING TO REPORT OF CONFERENCE ON GLIDE BOMBS, GLIDE TORPEDOES, ETC., THE FOLLOWING COMMENTS ARE SUBMITTED:

REFERENCE PARAGRAPH 4 OF ABOVE LETTER, IT IS AGREED THAT MUCH CONFUSION CAN BE AVOIDED BY STANDARDIZED NOMENCLATURE. THE TERMINOLOGY OUTLINED IN PARAGRAPH 4 IS CONCURRED IN WITH THE EXCEPTION OF THAT IN PARAGRAPH 4 (b) BOMBS. IT IS BELIEVED THIS TERM SHOULD BE CHANGED TO CONTROLLABLE BOMBS TO PERMIT THE NORMAL UNCONTROLLABLE FREE FALLING TYPE STILL TO BE REFERRED TO AS BOMBS. IT IS AGREED THAT THE TWO MAJOR CLASSIFICATIONS, TORPEDOES AND CONTROLLABLE BOMBS, SHOULD BE FURTHER DIVIDED AS OUTLINED IN THE SUBJECT LETTER. IT IS AGREED THAT THE U. S. ARMY AIR CORPS SHOULD CONTINUE DEVELOPMENT OF THE POWER DRIVEN BOMB AND OF THE GLIDING BOMB OF SUCH CHARACTER THAT THE CARRYING STRUCTURE CAN BE USED WITH A NAVAL TYPE TORPEDO, AND THAT THIS EQUIPMENT SHOULD BE MADE AVAILABLE TO THE NAVY DEPARTMENT FOR TEST. IT IS RECOGNIZED THAT THE ACCELERATED DEVELOPMENT OF THIS PROGRAM WILL BE FACILITATED BY THE INTERCHANGE OF TEST REPORTS BETWEEN THE SERVICES AND BY THE MAINTENANCE OF

MDAC-6-WF-9-12-40-75M

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CCF MX-8 F4
(2/5)

TELETYPE MESSAGE

DATE: May [illegible], 1941

FROM

ATTENTION:

CHIEF, ENGINEERING SECTION
EXP-T-890

REMOVE FROM RECORDS

CLOSE LIAISON. A STUDY IS CURRENTLY BEING CONDUCTED OF A [illegible] DETAILED NOMENCLATURE WITHIN THE GENERAL TERMINOLOGY OUTLINED IN PA[illegible] 4 OF THE SUBJECT LETTER. A REPORT OF THIS STUDY WILL BE SUBMITT[illegible] TEN DAYS.

EXPERIMENTAL [illegible] SECTION

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LETTER OF INSTRUCTIONS

839

OFFICE, CHIEF MATERIEL DIVISION, AIR CORPS (4-B-1)

WASHINGTON, D. C.

2260

Serial No. LI-115. Date: April 2, 1941.

Subject: Development and Procurement of Radio Controlled Aerial Targets and Dirigible Weapons.

To: Assistant Chief, Materiel Division
Wright Field
Dayton, Ohio

1. It is directed that you proceed with the development and procurement of radio controlled aerial targets and dirigible weapons.

2. Funds for this development will be made available by you from your current expenditure program in an amount not to exceed three-million dollars ($3,000,000.00).

3. A program of development for this type of equipment will be submitted at the earliest practicable date - this program to indicate what activities will be undertaken during the remainder of the current fiscal year, and will also indicate what activities will be anticipated during the fiscal year of 1942 and will contain an estimate of the additional funds required for 1942.

O. P. ECHOLS
Brigadier General Air Corps
Chief, Materiel Division

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EPW:ek:54
Wright Field, Dayton, Ohio
April 9, 1941

Commanding Officer, Wright Field.

Space for Special Weapons Unit,
Equipment Laboratory, Experimental
Engineering Section.

1. To comply with Letter of Instructions dated April 2, 1941, Serial No. LI-115, subject: "Development and Procurement of Radio Controlled Aerial Targets and Dirigible Weapons," copy attached, and to conduct a greatly expanded activity in the development of radio controlled aerial targets, dirigible bombs and torpedoes, it will be necessary to increase the Special Weapons Unit of the Equipment Laboratory, Experimental Engineering Section by some thirty officers, engineers, and clerical personnel.

2. It is expected that eventually a building with proper facilities will be constructed for the subject Unit, but most recent advices indicate that a delay of one and one half years may take place prior to installation of the usual facilities. For this reason, it is strongly recommended that, upon completion of the north wing of the Laboratory Building, the space formerly occupied by the Equipment Laboratory and now utilized by the Government Furnished Equipment Unit of the Production Engineering Section, be returned to the Equipment Laboratory. Such a procedure will make possible the assignment of this space to the new personnel secured for the Special Weapons Unit, for which Unit there is no adequate present space provision.

F. O. CARROLL,
Lt. Colonel, A. C.,
Chief, Experimental
Engineering Section.

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EPW:ek:54
Wright Field, Dayton, Ohio
April 14, 1941.

Chief, Experimental Engineering Section, Wright Field.

Personnel to Conduct the Aerial Target, Dirigible Bomb and Torpedo Program.

1. To comply with Letter of Instructions, Serial No. LI-115, from the Office, Chief Materiel Division, dated April 2, 1941, subject: "Development and Procurement of Radio Controlled Aerial Targets and Dirigible Weapons," and to conduct a greatly expanded activity in the development of radio controlled aerial targets, dirigible bombs and torpedoes, it will be necessary to increase the funds for personnel of the Equipment Laboratory beyond the requirements shown in the first fiscal year 1942 complement, dated March 1, 1941. The additional personnel and funds needed for the fiscal year 1942 are as follows:

1	P-5	Senior Mechanical Engineer	$4600.
1	P-4	Mechanical Engineer	3800.
1	P-4	Aeronautical Engineer	3800.
1	P-4	Electrical Engineer	[illegible]
1	P-3	Associate Aeronautical Engineer	[illegible]
1	P-3	Associate Electrical Engineer	[illegible]
1	P-2	Assistant Aeronautical Engineer	[illegible]
1	P-2	Assistant Electrical Engineer	2600.
3	P-1	Junior Mechanical Engineer	6000.
2	P-1	Junior Electrical Engineer	4000.
2	P-1	Junior Aeronautical Engineer	4000.
2	SP-8	Head Engineering Aide	5200.
2	SP-7	Principal Engineering Aide	[illegible]
2	SP-6	Senior Engineering Aide	4000.
2	SP-6	Senior Engineering Draftsman	4000.
2	CU-5	Senior Mechanics	4000.
1	CAF-3	Asst. Clerk Stenographer	1620.
1	CAF-2	Junior Clerk Stenographer	1440.
		Total -	$[illegible]

2. It is requested that the actual personnel funds allocated to the Equipment Laboratory for the fiscal year 1942 be increased from $302,280.00, shown in the March 1, 1941 complement, to $366,740.00. The April 11, 1942 complement included the above in a larger number, to permit elasticity in reclassification and to allow for further expansion.

[redacted]

RANDOLPH P. [illegible],
Major, Air Corps,
Chief, Equipment Laboratory.

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TELETYPE MESSAGE

~~ROUTINE~~ PRIORITY

DATE: APRIL 22, 1941.

TO: EXECUTIVE,
ATTENTION: FISCAL DIVISION.

FROM: E. H. WHITE,
MAJOR, AIR CORPS,
BUDGET OFFICER.

BUD(F)430.........IT IS REQUESTED THAT THE 1941 EXPENDITURE PROGRAM BE AMENDED TO INCREASE PROJECT 73 IN AMOUNT OF $2,195,679. AND TO DECREASE PROJECT 71 IN LIKE AMOUNT. THIS TRANSFER IS REQUESTED IN CONNECTION WITH PROCUREMENT OF AERIAL TORPEDOES, GLIDE BOMBS, ETC. AUTHORIZED BY LI-115. THE QUANTITIES OF SOME ITEMS BEING PROCURED ARE IN EXCESS OF AMOUNT WHICH CAN BE JUSTIFIED AS EXPERIMENTAL ARTICLES AND IT IS BELIEVED ADVISABLE TO CHARGE THESE ITEMS TO SERVICE TEST FUNDS. PLEASE ADVISE BY TELETYPE.

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BUDGET OFFICE

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April 24, 1942

Lieutenant General H. H. Arnold
Commanding General, Army Air Forces
Washington, D. C.

Dear General Arnold:

I am sorry that this letter is going to be rather long but I don't know how to make it short.

Since you were here I have a thought a great deal about the glide bomb project. Both General Fairchild and General Kuter have been here and both gave considerable attention to this project. Lt. Colonel Morse and I visited Mr. Kettering in Detroit and spent most of one night in conference with Colonel Williams and Lt. Colonel Holloman at Wright Field. I see the whole thing about as follows:

I. Kettering Power Bombs.

a. Production -- after all is said and done this weapon consists of a small engine in a small airplane carrying a small charge of explosive. The engine probably has some margin of efficiency over other small engines and the airplane has a margin over others for rapid production. The engine is supercharged for high altitude, which is not true of other small engines. If we placed orders for this weapon today we would not have enough to justify exposing the idea before a year from today -- not more than the first five hundred. Thereafter we should be able to get them in large quantities. General Motors does not have available capacity to build either the engine or air frame in large numbers. We would, therefore, have to break in on some other aircraft and engine manufacturers or else develop a new engine plant and a new airplane plant for this purpose. Everyone with whom I have talked agrees that a five hundred pound explosive load is inadequate and this almost forces us to goto a two-engine airplane which means starting at the beginning with a completely new design as far as the air frame is concerned and that would add at least another three months to the time required to get a useable quantity.

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b. Flight controls -- Tests indicate that these airplanes can be launched and flown by radio without difficulty but all agree that each must be followed by a control airplane and that not more than five to ten could be operated in a single target area simultaneously because of radio interference. The control airplane might, however, carry other bombs and perhaps tow some as you suggested in your letter of April 18. (See paragraph III a. below) the A3 and A4 pilots do not operate well over long distances without personal attention and both require a hydraulic system to operate the controls, so Colonel Williams and Lt. Col. Holloman have arranged with Mr. Kettering's laboratory to use as many Sperry parts as are applicable and assemble a new pilot not requiring the hydraulic system. They do not anticipate any trouble keeping production of this pilot ahead of engine and airplane production.

c. Directing the weapon onto the target.-- This weapon can easily be flown into a city with nothing more than the standard radio control. The means for directing it onto a point target are not yet perfected. Mr. Kettering demonstrated a control in the laboratory which will very positively follow a source of heat. This device does just about what the radio controls which I have recently seen at M.I.T. and at the Sperry Gyroscopic Company do. Although recognizing Mr. Kettering's unusual ability to do things that other people are unsuccessful in doing I know that we have a long seige of experimentation, development and test ahead before either of these devices can be put to practical use. If, however, we are going to wait until a year or fifteen months from now to expose this weapon, I believe that Mr. Kettering can have his heat seeking control or some equivalent means ready.

d. Alternate Suggestion -- A possible alternate way that we might get these weapons this year would be to expedite productioh of the pilot and radio equipment and produce a quantity of convention training or combat airplanes (stripped of all pilot furnishings, instruments, etc.) for the purpose. This of course would reduce the number of training or combat aircraft available for normal uses by almost an equal quantity. (Some quantity of airplanes not requiring all the hard to get government furnished equipment might be produced without interference with the regular production schedules.)

e. Recommendations -- I believe that the question for which you want answer is: Should we proceed immediately with production of this weapon or conservatively wait until it is perfected?

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(1) I would recommend against any quantity production of these weapons unless we can simultaneously train pilot-engineer operators in proportion. I should think we would have to have the pilots of eight or ten bombardment groups trained to fly these weapons, in addition to their regular bombardment aircraft.

(2) If you think the last half of 1943 and 1944 is soon enough to use them, I would say - Start production now.

(3) I am more favorably inclined toward producing automatic pilots and radio equipment and diverting training airplanes if we think we see a definite need for this weapon later this year.

(4) We should carry on uninteruptedly with the development of these weapons whether we produce them in quantity or not.

II. Glide Bombs.

a. Colonel Williams and Lt. Colonel Holloman react quite favorably to your wish to have glide bombs made available, equipped with automatic pilots only. I believe you already know that we are now buying a thousand sets of wings for standard two thousand pound bombs. These can be built by cabinet makers or any other wood manufacturers, (of which there are many looking for work), in any quantity, without interference with any other production. They can easily be shipped to any part of the world to which we can ship bombs.

b. The automatic pilot has to be a little different from the A3 and A4 types because there is no hydraulic system on this glider, as explained in paragraph I b., above. Colonel Williams and Lt. Colonel Holloman are guessing that pilot and everything could be in quantity production by the middle of August.

c. So far these have been carried only on a B-23 airplane and without some study it looks like their combat use might be limited to the B-17. As yet they haven't been tried on a B-17 and there may be aerodynamic problems we cannot foresee. We should make provisions to test them on the B-17 immediately if we contemplate producing them this summer.

d. Recommendations:

(1) If I were the Boss I would direct that a test on the B-17 be made immediately and if nothing goes wrong, order necessary attachements on B-17's and production started immediately on a few more thousand wings and automatic pilots to match.

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(2) I think we should proceed with the development of television, heat seeking and other promising means of directing these bombs to a point target. These features can be added if, and when, they are reduced to a state of practical operation.

III. You asked about using the thin-skinned four thousand pound bombs, and, in your l tter of April 18, you asked about towing these bombs, both of which items have been carried as a part of this general program.

a. We already have an order ten of these bombs to carry two thousand pounds of explosives and two to carry four thousand pounds of explosives to be towed behind an airplane. These would be equivalent to the thin-skinned airplane and the explosive container could actually be of cylindrical shape if desired but we had though it would be just as effective to have the fuselage itself be the case of the bomb regardless of what shape it might turn out to be. The first one of the two thousand pound type is now ready for test and Colonel Dent is enroute to California for that purpose. We are considerably concerned about our ability to control this bomb while getting it off the ground and above the propeller wash of the towing airplane. This bomb has to have a much larger wing since it has to take off at some reasonable speed. The ones we are carrying under the airplane have a very high wing loading since their take-off speed is about 150 to 200 miles per hour.

Very respectfully,

GRANDISON GARDNER
Colonel, Air Corps
Commanding

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WAR DEPARTMENT
ARMY AIR FORCES, MATERIEL DIVISION
ENGINEERING DIVISION

MEMORANDUM REPORT ON

JL/ba - 50

Date February 5, 1943

SUBJECT: Remote Controlled Aircraft Power Driven (Man-Carrying)

SECTION Technical Staff

SERIAL No. ENG-M-50-810

mx-53

Contract No.
Expenditure Order No.
Purchase Order No.

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A. Purpose

1. To present a summary of the Remote Controlled Aircraft Power Driven (Man-Carrying) being procured by the Engineering Division.

B. Factual Data

1. At present the Engineering Division has under development two different types of Radio Controlled Airplane Targets. The primary objective has been to obtain a target made of non-strategic material and having a higher top speed than the Type PQ-8A Targets and, at the same time, to improve the remote control equipment to be used in the Controllable Bombs.

a. The first of these targets, Type XPQ-12A, was originally designed with a six cylinder opposed, supercharged engine (Franklin XO-300-5) developing 175 H.P. for take-off and 150 H.P. at 17000 feet. The guaranteed high speed of this aircraft was 200 m.p.h. at 17000 feet. This aircraft was flying prior to the contract delivery date (December 27, 1941) but the XO-300-5 engine was not satisfactory and did not look promising. Therefore, a Change Order was written to provide for the installation of the XO-435-5 (Lycoming - 6 cylinder opposed, 225 H.P.) engine. At the same time the contract was changed to call for a C.A.A. approved automatic propeller. Provisions were made to use this Airplane Target as a pilot flown aircraft for check and short range ferry flights, as a Target, or as a Controllable Bomb capable of carrying one 500 pound bomb. Self-sealing fuel tanks and slight amount of armor plate protection of the remote control equipment are included. These are the only targets having these items installed and it is believed that valuable data may be obtained from their use in the service.

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Engineering Division
Memorandum Report No. ENG-M-50-810
February 5, 1943

b. In changing the engine installation and in making provisions for the extra items desired, the performance guarantees were decreased considerably. The guaranteed high speed in the three conditions are as follows:

	Sea Level	17000 Ft.
(1) Target	176	158
(2) Bomb	171	
(3) Pilot	161	142

It is noted that these performance guarantees are based upon the aircraft having an automatic propeller, which to date is not approved by the C.A.A.

c. The first YPQ-12A Aircraft is scheduled for delivery on March 1, 1943 and the remaining forty-nine (49) aircraft are to be delivered to the Government within four months after acceptance of the first article.

d. The cost of the YPQ-12A Aircraft will be approximately $8000 to $10,000 when in production. This cost does not include the remote control servo, radio, television or communication equipment (approximately $3500) that may be installed. In comparison, the cost of the pre-set mechanically controlled Naval torpedo is about $8000.

e. The second of these targets, Type XPQ-14, is a revision of the XPQ-9 which was originally contracted for having the same performance as the PQ-12 Aircraft. Due to the flat spin characteristics of the XPQ-9 Aircraft a Change Order was written to redesign the fuselage and the aircraft was redesignated as Type XPQ-14. This aircraft can be used only as a pilot flown aircraft for check and ferry flights or as a target. The guaranteed high speed (substantiated by wind tunnel tests) is as follows:

	Sea Level	17000 Ft.
(1) Target	200	183
(2) Pilot Flown	195	180

f. The XPQ-14 Aircraft was designed around the XO-300-5 (Franklin - 6 cylinder - 155 H.P.) engine as this was the engine originally scheduled for installation in the PQ-9 and PQ-10 Aircraft, 30 each of which were contracted for on Contract W 535 AC-19214,

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and a considerable amount of parts had been constructed for these engines.

g. After completion of the XPQ-14 Target and after production is started on the aircraft called for in Contract W 535 AC-19214, which will be changed to call for 100 YPQ-14 Targets in lieu of 50 each PQ-9 and PQ-10 Targets, it is considered desirable to install an XO-405-7 (Franklin - 6 cylinder, geared and supercharged) engine in the Type XPQ-14 Aircraft. This aircraft will more closely simulate the higher speeds at altitude and the higher landing speeds that will be obtained in the Controllable Bombs and it will provide an aircraft having considerably greater use as a target because of the much higher speeds obtainable.

h. The cost of the YPQ-14 Aircraft will be about $5000 to $6000, less remote control servo, radio and communicating equipment.

2. There are five different types of Controllable Bombs, power driven, ground launched (man carrying) now being procured for experimental purposes.

a. The first to be considered in the line of development is the Type XBQ-4. This aircraft is identical to the Navy XTDR-1 aircraft being procured from Interstate, Aircraft & Engineering Corporation. Two XTDR-1 aircraft are being procured by the Navy to be turned over to the Army. Modifications required to install the Army type control equipment will be made at Wright Field and remote control tests will be conducted.

b. The Type XBQ-4 aircraft is designed to operate for a short time only. The maximum range is approximately 400 miles and the high speed at sea level will be approximately 165 m.p.h. This aircraft will carry a 2000 pound bomb load. In the Navy version, provisions are made for carrying either one torpedo or two 650 pound and two 325 pound depth charges. All these items are droppable. In the Army version, provisions for one 2000 pound AN-M34 bomb will be made and the aircraft will be flown into the target thus obtaining greater accuracy.

c. The engines to be installed in these aircraft are the XO-435-2 (Lycoming - 6 cylinder, geared, 225 H.P.) engines. Type tests of the engines have not been required by the Navy but the basic engine is considered good.

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Engineering Division
Memorandum Report No. ENG-M-50-810
February 5, 1943

d. The second Controllable Bomb to be considered in the line of development is the Type XBQ-5. This aircraft in general configuration is identical to the Navy XTD2R-1 Aircraft also being procured from Interstate. Basically the XBQ-5 Aircraft is similar to the XBQ-4 except for the installation of XO-805 (Franklin - 12 cylinder, geared) engine in lieu of the XO-435-2 engine. Additional fuel is also installed, the bomb load remaining the same.

e. The range of these aircraft will be approximately 1200 miles and the high speed at sea level will be approximately 225 m.p.h. Type test of this engine too, is not required. Two each XTD2R-1 Aircraft are being procured by the Navy, for the Army, in the same manner as the XBQ-4 Aircraft.

f. The next aircraft in the line of development are the XBQ-1 and XBQ-2A. In these aircraft, provisions are made for the barest essentials to enable a pilot to ferry these aircraft by dead reckoning only, a distance of approximately 3000 miles. After arrival at its destination the aircraft can be loaded with a 2000 pound AN-M34 bomb and can be flown 1500 miles into the target by use of television, altitude control equipment, and remote control equipment.

g. The XBQ-1 and XBQ-2A are similar with the exception of the engines installed. The performance of these aircraft will permit use of a B-17 (or similar) aircraft as a Control Airplane.

h. The next step in the development of Controllable Bombs is the XBQ-3. This aircraft is being designed to use as much of the AT-14 structure as possible (wing panels, engine installation, landing gear, and empennage). Provisions are made for a pilot and a navigator and additional navigation equipment (astro-dome and astro-compass, driftmeter) are installed for ferry flights. All equipment not necessary for the bomb mission is made readily removable.

i. No winterization is provided on either the XBQ-1, XBQ-2A, or the XBQ-3. Oxygen equipment is installed in the XBQ-1, XBQ-2A and XBQ-3 aircraft to allow the ferry pilot to fly as high as possible and attempt to get over any icing conditions that may be encountered. The XBQ-3 has a range of 2900 miles in ferry condition. In lieu of adequate navigational radio equipment, reliance is placed in the navigator with his sight aids. In the bomb condition XBQ-3 will carry a 4000 pound bomb non-droppable, or two 2000 pound bombs, droppable if preferred, or two Naval torpedoes, droppable.

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Engineering Division
Memorandum Report No. ENG-M-50-810
February 5, 1943

C. Conclusions

1. The Type XBQ-4 Controllable Bomb is designed to be used on short range missions where high speed is not essential. The stalling speed will be approximately 66 m.p.h. and it is believed that the only difficulty that may occur in remote operation of this aircraft is that some means will be required to obtain direction control at low speeds while on the ground.

2. The Type XBQ-1 and XBQ-2A and XBQ-3 Controllable Bombs are being designed to carry the maximum bomb load a distance of approximately 1700 miles and to have sufficient speed so that a B-17 (or equivalent type aircraft) may be used as the control airplane. It is believed that the stalling speed will probably be too high for safe landings by remote control and may also be excessive when flown by an airman pilot. However, the stalling speed will decrease substantially upon use of the fuel necessary to complete the ferry mission. These items are brought out here in an endeavor to inform higher authority that remote flight of these type aircraft is highly experimental and that it may be necessary to alter these aircraft to decrease the range and/or bomb load in order to permit satisfactory remote controlled flight. Further, if the stalling speed in the airman pilot flown condition is considered excessive, it may be necessary to use aircraft no further advanced (pertaining to speed and range) than the Type XBQ-4 Controllable Bomb or that larger, more expensive engines must be used.

3. It is believed that these aircraft will not be landed by remote control except that an attempt may be made to land the Type XBQ-3 Controllable Bomb after the 4000 pound torpedo load has been released. This landing will be made in the light condition only, that is, no torpedoes and very little fuel.

4. It is further noted that the XBQ-1 Controllable Bomb is being designed around experimental engines (XO-405-7) which may prove unsatisfactory at a later date but at present seem to be progressing satisfactorily.

5. To date, remote operation of twin engine aircraft has not been definitely proven; however, from tests conducted on an

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Engineering Division
Memorandum Report No. ENG-M-50-810
February 5, 1943

AT-11 Airplane equipped with remote control equipment, it is believed that most of the difficulties have been overcome.

D. <u>Recommendations</u>

1. It is recommended that after completion of the XPQ-14 Target action be taken by the Engineering Division to have the Franklin XO-405-7 engine installed in this aircraft.

2. It is further recommended that tests now being conducted by Special Weapons Unit of the Equipment Laboratory on the AT-11 Airplane equipped with remote control equipment, be expedited so that necessary changes in the Controllable Bombs may be incorporated before the design has progressed too far.

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Jack Leet
Jack Leet, Captain, A. C.

H. Z. BOGERT, Colonel, A. C.
Technical Staff
F.O. CARROLL, Brig. General U.S.A.
Chief, Engineering Division

C.G., Mat. Command, Att: Chief of Staff
C. G., Mat. Command, Att: Asst. Chief of Staff (E)
Aircraft Radio Laboratory
Chief, Equipment Laboratory
Central Files
Special Weapons Br.,
Equipment Laboratory

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Army Air Forces

Headquarters of the Materiel Command,
Washington, D.C.
February 16, 1943.

Technical Instructions

Serial No: CTI-1102 ua

Subject: Power Driven Controllable Bombs.

MX-53 Confid

TO: Technical Executive,
Materiel Center, Wright Field, Dayton, Ohio

1. Problem Presented:

a. To authorize the continued development of power driven controllable bombs and to establish a definite procurement.

2. Authority:

a. Commanding General, Headquarters Army Air Forces.

3. Factual Data:

a. The Navy has agreed to the transfer of two (2) TDR-1 and two (2) TD2R-1 airplanes to the Army Air Forces as soon as available - these airplanes to come from Navy production lines as is, and if modifications are desied, they will be made by the Army Air Forces. The Navy further state that they will supply complete engineering and prototypes of the subject type airplanes at the earliest possible date and will supply a complete set of all production drawings and pertinent information the STD2R-1 airplane as soon as it has been released by the Naval Inspector. Thet further agreed to request Interstate Aircraft and Engineering Corporation to assign one (1) Liaison Engineer to the Army to assist in engineering and production problems, but no contact will be made or anything done to delay the engineering and production of the TDR-1, -2 and -3 airplanes at the earliest possible moment.

4. Action Desired:

a. Continue the intensive development of powder diven bombs including various methods of remote control.

b. Initiate procurement of one-hundred (100) Interstate Type BQ-5 power driven bombs having the following characteristics:

(1) A minimum of 1000 mile range.
(2) Speeds such that they can accompany B-17 and B-24 Type airplanes.

c. Procurment of these glide bombs will be made from the Interstate Aircraft ane Engineering Corporation at El Segundo. No Contact will be made with the Interstate at Wilshire.

d. This office will be advised when procurement of these items has been accomplished.

By Command of Major General ECHOLS:
B. W. CHIDLAW, Brig. Gen., Asst. Ch. of S

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WAR DEPARTMENT
ARMY AIR FORCES, MATERIEL DIVISION
ENGINEERING DIVISION
MEMORANDUM REPORT ON

JL/esg - 50

Date March 1, 1943

SUBJECT: Controllable Bombs, Power Driven, Ground Launched

~~SECTION~~ Technical Staff

SERIAL No. ~~ENG-M-50-820~~ 213

MX-53

Contract No.
Expenditure Order No.
Purchase Order No.

A. Purpose.

1. To present data relative to the procurement of a quantity of one hundred (100) Controllable Bombs, Power Driven, Ground Launched, Type BQ-5, as directed by Materiel Command CTI-1102 dated February 16, 1943. The items mentioned in Factual Data below were discussed in a conference held at the Materiel Center on February 24, 1943 with the following personnel present:

Interstate Aircraft and Engineering Corp.
Mr. Donald P. Smith
Mr. Walter A. Hite
Production Engineering Section
Lt. Col. E. W. Dichman
Capt. D. E. Riley
Lt. J. H. Dungan
Engineering Division
Lt. Col. L. D. Hoffman
Capt. J. Lest

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By ______ Signature and Grade
Date 11-1-45

B. Factual Data.

1. Complete remote operation of twin engine aircraft has not satisfactorily been accomplished by the Materiel Center to date, although it is considered entirely practicable if the aircraft to be flown have the proper equipment installed. This necessitates that numerous small items be incorporated in the aircraft design to enable proper installation of the control equipment and to enable complete control by use of as few remote controlled items as possible.

2. In order to convert the Navy Type TDR-1 Aircraft to the Army Air Forces Type BQ-5 Controllable Bomb, it is considered necessary that the items listed below be included in the design of the aircraft to be procured. If these items are not incorporated in the basic contract, it is believed that a great deal of rework will be required before the aircraft can be successfully controlled remotely.

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a. <u>Servo Equipment Installation.</u> (1) It will be necessary to have the Army Air Forces 3 axis stabilized, 24 volt, compact servo unit installed in lieu of the Navy Control equipment. This unit is approximately 18 inches long, 16 inches wide, and 16 inches high and weighs approximately 115 pounds. It is believed that this unit can be installed in the location now provided for the Navy Gyro equipment in the TDR-1 Aircraft. It will also be required that the surface controls be connected to the appropriate piston on the compact servo unit. This requires several revisions in the control system to the servo equipment.

(2) It is further desired that each engine be equipped with both a hydraulic and vacuum pump with sufficient capacity so that the compact servo unit may be operated with only one engine running. This may require a change in the engine accessory drives unless a combination hydraulic-vacuum pump with sufficient capacity can be obtained and installed on these engines.

b. <u>Television Equipment Installation.</u> (1) It is believed that the television equipment, Type SCR-[illegible], can be installed in approximately the same location as the Navy equipment. However, it is considered desirable to be able to adjust the television camera unit so that the line of sight can be regulated from one degree above to five degrees below the line of flight of the aircraft.

(2) It is also considered necessary to have a window in front of the television equipment. This window should be equipped with some means of defrosting and deicing. At present this unit is not fully developed, but it appears that best results can be obtained from a plate having thickness enough to take the aerodynamic forces and a smaller plate placed in front. Electric heater wires should be placed between the two glass plates. The glass should be coated with R.C.A. Magicote, or equivalent, to minimize reflections.

(3) A transparent plastic cover should be placed in front of the television window in order to keep it free of all foreign matter. This cover should be jettisonable when the television equipment is turned on.

(4) In connecting the television equipment to the aircraft power supply it is required that the voltage regulation be such that the rate of change of the voltage is less than 1/[illegible] volt per minute. This is required so that the image will not be distorted.

MX-573

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Engineering Division
Memorandum Report No. ENG-M-50-620
March 1, 1943

c. Power Plant Control. It is considered desirable that some means of engine synchronization be provided. At present these details have not been worked out, but it is believed that synchronization can be obtained by control of the propeller pitch and the manifold pressures. These items are now being investigated and every effort is being made to supply the desired answer in time for incorporation in the experimental Controllable Bombs now under procurement.

d. Automatic Engine Controls. It is desired that all Controllable Bombs be equipped with as many automatic engine controls as possible. It is requested that automatic control of the carburetor air temperature, oil cooler, and cowl flaps (if installed) be added to these aircraft.

e. Bomb Installation. Satisfactory means of hoisting the bombs into position should be provided. Means of arming the bomb during flight should be incorporated. This can be done by use of an electric motor or solenoid to pull the arming wires during flight and allowing an air blast to turn the fuse propellers. An alternate method of arming is by connecting a small electric motor to each fuse and having these motors turn the arming vanes. In each method only one amp. impulse is available from the radio equipment which is sufficient to operate a relay switch.

f. Torpedo Installation. With the torpedo as installed in the Type [illegible] Aircraft, the "torpedo run" will be limited to a certain altitude and speed. It may be more advantageous to drop the torpedo from a lower altitude and closer to the target. For this reason it is considered desirable to have the angle of the torpedo in the aircraft adjustable. This angle will depend upon the speed and the height of drop and can only be determined by actual tests.

g. Radio Control Equipment. Provisions should be made for installing the Army Air Forces Radio Control Equipment so that it is available for ready adjustments.

h. Communication Equipment. The Bendix Model 3501 communication equipment should be installed so that it is available to the pilot during ferry and check flight. This equipment should be made readily removable when the aircraft is used as a bomb.

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Engineering Division
Memorandum Report No. ENG-M-50-820
March 1, 1943

1. __Flight Instruments.__ It is desired that the ferry pilot be provided with sufficient instruments to make the ferry flight. The instruments should include Rate of Climb, Turn and Bank, Artificial Horizon, Directional Gyro, Clock, Airspeed, Compass, Altimeter and an absolute Altitude Indicator that can be connected to the altitude control equipment. These items shall be readily removable when the aircraft is used tactically.

j. __Nose Wheel Steering.__ On the basis of all tests conducted to date on remotely controlled aircraft, it is considered necessary that the nose wheel be made steerable with the rudder. This is necessary so sufficient directional controllability at low speeds will be available during take-off.

[illegible]. __Engine Type Test.__ The engines being installed on the Type TD2R-1 Aircraft are being accepted by the Navy on the basis of a 50 hour model test. It is desirable that an aircraft of this range have engines that have satisfactorily passed Army Air Forces type test.

3. Interstate Aircraft and Engineering Corporation estimates that, on an order of 100 aircraft similar to the TD2R-1 Aircraft, delivery of the first article can be made in August. With the changes required to make it a satisfactory Controllable Bomb, as listed under paragraph 2 above, it is estimated that delivery of the first article will be delayed at least one month. It is also desired that the first article be delivered to the Engineering Division prior to acceptance of any of the remaining items. Remote Control Tests will be conducted and any changes found necessary will be made in the first article. Upon completion of these tests, which are estimated to require approximately one month, the contractor will be informed of the changes to be made in the remaining articles. On the basis of the above information it is estimated that the Type BQ-5 Controllable Bombs will not be available until November or December of 1943.

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Engineering Division
Memorandum Report No. [illegible]-820
March 1, 1943

4. The performance of the Type [illegible] Aircraft is estimated to be as follows:

	CHECK PILOT G.W. = [illegible]	FERRY PILOT G.W. = [illegible]	[illegible] G.W. = [illegible]
High Speed at S.L.	199	[illegible]	[illegible]
High Speed at Max. Ceiling	177	[illegible]	[illegible]
Service Ceiling	11,500	12,000	[illegible]
Time to 5,000 Feet	8	9	[illegible]
Take-Off (Ground Run)	800	[illegible]	1,[illegible]
Stalling Speed	76.7	80.4	[illegible]
Maximum Range	1,225	1,600	[illegible]
Range at Full Speed	900	1,125	[illegible]

5. The Engineering Division of the Materiel Center is [illegible] ing several other Controllable Bombs as noted in Engineering Division Memorandum Report, Serial No. [illegible], dated February [illegible], 1943. One of these Controllable Bombs, Type [illegible], is scheduled for delivery in May, 1943. The performance of this aircraft will be as follows:

	CHECK PILOT (Guaranteed)	FERRY PILOT (Estimated)	[illegible] (Guaranteed)
High Speed at Sea Level with 950 H.P.	195	195	[illegible]
Oper. Speed at S.L. with 75% Power	174	177	[illegible]
Service Ceiling	15,500	14,[illegible]	14,[illegible]
Time to 10,000 Feet	10.2	11	[illegible]
Take-Off over 50 Foot Obstacle	1,500	2,[illegible]	2,[illegible]
Stalling Speed, Flaps Extended	71	[illegible]	77
Maximum Range at Sea Level		2,[illegible]	1,7[illegible]
Range at Operating Speed at S.L.		—	1,3[illegible]

6. The second Controllable Bomb, scheduled for delivery in July, 1943, is the Type [illegible]. This aircraft will be [illegible] to the Type [illegible] except that the [illegible] engine will be installed in lieu of the [illegible] engine. The performance of this aircraft will be as follows:

[illegible]

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Engineering Division
Memorandum Report No. ENG-M-[illegible]-20
March 1, 194[illegible]

	[illegible] PILOT ([illegible]) [illegible]	FERRY PILOT (Estimated) [illegible]	[illegible] ([illegible]) [illegible]
High Speed at 17,000 Feet at [illegible] B.P.	[illegible]	[illegible] (S.L.)	[illegible]
Oper. Speed at 17,000 Feet at 75% Power	[illegible]	160 (S.L.)	191
Service Ceiling	27,700	[illegible],000	25,000
Time to 10,000 Feet	9.5	13.9	12.1
Take-Off Over 50 Foot Obstacle	[illegible]	2,710	3,070
Stalling Speed, Flaps Extended	65	77	78
Max. Range at 17,000 Feet		[illegible]	1,[illegible]
Range at Oper. Speed at 17,000 Feet			1,[illegible]

7. The cost of aircraft similar to the [illegible] Type [illegible], in quantities of 100, is estimated to be approximately [illegible] each, less all government furnished equipment. This estimated cost does not include the changes required to convert these aircraft to the Type B[illegible]-3 Controllable Bomb.

6. The cost of the Type [illegible]-1 and [illegible] Controllable Bombs in production quantities of 500 is estimated to be approximately [illegible],000 each. This estimated cost does not include the cost of all government furnished equipment.

C. Conclusions.

1. On the basis of information brought forth under Factual Data above, it is concluded that the first Type B[illegible] cannot be delivered to the Engineering Division before [illegible], 194[illegible]. Tests on this first Controllable Bomb will require approximately one month or more if found necessary, and desired changes in the original aircraft to permit remote controlled flight, must be included in the production article which necessitates an additional delay. It is, therefore, believed that the production Type [illegible] aircraft will not be available until November or December of 194[illegible].

2. The Type [illegible] Controllable Bomb is scheduled for delivery to the [illegible] Center in [illegible] 194[illegible]. It is estimated that approximately one month of testing will be required before this [illegible]

[illegible]

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aircraft will be ready to go into production. The Type XBQ-1 Aircraft is basically the same as the Type XBQ-2A and should be able to go into production shortly after the Type XBQ-2A.

3. The Type XBQ-1 Controllable Bomb is considered more satisfactory for use with the Type B-27 Aircraft because of the supercharged engines installed allowing a much higher service ceiling and higher speeds at altitude.

4. It is further concluded, from the estimated costs submitted, that the Type BQ-1 or Type BQ-2A Controllable Bombs will cost approximately one-half the cost of the Type BQ-5 Controllable Bomb and will be more suited for land based remote operation. However, no provisions for carrying a torpedo are made.

D. Recommendations.

1. It is recommended that, in order to provide the items essential for satisfactory remote controlled operation, all the items mentioned in paragraph B.8. above, be incorporated in the Type BQ-5 Aircraft being procured from Interstate Aircraft and Engineering Corporation.

2. It is recommended that the contract for the Type BQ-5 Controllable Bombs be written in such a manner that will allow the first article to be tested by the Materiel Center and changed if necessary. The changes that may be required should be made in the production aircraft prior to delivery to the Army Air Forces.

3. If it is considered essential that this type aircraft be in production in the shortest possible time, it is recommended that the advisability of going into production on either the Type BQ-1 or Type BQ-2A Aircraft be investigated.

MX-53

Jack Leet
Jack Leet, Captain, A.C.

H. Z. BOGERT, Colonel, A.C.
Technical Staff

F.O.B.
F.O. CARROLL, Brig. General, U.S.A.
Chief, Engineering Division

C.G., Materiel Command,
Attention: Chief of Staff
C.G., Materiel Command,
Attention: Asst. Chief of Staff (M)
Aircraft Radio Laboratory
Chief, Equipment Laboratory
Special Weapons Br.

Equipment Laboratory [redacted]
Central Files

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[redacted] Written August 28, 1942

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SUBJECT: Radio Controlled Aircraft

TO: Chief, Bureau of Aeronautics
Navy Department
Washington, D. C.

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1. Boeing Airplane Company, Wichita Division, has recently contacted the Materiel Command, Army Air Forces, relative to three conversions of the AAF Model AT-15 airplane which representatives of the Boeing Company had discussed with the Bureau of Aeronautics. These conversions carry the following Boeing Airplane Company's designations:

a. Torpedo Bomber Model 379. It is understood that this design will require a new fuselage designed to accommodate one torpedo or two depth charges in the bomb bay and a single pilot's station with removable enclosure and tricycle type undercarriage. The fuselage will be designed to use non-strategic materials; that is, steel tubing and fabric faired rear portion.

The Boeing Airplane Company, Wichita Division, estimates that approximately 80 engineers will be required throughout the months of November and December, 1942, and January, February and March, 1943, to accomplish the engineering involved in this project.

b. Coastal Convoy Model 378. The empennage, outer wing panels, center section, nacelle, and fuselage structure will be identical to the AT-15 crew trainer (Model 120), except where modified to carry depth bombs and .50 caliber machine gun loads. The general arrangement of his design is similar to the present Model AT-15. The crew will consist of a pilot, co-pilot, and an observer gunner. It is understood that the engineering for this design is already well along, and it is further understood that it is contemplated making the actual conversion at the Naval Aircraft Factory, with the assistance of a liaison group furnished by the Boeing Airplane Company.

c. Crew Trainer Model 120. It is understood that the Navy's interest in this design parallels that of the Army Air Forces, and that in the event of procurement no changes of any magnitude would be required.

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Chief, Bureau of Aeronautics [redacted]
"Radio Controlled Aircraft"

2. The Army Air Forces has no objection to Navy participation in the AT-15 project to the extent covered by conversions b and c above. It is believed, however, that the torpedo bomber version of this airplane constitutes a duplication of a similar project which the Army Air Forces now has under way with the Fairchild Engine and Airplane Corporation, Hagerstown, Maryland. This latter project consists of the conversion of the XAT-14 airplane to the XBQ-3 controllable bomb. The XBQ-3 is basically the XAT-14 with the exception of the fuselage. This aircraft is already equipped with tricycle type landing gear and, consequently, this portion of the airplane requires little redesign. The XBQ-3 will have provisions for remote controlled flight by use of television, radio and Servo equipment. It is being designed to carry either one (1) 4000-pound bomb, two (2) 2000-pound bombs, or two (2) torpedoes. Both the XAT-14 and XBQ-3 will be powered with two (2) Ranger V-770-6 engines. The XAT-14 airplane is scheduled for its initial flight within a period of 5 weeks from September 1, 1942. The XAT-13, which is identical to the XAT-14 except that it is equipped with Pratt and Whitney R-1340-AN-1 engines, is now flying and gives every indication of being a satisfactory airplane.

3. It is suggested that duplication of effort can be avoided if the two Services can cooperate on the Fairchild project. With this in mind, it is further suggested that a meeting be held in the near future, attended by representatives of both Services, to discuss the development of this type of radio controlled aircraft. In the event you concur in the desirability of this procedure, it is requested that you inform the AAF Materiel Command when it would be convenient for representatives of the Bureau of Aeronautics to attend such a conference. It is contemplated that this conference would be held at the AAF Materiel Center, Wright Field Dayton, Ohio.

4. In the meantime the Army Air Forces has no objection to you proceeding with the negotiations with Boeing Airplane Company, Wichita Division, in connection with the conversions discussed in paragraphs 1. b and c above. Inclosed is copy of letter dated August 28, 1942, to Boeing Airplane Company transmitting this information.

400.112 - Research + Development

will be forwarded Boeing separately

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1 Incl.
Cy. ltr. to Boeing
dated 8-28-42

Copies to:
Naval Aircraft Factory
Boeing Company, Wichita Div.
Equipment Lab., Special Weapons
G.I.N.A., Wright Field
Production Engineering Section
N.A.C.A. Liaison, Tech. Staff

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January 17, 1942.

Chief, Materiel Division, O.C.A.C., Washington, D. C.

Controllable Bomb Project.

1. Reference is made to paragraphs D-1, D-2 and D-13 of Memorandum Report EXP-M-54-673-10 dated December 20, 1941, Subject: Controllable Bomb Project (copy attached).

2. The power driven controllable bomb has certain advantages over the glide bomb or the bomb carrying glider types. The principal of these advantages is its ability to attack horizontally at minimum altitude. Such an attack is especially applicable to televised assaults on naval objectives. Although simultaneous mass bombing attacks are not readily visualized with this equipment, it has application to attacks on vessels operating Japanese marine lines of communication.

3. To date no reflection of opinion has been received from the Air Staff concerning the use of the General Motors controllable bomb, as recommended in paragraphs D-1 and D-2 of the above reference. This weapon has a destructive application to merchant marine and relatively lightly armored naval vessels within its flight range. It is especially applicable to short range shore defense against invasion forces, provided accompanying air protection can be afforded.

4. Representatives of the Research Laboratories Division of the General Motors Corp. have informally submitted a study of a bimotored controllable bomb which utilizes the same motor as the single engined bomb tested at Muroc Lake during November last. Tentative consideration of the proposed bimotored bomb indicates the following performance characteristics:

a. Radius of action - 900 to 1200 miles at 150 m.p.h.
b. Ceiling - 20,000 feet.
c. Bomb load - one 2000 pound bomb.

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I.O.M. to Chief, Materiel Division
January 17, 1942.
Subject: Controllable Bomb Project.

5. The representatives of the Research Laboratories Division of the General Motors Corporation agreed to make a more complete study of the proposed bimotored bomb. They further agreed to expedite delivery of six single engine controllable bombs now on order. Tests with these items are planned for Eglin Field during February, 1942, to demonstrate the accuracy of this equipment both televised and untelevised. The engine for this bomb has been flown over six hundred hours in a Cessna airplane with favorable results. It is estimated that type testing at this Office can be completed in approximately thirty (30) days after the engine is delivered provided no difficulties are encountered which will cause design changes or other modifications.

6. The principal bottleneck in the production of the General Motors power driven bombs will be the engine units. Tooling for mass production will take six to nine months, and may be further delayed by space allocations to other uses, unless proper planning measures are taken in the near future. Tooling for one thousand engine units a month would provide for a consumption of about sixteen controllable bombs a day, not an excessive number for war operations in an active theatre.

7. In view of the above, and the extreme importance of power driven controllable bombs, an expression from the Air Staff as to the suitability of the performance characteristics of the single engined General Motors bomb and of the projected characteristics mentioned in paragraph 4 above is requested at the earliest opportunity. In this connection it is pointed out that control of the power driven bomb can be exercised by radio from any bombardment type airplane, without any modification of the bomber other than radio control installation. It is further pertinent that the single bomber on an attack mission can carry normal bombs in the usual racks and still control a power driven bomb by radio.

JAN 21 1942

F. O. CARROLL,
Lt. Colonel, A. C.,
Chief, Experimental
Engineering Section.

1 Incl.
Cy. Memo. Report
EXP-M-54-673-10

Signature ______________________

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Minco. Cont Missils
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Copy No. 17

15 April 1944

DETAIL OF A.A.F. GUIDED MISSILES PROGRAM

1. UNITS IN PRODUCTION (200 OR MORE ON ORDER) INCLUDING AZON 1000 LB. GB-4, GB-8, GB-1, GT-1, GB-7, FELIX

a. Azon 1000 lb. High Angle Bomb (MX-225, A.C.-36):

(1) Description: The Azon tail replaces standard tail on 1000 lb. bomb and the Azon can be carried in the bomb bay on standard 1000 lb. bomb shackles. Six can be carried in a B-17, eight in a B-24, two (with possibly three) in a B-25, and four in a B-26. Gyro stabilized against rotation. Remote radio control for azimuth only, by bombardier. A brilliant flare in the end of the Azon tail permits observation during the complete fall. Flares come red, white and green. Two more colors being requested. Radio frequency adjustment permits up to six simultaneous drops controlled by six different bombardiers.

(2) Characteristics: Can be controlled 2000 to 3000 ft. right or left when dropped from 15,000 ft. Great accuracy in azimuth. The last 108 bombs dropped on the N.D.R.C. experimental order were used in operational practice by inexperienced bombardiers. The Army Air Force Board reports: "108 bombs dropped. 58 functioned properly. 88% of successful drops within 50' deflection. Average circular errors converted to 12,000 ft. is 234 ft." Most of the functional faults have been corrected on the production order and it is expected that at least 80% of the production articles will function properly. Accuracy in range was expected to be worse than standard bombs due to effect of azimuth control, but has been as good or better in practice drops - probably because the bombardier can concentrate more on range and because the Azon tail is precision built and rugged and less subject to damage than a standard tail.

(3) Availability: (a) 10,600 on production order with an additional procurement request for 10,000 issued. Of these, 600 are for the Navy, and the British are about to order experimental quantities of at least 50. (b) 200 experimental were received on a N.D.R.C. order. Approximately 500 were built on the production order in March, at least 1000 should be built in April, 2000 to 2500 in May, and 3000 per month thereafter. (c) The tail production could go to 3000 per month shortly but radio shortages are the bottleneck. Studies are being started on increased production rates for both the Azon tail and the radio.

(4) Training: (a) Six B-17 airplanes were equipped for Azon in March. The crews were trained at Orlando with 108 total drops, and left for Italy on approximately 1 April 1944. 100 Azons have been shipped by air to Italy. (b) Ten B-24 airplanes are now being equipped and the crews trained at Orlando for operation with the Tenth Air Force. They will drop 100 of the production Azon during training. They should depart in late April. (c) Train of further heavy bombardment squadrons is planned, starting May, 1944. Guided Missiles teams are also being trained. These teams consist of one officer and

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Minneo Cont. Missiles
AC-36 - 68 (3/15/44)
AL, B2B

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25 enlisted men, trained in factory schools on the special guided missiles equipment for which they are to be responsible. Any team can set up and maintain the equipment involved in using Azon, Felix, GB-4 and GB-8. Training rate of these crews will be one in May, two in June, four in July, and eight per month thereafter until 55 have been trained.

(5) COMMENTS: Suitable for long narrow targets such as roads, railroads, landing strips, ships, bridges, docks, etc. Equipping of airplanes and training of bombardier are quite simple. Airplane modification instructions are available for B-17, B-24 and B-26. Instructions will be prepared for B-25. Extended bombing run (30 seconds plus) after release of bomb is an additional hazard. A number of runs have been made with a shorter than normal run prior to release, but no firm operating practice has been established yet. Visibility must be good enough to see the target. Several drops have been made in trains and more dispersion was secured than desired. Experiments with train drops are planned for early May, and it is believed that further practice and development will decidedly decrease the over-dispersion.

b. GB-4 2000 lb, Television Glide Bomb (MX108-4):

(1) Description: Gyro stabilized Pomykata glider with 12 ft. wing spread and approximately 12 ft. overall length including bomb. Has remote radio control of range and azimuth with a Block III (AN/AXT-2) Television transmitter for determination of position. Placed in a "bathtub" shaped container below the bomb. Pomykata vehicle is "cleaner" better streamlined and more expensive than Aeronca vehicle. B-17 carries two on external bomb racks and B-25 carries one.

(2) Characteristics: Glide ratio is over 8 to 1. Speed at this glide path is approximately 220-240 mph. This speed can be increased by diving. Preset tests indicate vision for 7-10 miles on television but identification of target is difficult unless target or surroundings have easily identifiable characteristics. Control up to 20 miles under good conditions is planned (this is the estimated limit of the television reception and the radio control). Television antenna is directional and with a fixed antenna, the airplane turns 180° after dropping. Hope to use the gyro stabilized directional antenna, which has been developed. This will permit airplane to maneuver in any direction after drops. Accuracy should be good when all equipment operates and if the bombardier "finds" the target in time with the television. If bomb lands in front of target it will slide for long distances, due to low angle of approach. No figures are available on the amount the GB-4s cut the speed of a B-17, but it should be somewhat less than the GB-1 or GB-8 (which is approximately 10 miles per hour). The speed and maneuverability reduction on a B-25 is considered negligible. No tests have been tried from a B-24 (could only carry one) or a B-26.

(3) Availability: 2000 are on the production order. Developmental models are now being tested and experimented with at Tonopah, Nevada. The present delivery status follow:

On the experimental order for 200, approximately 8 complete GB-4s are available for training (without high altitude heater element). All of the 200 airframes have been delivered and at least 150 are left. 150 of the RT control boxes

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thirty-five. Actual production will start in about September with approximately 200 production models finished by 1 January 1945 and 150 per month thereafter. The Navy now estimates that the Army will secure a total of approximately 70 production models by 1 January 1945 and 50 per month thereafter. Procurement of 500 airframes by Materiel Command has been requested, but no procurement will be made until completion of present tests at Floyd Bennett Field and Patuxent. No estimate is now available on the completion of these tests.

(4) __Training__: AC/AS,Training, will not set up a program until further progress has been made.

(5) __Comments__: Preferable to RHB in operation because the airplane can forget about the bomb after releasing it. Has the potential use of homing on a "corner reflector" that could be planted by various means at the target.

h. __"Felix" (Bemis) (Heat Seeking Razon) 1000 lb. High Angle Bomb__:

(1) __Description__: Standard 1000 lb. bomb with false nose containing metallic bolometer heat-seeker and with wires to the controls in tail. Gyro-stabilized. Two types of tails being tried. The octagonal shroud and the cruciform (like Azon). The cruciform is preferred, but tests to date indicate that the octagonal shroud can be controlled more successfully. Will probably be necessary to use the 2000 lb. rack. This is still a N.D.R.C. development.

(2) __Characteristics__: Designed to home on strong heat source. Controls for both range and azimuth. Extent of control expected to be at least 2000 ft. in a 15,000 ft. drop.

(3) __Availability__: 240 are on order by N.D.R.C. of which 40 are considered experimental. Deliveries are starting now and expedited tests will start about the third week in April, on approximately 24. Delivery completion of the 240 is planned by 15 May 1944. Production would probably take about three months to start after the placing of a production order.

(4) __Training__: See Azon Training 1a(4)(c).

(5) __Comments__: N.D.R.C. feels that the trial drops indicate sufficient possibilities of accuracy to warrant the crash program. However, no series of successful drops has actually been made as yet. Article cannot be used successfully when low overcast prevents sufficient infra-red radiation from targets, but the article can probably be used through high overcast with a radar bombsight. The Navy is very interested in heat-seekers of this nature and in countermeasures to them. In regard to potential targets, large marine moving targets give satisfactory homing signals, except in case of low overcast or cold wind with warm water. A Materiel Command heat survey on land targets indicates that steel mills, isolated power-plants, and factories give satisfactory signals. For uniformly accurate results, however, a heat survey of area surrounding target for distracting heat sources appears essential by airplane making the drop. Flight tests on a new article for these tests are starting now. It is hoped that this heat-search device will

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Guided Cont Missiles
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miles to target, where it is abruptly dived. Minor modifications planned for bomb sight.

(3) Availability: 15 AYD (APN-1) altimeters are now available. No check has been made on further availability pending results of tests. These tests are scheduled for Tonopah during April.

(4) Comments: A very promising application of the GB-8 glider. Better accuracy in azimuth and decidedly better accuracy in range can be secured with a low flying glider at a known constant altitude. Jet propulsion is also being studied to extend range of level flight to ten miles. Studies are being made with U. of Michigan to determine the effect of this propulsion on the static and dynamic stability in steady flight.

g. GB-10 Television Glide Bomb:

(1) Description: The GB-8 glider with a television equipment in a PY plywood nose instead of underslung as in the GB-4. Requires a different size Farnsworth equipment or modified Block III with image orthicon.

(2) Characteristics: Can be flown on a glide path or on the GB-9 principle.

(3) Availability: Three Farnsworth equipments on order with delivery of first estimated for April, second in May, and third (with Schmidt Optics) in August. No production order has been placed and none is anticipated at present. RCA is working on a design to fit into this structure.

(4) Comments: It will possibly be an advantage to use the television on this Aeronca type glider in order that it can be dropped on the GB-9 principle and travel at a fixed, comparatively low altitude.

h. ROC - Medium Angle Bomb (Douglas Project):

(1) Description: Four symmetrically spaced stub wings. Overall span 82". Overall Length 137". Dives at an angle of 30 to 60°. Planned to be controlled for range and azimuth by various "seeking" devices in the nose. Carried under fuselage or wings of airplane. Proposed to be used for 1000 G.P. bomb or 1100 lb. semi-armor piercing bomb. N.D.R.C. project.

(2) Characteristics: N.D.R.C. believes that hits can be made on evasive targets with target speeds up to 60 miles per hour. Success of item depends on development of a satisfactory seeker or small television. Item does not have to be stabilized against roll, and rolls slightly in flight.

(3) Availability: Have expended first nine with Douglas light seeker. Further tests will start about 1 May on 6 more with Fairchild Light Seeker. Will make up 10 more for tests with Radar type seekers in August. Have just completed drawings for production type load-carrying models and hope to get an order for 20 from N.D.R.C. in April. These could be completed in

[redacted]

0072

Mun. Cont. Missiles
AC-36, 68 (13/15 pp)
R 2, D 28

approximately August, 1944.

(4) Comments: N.D.R.C. development that the A.A.F. decided in March to sponsor. A potentially good vehicle for heat, light or radar "seeker" if a satisfactory seeker is provided. Still decidedly experimental and none of the experimental articles produced up to the present will carry both the necessary equipment and a pay load.

i. Power Driven Bombs (XBQ):

(1) Description: Two engine airplanes. Remote control by radio and television.

(2) Estimated Characteristics and Availability: One each of the following on order:

	BOMB LOAD	RANGE	SPEED	HORSE POWER	MFGR.	DELIVERY DATE
XBQ-1	2000 lb	3200 mi	230	450	Fleetwings	Delivered app. 15 May 44
XBQ-2A	2000	1725	179	450	"	Delivered
XBQ-3	4000	1700	220	900	Fairchild	Delv. app. 20 April 44
XBQ-4 (Navy assault Drone XTDR-1)	2000	425	140 (without landing gear)	450	Interstate	Delivered
XBQ-5 (Navy assault drone XTD2R-1)	2000	1470	230	900	Interstate	Order has been cancelled

Actual production in any quantity would probably take at least a year.

On 21 March, the Materiel Command was authorized to cancel the one XTDR-1 and the two XTD2R-1 remaining on order with the Navy.

(3) Comments: Doubtful whether any quantity will be ordered. Too long to procure, too hard to use and too expensive in comparison with glide bombs.

j. Power Driven Bombs - Standard Airplanes:

Standard airplanes could be converted faster than the special BQ airplane could be built. The use of standard airplanes would probably involve a take-off by a pilot - who would then bail out. The C-47 is readily adaptable to conversion, and a remote control unit has been developed. The Materiel Command has started a study on devices to permit other airplanes to be remotely controlled, with the thought that "battle-worn" heavy combat airplanes could

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Cont. F MX53
(1/2)

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WAR DEPARTMENT
HEADQUARTERS, MATERIEL COMMAND

JWO:vl:al-2
Wright Field, Dayton, Ohio
5 July 1943

TECHNICAL INSTRUCTIONS

Serial No.: CTI-1102, Addendum No. 1. /cb

Subject: Power Driven Controllable Bombs.

To: Engineering Division,
Wright Field.

MX-53

1. Problem Presented:

a. To delete from CTI-1102 dated 16 February 1943 the requirement to procure one hundred (100) Interstate Type BQ power driven bombs and to substitute in lieu thereof "Procurement will be made of one hundred (100) BQ airplanes of the type that the Engineering Division determines to be the best and which can be obtained with the least delay". Characteristics of the type procured will conform to the characteristics as set forth in CTI-1102.

2. Factual Data:

a. In accordance with directive from General Arnold, no other quantity procurements of this type bomb will be made for other than experimental and development purposes. This is primarily based upon the fact that until definite determination of the capabilities of this type of equipment can be made and a definite plan of action formed, Operations, Commitments and Requirements cannot establish future requirements.

3. Authority:

a. Commanding General, Army Air Forces, per letter dated 26 June 1943 from the Office of the Assistant Chief of Air Staff, MM&D, subject same as above.

4. Action Desired:

a. Procurement as stated in paragraph 1, Problem Presented.

b. To prepare a program of tests and demonstrations at the earliest practicable date using, if necessary, other similar types of equipment such as the PQ-8 or the PQ-12 airplanes. This program to be arranged so that personnel of the Assistant Chief of Air Staff, Operations, Commitments and Requirements may witness same and from data so gathered be in a position to determine the future of this type of equipment. The tests should be very complete using both land and water targets under conditions simulating actual combat activities.

c. The Office of the Technical Executive, Materiel Command, is to

Classification cancelled
or changed to
AUTH: EO 3356
By [redacted]
Signature [illegible] FILES

C-7-323

AFMC-100-WF-4-30-43-2 MH.

COM. GEN.
TECH. EXC. JWO
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
TECH. DATA
CIV. PERS.
OTHERS
18

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Cent. F MX 53
(2/2)

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CTI-1102, Addendum No. 1,
5 July 1943.
Subject: Power Driven Controllable Bombs.

-2-

be advised at the earliest practicable date as to when the program of tests and demonstrations will be run in order that interested personnel of the Army Air Forces will be invited to attend.

By Command of Brigadier General BRADSHAW:

W. R. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

Distribution:
Production Division

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I. F. S.
A. & C.
TECH. DATA
CIV. PERS.
OTHERS

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AAFMC-104-WF-8-20-43-5M

CENTRAL FILES

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955 [redacted]

"Use of airplane as Remotely Controlled Bomb"

RSR:bb:54:08912
12 APR 1944

1st Ind.

20446 Hq., Materiel Command, Wright Field, Dayton, Ohio

To: Commanding General, Army Air Forces, Washington 25, D.C.
Attention: Development Engineering Branch, Mat. Div., AC/AS, MM&D.

1. As a result of a conference held between personnel of your Office, General Doolittle's staff and this office, an investigation of obsolete or battle damaged combat planes for this purpose will be made.

2. Upon completion of the study a recommendation as to the exact type of aircraft will be made.

For the Commanding General:

G. E. WINDSOR, Capt., A. C.
For F. C. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.
15 APR

416
guided missile

Classification cancelled
~~or changed to~~
AUTH: CD-356
By
Signature and Grade
Date 10-1-45

COM. GEN.
TECH. EXC.
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C-4-631

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AAFMC-190-WF-12-17-43-500M

CENTRAL FILES

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MX-541
1-(4 upp).
Central Files

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(AFDMA-SV)

20

25 March 1944

SUBJECT: Use of Airplane as Remotely Controlled Bomb

SECRET
By Authority of
The ... General
Army Air Forces
3/26/44 MCD
Date Initials

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Equipment Laboratory, Special Weapons Br.

1. The Air Communications Officer who is Army Air Forces Project Officer for Guided Missiles has requested that twelve (12) complete control equipments, exclusive of the carrying plane, be procured, and that one of these equipments be assembled in a mock-up form in whatever type plane may be available or desirable.

2. A general statement of policy regarding the use of airplane or glider as remotely controlled bomb by the Air Communications Officer states that developmental work should be carried on but that no actual production should proceed on power driven bombs.

By command of General ARNOLD:

R. A. L[illegible]
Colonel, Air Corps
Actg. Chief, Devel. Engr. Br., Materiel Div.,
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution.

Classification cancelled
By authority of CD-356
Signature and Grade
Date 10-1-48

12:58
ENG. WEAPONS DIV.

FRR/lb
AFDMA-2

[redacted]

B-7218 20

956 [redacted]

ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION:

HEADQUARTERS, ARMY AIR FORCES (AFDMA-2F)
WASHINGTON

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

8 June 1944.

1747

SUBJECT: Use of Airplane as Remotely Controlled Bomb

[redacted]

By Authority of The Commanding General Army Air Forces
8 June 1944 MED
Date Initials

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Equipment Laboratory, Special Weapons Br.

1. It is directed that twelve (12) complete control equipments, exclusive of the carrying airplane, be procured immediately for the remote control of airplane to be used as a remotely controlled bomb.

2. This equipment is to be suitable to tie-in with the Minneapolis-Honeywell type automatic pilot as used in a B-17 and B-24. The twelve (12) equipments should be divided equally among these two types of airplanes.

3. It is proposed that this remotely controlled airplane shall carry a Block III television equipment in the nose.

4. Of the equipment for the controling airplane, the total of five (5) sets should be procured, one of them to be engineered into a P-38.

5. Requirements Division, OC&R, has requested that one (1) BB-17F and one (1) BB-24H be allocated immediately for this purpose.

6. This project is to be given a high priority owing to an urgent cable received for this equipment from the theater.

By command of General ARNOLD:

Classification cancelled or changed to ...
AUTH ...
By CD-352
Signature and Grade
16-1-45

for M. C. Demler, Col. A.C.
R. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Materiel Div.,
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution.

21
C-2145

[redacted]

Materiel Division
AC/AS, RM&D

1 July 1944

DETAIL OF A.A.F. GUIDED MISSILES PROGRAM

1. SPECIAL PROJECTS - Including Castor

2. UNITS IN PRODUCTION (200 OR MORE ON ORDER) - Including Azon 1000 lb., GB-4, GB-8, GB-1, GT-1, GB-7, Felix

3. UNITS ORDERED IN EXPERIMENTAL QUANTITIES (LESS THAN 200) - Including Azon 2000 lb., Razon, GB-5, GB-6, GB-7, Moth, GB-9, GB-10, ROC, VB-5, 7, and 8, XBQ, Gliders, A-3 Water Borne.

4. AVAILABILITY FIGURES FOR UNITS IN 1, 2, and 3.

NOTE: On many of the N.D.R.C. projects, only a partial detail is given. Reference is made to the N.D.R.C., Division 5, Bimonthly report of 15 June 1944.

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4-1(3416) [redacted] 274

1 July 1944

DETAIL OF A.A.F. GUIDED MISSILES PROGRAM

SPECIAL PROJECTS

1. Castor -- Use of Airplane as Remotely Controlled Bomb

a. Description: War scarred B-24s and B-17s are equipped with radio controls monitoring the Minneapolis-Honeywell automatic pilot. In addition each aircraft is equipped with a Block III Television camera and transmitter, sending back to the control airplane, a picture of what the missile airplane is seeing. The missile plane is loaded with explosives. The automatic control equipment controls flight only, plus detonation if needed. All other functions are performed by a safety pilot who takes the plane off, retracts the landing gear, synchronizes the engines, takes the plane up to altitude, arms the explosive load, sets the television gear in operation and then bails out.More than 20,000 lbs. of explosives can be carried.

b. Characteristics: The aircraft planes that have been badly beaten in combat missions but still flyable, are tuned up for a flight of 100 to 600 - perhaps more. The television will give clear vision of the target at 7-10 miles in good visibility. It is planned to control either from other B-17s or B-24s or from a P-38. The control plane would have to stay within 20 miles but might, if combat conditions permit, stay quite close if great accuracy in the final dive is needed. Fighter cover can be provided if needed.

c. Training: Such training as will be needed for the first few units made under this project will take place at Special Weapons Branch, Materiel Command. Further training will take place in the theater where the control equipments will be installed in airplanes provided in the theater. The development of a more general training program for this project will await its initial combat test.

d. Comments: The heavy B-24s and B-17s will provide the television with a steady base from which to relay information back to the control plane. It is expected that the difficulty experienced in keeping the target on the television screen when used with glide bombs, will be a negligible factor with Castor planes. The use of a fighter control plane — using the P-38 "Droop Snoot" modification — is expected also to give a decided advantage, in that the control plane will be able to keep very high and take evasive action. Also, once the missile has been driven home, the P-38 will be free to return home at speed rather than holding back the fighter cover for the return trip.

A further remote control project of similar nature is being worked on in the theater, using modified Azon transmitters and receivers.

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2. UNITS IN PRODUCTION (200 OR MORE ON ORDER) INCLUDING AZON 1000 lb. GB-4, GB-8, GB-1, GT-1, GB-7, FELIX

a. Azon 1000 lb. High Angle Bomb (VB-1)

(1) Description: The Azon tail replaces standard tail on 1000 lb. bomb and the Azon can be carried in the bomb bay on standard 1000 lb. bomb shackles. Gyro stabilized against rotation. Remote radio control for azimuth only. Flare in tail permits observation. Flares come red, white and green. Radio frequency adjustment permits up to six simultaneous drops controlled by six different bombardiers.

(2) Characteristics: Can be controlled 2000 to 3000 ft. right or left when dropped from 15,000 ft. Great accuracy in azimuth. Trajectory is approximately the same as standard 1,000 lb. bomb. Allowance of about 6 mills trail has to be made to compensate for range decrease caused by average amount of control in azimuth.

(3) Training: Six crews for B-17s were trained by the AAF Board and are now in Italy. Ten crews for B-24s, originally trained for the CBI theater, were diverted with their aircraft to England. Further training is going on in both Italy and England to provide combat crews for additional airplanes being modified in the theater and in this country. A further program for 10 airplanes is under way to replace the unit diverted. Training of further bombardment squadrons is underway. A crew of 16 mechanics were trained in maintenance of Azon and shipped to the 9th Air Force, 14 June 1944. A total of 2 officers and 50 enlisted men will have been completely trained in maintenance of Azon by 10 July 1944 at Fort Dix. Due to the lack of sizable requirements from the theaters of operations, the formation of Guided Missiles teams and the training of heavy bombardment squadrons has been suspended. The training of specialists in the maintenance of Azon, GB-4, and GB-8, however, continues.

(4) Comments: The first Azon group in Italy had spectacular success in blocking the Brenner Pass. They have secured other good results. Early reports from England indicated that the Azon crews had contributed substantially to the disruption of enemy communications by bombing bridges, roads, marshalling yards, etc. A sequel to those successes was the establishing of a demand for complete Azon assemblies of 1,000 a month for Italy and 2,000 a month for England. This absorbs the complete present production of Azon. A large increase over those figures has been asked for by cable. Suitable for long narrow targets such as roads, railroads, landing strips, ships, bridges, docks, etc. Equipping of airplanes and training of bombardiers are quite simple. Airplane modification instructions are available for B-17, B-24, B-25, and B-26. Extended bombing run (30 seconds plus) after release of bomb is an additional hazard. Visibility must be good enough to see the target. Several drops have been made in trains and more dispersion was secured than desired.

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7-1(36/61) [redacted] 246

b. GB-4 2000 lb. Television Glide Bomb (MX108-4)

(1) Description: Gyro stabilized Pomykata glider with 12 ft. wing spread and approximately 12 ft. overall length including bomb. Has remote radio control of range and azimuth with a Block III (AN/AXT-2) Television transmitter for determination of position. Placed in a "bathtub" shaped container below the bomb. Pomykata vehicle is "cleaner" better streamlined and more expensive than Aeronca vehicle. B-17 carries two on external bomb racks and B-25 carries one. The late model B-25J is so difficult to modify that it will probably not be used.

(2) Characteristics: Glide ratio is over 8 to 1. Speed at this glide path is approximately 220-240 mph. This speed can be increased by diving. Preset tests indicate vision for 7-10 miles on television but identification of target is difficult unless target or surroundings have easily identifiable characteristics. Control up to 20 miles under good conditions is planned (this is the estimated limit of the television reception and the radio control). Television antenna is directional and with a fixed antenna, the airplane turns 180° after dropping. Hope to use the gyro stabilized directional antenna, which has been developed. This will permit airplane to maneuver in any direction after drops. Accuracy should be good when all equipment operates and if the bombardier "finds" the target in time with the television. If bomb lands in front of target it will slide for long distances, due to low angle of approach. No figures are available on the amount the GB-4s cut the speed of a B-17, but it should be somewhat less than the GB-1 or GB-8 (which is approximately 10 miles per hour). The speed and manoeuverability reduction on a B-25 is considered negligible. No tests have been tried from a B-24 (could only carry one) or a B-26.

(3) Training: A total of 15 officers have completed training on television equipment and are undergoing further training in Guided Missiles at Fort Dix. A total of 43 enlisted men will have completed training in maintenance of television equipment by July 15.

(4) Comments: This weapon should be effective against easily identifiable targets such as bridges, docks, tunnels, dams, large boats, buildings, etc. Also it is the most promising development for point targets, but further experimentation on identification of camouflaged and hard-to-identify targets is necessary. Army Air Forces Board tests scheduled for late June were postponed due to faulty television pictures secured with present equipment and antenna. Good results were obtained with this same equipment previous to these tests. Work is now going to determine what the trouble was. Limitations are: susceptibility to jamming, inability to see through smoke or overcast, careful training of bombardiers a rigid requirement, and necessity for extra careful servicing and adjustment by expert personnel prior to use.

In spite of its limitations and condition of not having been thoroughly tested, theater emergencies are such that a combat tryout is a distinct probability.

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c. GB-8 2000 lb. Glide Bomb, Visually Directed

(1) Description: Aeronca glider structure, with 12 ft. wing spread and approximately 12 ft. overall length. Simpler, cheaper, and sturdier than GB-4. Control equipment has same basic components, but has different size containers for these components. Will probably use five bright flares to enable bombardier to follow its flight.

(2) Characteristics: Glide Ratio from 5-1 to 6-1. Speed at this glide path is approximately 250 mph. This speed can be increased by diving. Will not be as accurate as the GB-4 due to the greater seeming distance of the observer from the target, and the difficulty of observing the altitude of the bomb in order to control the range.

(3) Comments: (a) Could be used on targets where accuracy in range is not of supreme importance when the following points are of value: 2000 pound bomb (instead of 1000 lb Azon) that can be dropped much farther away from target than Azon and skips along surface of ground after landing due to low angle of approach. No practice has been made against these types of targets. (b) All tests have been made against point targets with a procedure of flying the airplane in a curved path after the bomb has been dropped, with the bombardier keeping the bomb lined up between his eye and the target. Two operators are used to control range and azimuth. This procedure results in a spiral path for the bomb. Army Air Forces Board tests, conducted in June with a small amount of practice, ended in unfavorable results against point targets. The spiral path procedure resulted in errors in azimuth as well as the inherent errors in range. Most promising use of GB-8 may be as modified into GB-9.

In spite of its limitations for use against point targets, theater emergencies are such that a combat tryout is an imminent probability.

(4) Training: Training plans for the GB-8 are still incomplete. Since the controls of the GB-8 and GB-4 are practically identical GB-4 trained personnel can be used for the GB-8.

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d. GB-1 2000 lb. Preset Glide Bomb (MX-108)

(1) Description: Aeronca glider structure having 12 ft. wing spread with approximately 12 ft. overall length, including bomb. Preset with no control after leaving airplane. Gyro stabilized in azimuth. B-17 can carry two on external bomb racks. B-25 carries one under bomb bay.

(2) Characteristics: Glide ratio of approximately 6-1. Accuracy from 15,000 ft. estimated at not better than 1/8 mile in azimuth and 1/2 mile to one mile in range.

(3) Training: 143 crews had been trained and 143 B-17s equipped in U. K. in a program completed 2 December 1943.

(4) Comments: Intended for use in area bombing of targets heavily protected by anti-aircraft. Despite their inherent lack of accuracy and the slowing effect on the carrying aircraft, the importance of evading heavy flak concentrations was such that a mission was sent to the South Ruhr near the end of May. The City of Cologne and the heavily concentrated manufacturing area near it is one of the most heavily defended centers in Europe. Our bombers suffered heavy losses on all missions against this area when conventional bombing techniques were used. The GB-1s — 116 of them — were dropped by 58 B-17s from a point over twenty miles away. All aircraft were able to turn, after releasing, short of the heavy barrage of anti-aircraft. Of those dropped 48 fell in the target area. There were many near misses and quite a few that went wide. Only a few spun in. The South Ruhr is thick with important vertical targets for the destruction of which these bombs are ideally constructed. Despite this ,, it is significant that the theater has asked for no further GB-1s. There are probably less than 500 GB-1s left in ETOUSA.

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2-1 (39761) [redacted]

o. Glider Borne Pattern Torpedo - GT-1 Kit (MX-446)

(1) Description: Uses preset GB-1 for airframe, with 6-1 gliding ratio. GT-1 kit contains special paravane that frees the torpedo from the wings by actuating other devices, including explosive pins, when it contacts the water.

(2) Characteristics: This device solves difficult problem of proper entry of an airborne torpedo into water. Torpedo used does not have any "seeking" device or remote control but follows a zig-zag or expanding circle pattern. The missile was ordinarily dropped from 5000 to 6000 ft. altitude in the operational practice at Eglin and customarily landed within a 1000 ft. circle with some drops landing within a 300 ft. circle.

(3) Training: 18 B-25s have been equipped and 18 crews have been trained. These departed for the theater in early April. No further training is planned.

(4) Comments: For use against crowded, heavily defended harbors or large convoys. No use by the theater has been reported.

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7-1(40/61) [redacted] 250

f. GB-7A (RHB) 2000 lb. Glide Bomb, Radar Target Seeker

(1) Description: Radar Homing bomb, with an RC-171 Radar receiver, carried on an Aeronca 2000 lb. Target Seeker vehicle. This vehicle has a similar airframe to the GB-8, but has a special PY plywood nose and a different control box. The RC-171 is a Navy procured device (Navy Nomenclature: Radar Equipment Mark I, Model II) which they will probably use with a 500 lb. or a 1000 lb. Dryden vehicle (Pelican).

(2) Characteristics: This device homes on radar pulses transmitted by a radar transmitter in the control airplane, and reflected from the target. The target must be sufficiently isolated to prevent distraction from other sources of reflection that would be within the scanning range of the bomb receiver. (Note: There is a target selector device in the bomb receiver by which one of several targets that might be in its scope can be selected before dropping. The target selected must be at least 500 ft. from the other targets.) Can't be used on enemy radar because of the different frequencies and pulsing. (See Moth for this purpose).

(3) Training: AC/AS, Training, are considering a program but none has been started as yet. The Navy has started a training school under the Bureau of Standards in Washington and have invited Army personnel to attend. The Materiel Command has no personnel available, at the present time, to attend this school.

(4) Comments: Planned for marine targets or isolated large buildings. Can be used night or day, in all weather, from distances of 8 to 10 miles (further on large ships). Airplane can turn 180° after dropping. There has been no study on land targets.

An RHB installed in an Aeronca vehicle was dropped from 6,000 feet against a beacon target on 28 June and hit within 7 feet. The Navy has already established a squadron for training personnel and plans to put a 500 pound missile in combat during 1944. NDRC developed the RC-171 — radar receiver for the RHB — and the Dryden vehicle. NDRC authorities are confident that on the basis of recent tests that the 500 pound vehicle should be very accurate — within approximately 50 feet of good reflective sources. NDRC late tests show that the angle made with the ground by the Target-to-bomb or target-to-airplane lines should not exceed 45 degrees when over water.

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e. GB-7B (SRB-BAT) 2000 lb. Glide Bomb Radar Target Seeker

(1) Description: A radar homing bomb similar in principle to RHB except that it carries its own radar transmitter to illuminate the target. (AN/APG-7 Radar Transmitting and Receiving Set). A Drydon 2000 lb. vehicle with a 12 ft. wing spread has been planned as an airframe, but consideration is now being given to using the Aeronca 2000 lb. Target Seeking vehicle. The AN/APG-7 is a Navy Procurement (Navy Nomenclature: Mark XXXI, Model I) and the Navy will probably use a 1000 lb. Drydon Vehicle.

(2) Characteristics: Must have isolated targets, like RHB. Strength of signal increases as the bomb approaches the target.

(3) Training: See Training for GB-7A.

(4) Comments: Preferable to RHB in operation because the airplane can forget about the bomb after releasing it. Has the potential use of homing on a "corner reflector" that could be planted by various means at the target.

NDRC late tests show that the angle from the horizontal of the target and the GB should not exceed 45° for affective results.

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h. "FELIX" (Bomis Heat Seeking Razon) 1000 lb. High Angle Bomb (VB-6)

(1) Description: NDRC development standard 1000 lb. bomb with false nose containing metallic bolometer heat seeker. The controls are in the tail. Gyro stabilized. Octagonal tail with increased control surfaces is now favored against previously considered models with octagonal shroud and cruciform tails.

(2) Characteristics: Designed to home on strong heat sources. Controls for both range and azimuth. Extent of control to be at least 2000 ft. in a 15,000 ft. drop.

(3) Training: No training program is underway, but AC/AS, Training will start a program if the test results look promising.

(4) Comments: NDRC feels that the trial drops indicate sufficient possibilities of accuracy to warrant the crash program. However, no series of successful drops has actually been made. Article cannot be used successfully when low overcast prevents sufficient infra-red radiation from targets, but the article can probably be used through high overcast with a radar bombsight. The Navy is very interested in heat-seekers of this nature and in countermeasures to them. In regard to potential targets, large marine moving targets give satisfactory homing signals, except in case of low overcast or cold wind with warm water. A Materiel Command heat survey on land targets indicates that steel mills, isolated power-plants, and factories give satisfactory signals. For uniformly accurate results, however, a heat survey of area surrounding target for distracting heat sources appears essential by airplane making the drop. Materiel Command has tried out land charting with promising results. Improvements have been made in the techniques of recording and Materiel Command believes that a charting device will be developed suitable for manufacture within two months. (Manufacture of this device would probably take an additional three to six months.) Many targets can be picked very well without such a charting device but it is hoped that the charting device will be good for locating camouflaged or underground factories.

[redacted]

[redacted]

3. UNITS ORDERED IN EXPERIMENTAL QUANTITIES (LESS THAN 200) INCLUDING AZON 2000 lb., RAZON, GB-5, GB-6, GB-7, MOTH, GB-9, GB-10, ROC, XBQ, JET PROPULSION, GLIDERS, A-3

a. Azon - 2000 lb. High Angle Bomb (VB-2)

(1) Description: Same gyros and radio as 1000 lb. Azon, but larger tail and control surfaces. Fits into shackles for 2000 lb. bomb. Still a N.D.R.C. development. B-17 will carry two internally and two externally. B-25 will carry one. B-24 will probably carry four. N.D.R.C. is now starting a study to determine exactly how many of the 2000 lb. bombs will fit in the bomb bay of all standard bombardment aircraft.

(2) Characteristics: Control is more sluggish than with a 1,000 lb. Azon. Maximum deflection appears to be about 1,000 feet when dropped from 15,000 feet. This smaller degree of control is considered satisfactory.

(3) Training: Same as Azon 1000 lb. Bomb.

(4) Comments: There was comparatively little push behind the development of this bomb until recently when the European theater cabled an interest. This originated when it was found that many multitracked railroad bridges needed more than a 1,000 lb. bomb to wreck them. Of 20 experimental units dropped recently control was satisfactory on all but one. Drawings and specifications are being prepared for production.

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b. Razon - 1000 lb. (VB-3) and 2000 lb. (VB-4) High Angle Bomb.

(1) Description: High angle bombs controllable in range and azimuth. Uses Felix airframe and servo mechanism. NDRC development.

(2) Training: None

(3) Comments: This device has taken second place to the Felix on the NDRC development list. The bombardier has difficulty similar to that for the GB-8 in determining range but range determination is simpler than GB-8 due to proximity to the target. This device and the GB-8 would undoubtedly be far more valuable if a suitable range determination device or procedure can be developed. The development of the airframe and servo will be complete when the Felix is complete. Final decisions will have to be made on the radio to be used, however. Drop tests will be resumed about 1 July. Work is now being concentrated on developing a sight to indicate the necessary range corrections. A bombsight modification designed by Franklin Institute is undergoing test at Tonopah.

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c. GB-5 Series, 2000 lb. Glide Bombs, Light Seekers.

(1) Description: All use the Aeronca Target Seeker 2000 lb. vehicle (Sq. RJB), Gyro Stabilized. This vehicle loses altitude at the rate of approximately 1000 ft. in 15 seconds. Various types of controls are still being experimented with.

(a) GB-5A Fairchild photo-electric, marine, target seeker that homes on light contrast. A cylinder 10½" diameter, and 11" long with a relay box 18" long by 12" wide by 2" thick plus a 12 volt battery. Three to five miles range in production type models with manufacturer trying to increase range to 5 to 6 miles to correspond to experimental models. Performance not as satisfactory as GB-5C but shape is preferable. Faults have become apparent in laboratory check of first five models, but it is believed they can be worked out satisfactorily.

(b) GB-5B Hammond Flare Seeker. Obsolete - superseded by GB-5D.

(c) GB-5C Hammond-Crosley photocell, scanning, marine-type, contrast light-seeker. Homes on marine targets offering visible contrasts against water. Should home on largest vessel in the fleet. Accurate for ranges up to 7-10 miles. Can be dropped at further distances to fly initially as preset with photocell "eyes" opened at operating range. Considered by Materiel Command as the most promising marine target seeker. Size approximately 12" cube with amplifier box 11" long by 8" wide by 4" thick. This device can also detect an aircraft up to 2 miles, providing it is looking upward (no horizon) and the background is uniform (cloudy or clear).

(d) GB-5D Fairchild (Fairchild Camera and Instrument Company) photocell type flare-seeker device. Detecting device can fit in cylinder 8" diameter, 10" long and can also be divided into the "eye" unit and an amplifier. This is similar in design to the device used by the NDRC group under Dr. Klemperer with Douglas Aircraft. Although these units have been designed for the 2000 lb. glide bomb, GB-5D, they should be adaptable for smaller units, such as a Razon, designed for a 100 lb. bomb, or larger, if an interest in such a development is indicated. This device appears to the Materiel Command to be a very satisfactory flare seeker. It has a cone of approximately 70° and will home on the strongest source of light. Its estimated accuracy is a 20 ft. diameter circle. Flares have also been developed to drop on land targets by low flying fast airplanes (manually or radio controlled). The present flares are dropped by parachute. They are 3 ft. long, 7 inches diameter, weigh 80 lbs and burn 3 minutes at 100,000 candle power and 3 minutes at 1,000,000 candle power. This device should also be effective against flares of the type used by the British with their Pathfinders, or against saboteur type, radio-fired incendiary bombs.

(2) Special Use for Flare Seekers The Materiel Command personnel developing the heat and light "seeker" glide bombs feel that they have real potentialities against specific targets, such as block houses or other point objectives. The light seeker is considered particularly promising against flares planted by a low flying fast airplane (remotely or manually controlled) or planted by other means-such as mortars or rockets. The flare would be

planted in front of the objective and the bomb coming in, due to its flat trajectory should skid into the target. Although the enemy would probably find means eventually of extinguishing this flare, they would have to act very rapidly. A very important possibility of confusing the enemy, after several have been used successfully and they find out what the flares mean - would be to use the flares against various targets - even when a glide bomb was not going to follow in. Recently the European theater stated an interest in the possibility of bombing spot targets with heat or light seekers after the planting of a heat or light source. This technique for target spotting has been successfully used by the British on several occasions. The Office of Strategic Services is also interested in flare-seeking bombs. A statement of requirements has been asked on which to base a priority for further development.

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d. GB-6A - 2000 lb. Glide Bomb, Heat Seeking

(1) Description: Aeronca target seeker, 2000 lb. vehicle (See RHB) Gyro stabilized. Equipped with Offner thermopile heat seeking device.

(2) Characteristics: Homes on source of heat strong enough and isolated enough to keep seeker from being distracted. Range up to 7 and 10 miles.

(3) Comments: A promising heat seeker if target is sufficiently isolated. See comments on Felix. Fifteen units are at Tonopah, Nevada, for tests. The heat target at Tonopah has been unsatisfactory and negotiations are under way for a new heat target using heated metal plates. Completion of this target is planned in July. Materiel Command believes that the GB-6A will be completed before the Felix.

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o. GB-7C Moth Glide Bomb ("Hairy Butterfly") Radar Target Seeking

(1) Description and Characteristics: Radar Target seeker (AN/APQ-14) for homing on enemy radar. Adjusted to enemy frequencies so that it will home on enemy radar antennae. Considered at present for 1000 lb. Dryden vehicle. NDRC development.

(2) Comments: Planned to be effective against enemy radar stations if the station is close enough to the antenna. Eighth Air Force is very interested, but progress has been slow and ACO reported to the Eighth Air Force on 23 March that recent tests had been unsatisfactory and that six months were required to complete development. Both Aircraft Radio Laboratory and NDRC consider it doubtful whether a satisfactory weapon of this type will be developed.

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f. GB-9 Ground Skimming Bomb

(1) Description: Similar to GB-8 Aeronca glider with the addition of pull-out stabilization and the use of an altitude control. (The Pouykata glider has "cleaner" lines, is less rugged, and flaps would probably have to be added for a "dive" operation.)

(2) Characteristics: This glider is dropped in a steep dive of approximately 45°. It is leveled out at an altitude of approximately 1000 ft. or less at a speed of 400 mph plus. Proceeds at constant altitude for 3 to 5 miles to target, where it is abruptly dived. Minor modifications planned for bombsight.

(3) Comments: A very promising application of the GB-8 glider. Better accuracy in azimuth and decidedly better accuracy in range can be secured with a low flying glider at a known constant altitude. Jet propulsion is also being studied to extend range of level flight to ten miles. Studies made at University of Michigan are now being limited to trajectory only and the N.A.C.A. laboratories have been asked to determine the aerodynamic effect on stability of adding jet units to the GB-8 type of construction. Jet units for this device should be available during July from Monsanto.

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c. GB-10 Television Glide Bomb:

(1) Description: The GB-8 glider with a television equipment in a PY plywood nose instead of underslung as in the GB-4. Requires a different size Farnsworth equipment or modified Block III with image orthicon.

(2) Characteristics: Can be flown on a glide path or on the GB-9 principle.

(3) Comments: It will possibly be an advantage to use the television on this Aeronca type glider in order that it can be dropped on the GB-9 principle and travel at a fixed, comparatively low altitude.

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h. ROC - Medium Angle Bomb (Douglas Project), VB-9, 1100 lb. Radar Homing; VB-10, 1600 lb. Radar Homing; VB-11, Heat Seeker.

(1) Description: The four stub wings originally considered for ROC have been replaced by a ring 48" in diameter in order to enable the device to fit inside the bomb bays of the larger airplanes. This ring is rocked about the yaw and pitch axes for directional control. There is also a fixed ring at the tail. The overall length is approximately 137". The payload is a 1000 lb. GP bomb.

(2) Characteristics: The minimum radius of turn is 7000 ft., and the glide angle is adjustable to anything higher than 34° from the horizontal. Maximum allowable speed at the maximum turn rate is 575 ft. per second. NDRC believes that hits can be made on evasive targets with target speeds up to 60 miles per hour. Success of item depends on development of a satisfactory seeker or small television. Item does not have to be stabilized against roll, and rolls slightly in flight.

(3) A N.D.R.C. development sponsored by the Army. A potentially good vehicle for heat and light seekers. The angle of flight is probably too steep for a radar target seeker (See comments on RHB, GB-7A). unless a method can be found for flattening the glide angle. Still decidedly experimental. Not designed for jet or rocket propulsion but is considered adaptable to this type of propulsion. The rate of turn is much faster than the other AAF types of guided missiles. (The Razon turning radius is 20,000 ft.).

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1. Other Variations of Razon 1000 lb. Vehicle

(1) VB-5 A light seeker device, homing on a flare, was put in the Razon vehicle as a method of testing the homing characteristics of Felix and Razon. Twenty hand made models have been expended. The device was not considered by NDRC as having a tactical value and no further development will proceed unless requested.

(2) VB-7 and VB-8 These were 1000 lb. and 2000 lb. Television seekers with a small image othicon television transmitter and camera (Mimo) designed for a Razon type vehicle. They have not been considered successful by NDRC and it was voted at the 1 June 1944 meeting to discontinue them.

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j. Power Driven Bombs (XBQ)

(1) Description: Two engine airplanes. Remote control by radio and television.

(2) Estimated Characteristics and Availability: The following are on order:

NO.	BOMB LOAD	RANGE	SPEED	HORSE POWER	MFGR.	DELIVERY DATE
1 XBQ-1	2000 lb.	3200 mi.	230	450	Fleetwings	Delivered
1 XBQ-2A	2000	1725	179	450	"	Delivered
2 XBQ-3	4000	1700	220	900	Fairchild	Delivered
1 XBQ-4 (Navy assault Drone XTDR-1)	2000	425	140(without landing gear)	450	Interstate	Delivered
1 XBQ-5 (Navy assault drone XTD2R-1)	2000	1470	230	900	Interstate	Order has been cancelled

Actual production in any quantity would probably take at least a year.

On 21 March, Materiel Command was authorized to cancel the one XTDR-1 and the two XTD2R-1 remaining on order with the Navy.

(3) Comments: Doubtful whether any quantity will be ordered. Too long to procure, too hard to use and too expensive in comparison with glide bombs.

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k. Jet and Rocket Propulsion

(1) Studies have been made of possible uses. The following two appear to be practical:

(a) Extend the horizontal flight of a Glide Bomb, using the "Ground Skimming" technique of the GB-9.

(b) Provide additional speed to a glide bomb for armor piercing.

(2) Prospective development of miniature television set would also permit jet propelled controllable missiles for air to air or ground to air attack.

(3) Aero-jets of 8 to 10 second duration, developed for aided take-off, have been investigated. Their temperature limitations disqualify them, however, for high altitude flying and low altitude storage.

(4) The Explosives Research Laboratory, Brucetown, Pennsylvania, Division 8 of N.D.R.C., and the Monsanto Chemical Company are developing jet propulsion motors for attachment to glide bombs. The operating temperature range specified is -40° to + 140°. The Materiel Command is trying to secure a 500# thrust for 120 seconds duration. Monsanto has completed a 55 second solid fuel propellent unit and the static tests of the first article have been completed. The first unit for flight test will be available about 1 July.

(5) The Navy have developed an "Annapolis" acid-aniline rocket motor for the Gorgon. Weight 420 lbs, thrust 340 lbs. for 115 seconds. The Navy also have a Westinghouse 9½" jet motor on order for the Gorgon, for deliveries in May, 9½" develops a 160# constant thrust for a duration up to 20 minutes. The Materiel Command will follow these developments.

(6) Recently the Special Weapons Branch, Materiel Command, initiated a project with the NACA to develop a suitable controllable vehicle for jet propulsion. They also asked an investigation of present vehicles as to aerodynamic suitability for jet propulsion.

(7) As the result of interest specifically stated by the 8th Air Force, study has been initiated on the development of jet propelled ground-to-air and air to air projectiles. Preliminary study indicates that these developments may be along the line of a missile that will find its target along a directed radar beam.

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1. Towed Glider Bombs

(1) There is no extensive Air Force program on the development of towed glider bombs with automatic pilots, remote control, and possibly television. The Air Force has felt that the high angle bombs and the glide bombs fit in better with their tactical uses and carrying airplanes.

(2) The Materiel Command has investigated the possibilities, however, of stripping down large "worn-out" airplanes and using them as towed gliders. These would have a pilot make the take-off and then the pilot would bail out. The estimated loads that could be carried are:

(a) B-24D (less engines fuel & armament) 25,000 lbs.

(b) C-46 (less engines and fuel) 20,000 lbs.

(3) On 25 March 1944, the Materiel Command was instructed that development work is to be continued on stripped airplanes as remotely controlled glider bombs, but that no production of equipment should proceed. The development of suitable remote controls should be covered in the development of remote controls for standard type airplanes to be used as Power Driven Bombs.

(4) The Navy has had a much more extensive program. Most of their glider bombs can be picked up from an aircraft carrier deck by an airplane and can be towed by the type of aircraft used on the carrier. The loads carried by various Navy gliders follow:

(a) Globs LBP 7300# glider, 30' x 32.5' x 10.5' 4200# explosive

LBT 4100# glider, 35' x 25' x 6' 1650# explosive

LBE 7290# glider, 32' x 30' x 12' 4000# explosive

(b) LRN (glider) 18,000# explosive

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m. A-3 Water Borne Target

(1) Description: 37 foot Speedboat, 11 ft. 3 inches beam, powered with 550 hp Kermath "Sea Raider Special". Designed to carry one 4000# bombs. Similar control to A-2 water borne target. Uses AN/VRW-1 receiver and AN/ARW-8 airborne transmitter.

(2) Characteristics: 40 miles per hour loaded. Draft at maximum speed and loaded is estimated at $4\frac{1}{2}$ ft. Designed to be controlled from airplane. Television can easily be added.

(3) Comments: Tests were conducted at Norfolk in early April for General Donovan's Office on the installation of television equipment in JR-1 and JR-3A Navy boats. Good television pictures were maintained for 2 mile vision in spite of 6-8 ft. waves. The boat was controlled from the air for distances up to 8 miles. It was definitely felt that the boat could be controlled into targets. The Office of Strategic Services had taken over the two A-3 boats and a number of the A-2 target boats developed by Materiel Command for use in the Campbell Project.

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4. AVAILABILITY OF GUIDED MISSILES.

a. Castor Project: This project is proceeding under high priority at Wright Field following receipt of cables from ETOUSA. Twelve (12) complete equipments for [illegible] airplanes are being put together and five (5) control equipments are also under procurement. Some spares are being procured. Flight tests are under way and two or three equipments may be shipped to the theater before 15 July. The balance are scheduled to be shipped prior to 1 August 1944. Measures are being taken to expand sources of supply in order that the project may go with success. The items used are very difficult to secure. A small number of Block III equipments, probably three (3) to six (6), are being shipped promptly to the United Kingdom for their modification project, (using Azon).

b. Azon 1000 lb. Bomb. (VB-1)

(1) Availability. The 1944 requirements were increased to [illegible] in June. The proposed Materiel Command delivery schedule is approximately 5,713 to 1 July 1944, 4,500 in July, 5,000 August, 5,000 September, [illegible] October, 10,000 November and 10,000 December. Of these, 598 have been [illegible] for the Navy and [illegible] for the British. The British are now asking for an increased quantity. The Air Communications Officer estimates the 1945 requirement at 100,000 Azon tails.

c. GB-4 2000 lb. Television Glide Bomb. The production order is for [illegible]. Deliveries of the airframe and control box have been decidedly delayed because of inability to secure desired accuracy results, and the expensive [illegible] of experimental drops. The present schedule for the production order follows:

	Airframes Including RT Control Boxes.	Block III Television: From A.R.L.	Block III Television: New Prod. Order
To 1 July 1944	61	0	
July	300	*60 (starting 10 July)	
August	325	*87	
September	**250/month)	*87	50
October	thereafter)	*46	300
November			400/mo) thereafter)

*These are in stock at the Aircraft Radio Laboratory but require modification. This rate can be increased if required.

**This rate could be extended to 350/month with no expansion of facilities. (Diversion of 100 RSF control units/month from the GB-8 production)

The unbalance of the television schedule has been called to the attention of the Air Communications Officer since March 1944, but due to uncertainties concerning the program, no increase in television deliveries was secured by that office. This obvious television shortage has made it difficult to expedite the balance of the program. 13 RT Control Units have been shipped to Fort Dix for Training. The previous experimental contract covered 300 airframes (all delivered) and 150 RT Control Units (104 delivered) A number of

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the airframes and 56 control units are available at Tonopah. Only 25 of these control units are considered satisfactory for combat use. No Block III units are available at Tonopah. Seven (7) of the experimental units have been shipped for a special experiment.

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d. GB-8 2000 lb. Glide Bomb, Visually Directed. The production order is for 2000. Deliveries have been decidedly delayed because of inability to secure desired accuracy results and the extension of the experimental program. The present schedule for the production order follows:

To 1 July 1944 App. 336 (Only 51 actually assembled)
App. 500/month thereafter.

12 Control Units have been sent to Fort Dix for Training.
100 GB-8's were delivered on the experimental order. A number of these (app. 50) are still available at Tonopah.
7 of the experimental units have been shipped for a special experiment.

e. GB-1 2000 lb. Preset Glide Bomb. Further production has been stopped. 1000 were shipped to United Kingdom in late 1943 and 200 were shipped out in March 1944 for the GT-1 Project. Others have been shipped for training and demonstration. The Air Service Command storage at Gadsden, Alabama, totals 2120 on hand, plus 18 nearly complete articles. (750 of these are being held for the GT-1 Project.)

f. GT-1 Kit for Glider Borne Pattern Torpedo. The total procurement calls for 950 complete kits with 48 partial kits as spares. 700 of the conversion kits are complete. Remaining 298 to be completed starting 13 July 1944 at rate of app. 50 per week. A shipment was made in April 1944 of 200 complete kits and 10 spare kits to a project in the Pacific. 100 kits have also gone to Eglin for practice and demonstrations.

g. GB-7A (RHB) 2000 lb. Glide Bomb, Radar Target Seeker. There are 200 RC-171 radar receivers on order from the Navy. 20 were received to 1 June 1944 and further delivery estimates by the Dayton Signal Corps are 25 - June, 25 - July, then 30/month to completion. The AAF have only made two drops. Delays have occurred at Floyd Bennett Field due to the priority given to Navy experimental drops and demonstrations. Three more vehicles were ready to drop in late June - two with controls developed with N.A.C.A. and successfully tested at Tonopah, and one with controls developed by Hammond (dropped successfully against a beacon on 25 June). Procurement of 200 airframe vehicles for the AAF has been directed, but none have been ordered until decisions can be reached concerning the proper controls to use. Materiel Command estimates two to three months before production orders can be released unless tests can be expedited. The Navy has approximately 3000 equipments on order for their own use. App. 40 pre-production RC-171 equipments have been delivered by N.D.R.C. Materiel Command feel there are still some "bugs" to eliminate in this equipment. Major difficulties, however, seem to be the integrating of the RC-171, the stabilization and servo system and the airframe. The Navy expects to be able to use their 500 lb units in combat during 1944. Two Navy tests with the 2000 lb. Dryden vehicle were unsuccessful.

h. GB-7B (SKB-BAT) 2000 lb. Glide Bomb, Radar Target Seeker. There are 1000 of the AN/APG-7 radar equipments on order from the Navy. Dayton Signal Corps reports the following estimated deliveries; 3-July 1944 (hand-made), 7-August (hand-made), 10-Sept, 15-Oct, 20-Nov, 20-Dec, 60-January 1945, 100-Feb, 140/mo thereafter. Procurement of 500 airframes has been directed, but Materiel Command do not plan on making any procurement until decisions are reached on the type of vehicle and controls to use. A model of an

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Aeronca vehicle with an extra-long target seeker type nose is [illegible] at N.A.C.A. for study. This study will probably take at least [illegible] month. Full scale [illegible] will be made if the study is successful.

i. "Felix (Bonus Heat Seeking Razon) 1000 lb. High [illegible] Bomb. (VB-6) The original N.D.R.C. orders were for 200. [illegible] have been received. The 100 cruciform tail bombs have been cancelled. 100 hand-made octagonal tail bombs are still on order. Drop tests have been delayed because of insufficient facilities at Tonopah and the fact that the previous heat target proved to be inefficient. It is expected that final answers can be secured by 1 [illegible] on the accuracy of the missile against strong heat sources and the limiting value of the heat source against which the missile can successfully be used. Parts for the 100 units are largely complete and all the units can be complete [illegible] in app. 30 days after final decisions are secured. 75 of these [illegible] available for combat use if tests are successful. Model shop production could continue at app. 20/month if necessary. N.D.R.C. is negotiating [illegible] to engineer Felix for mass production and [illegible] production [illegible] available app. 1 November 1944 and production [illegible] available by 1 January 1945.

j. Azon - 2000 lb. High Angle Bomb (VB-2). The N.D.R.C. order for [illegible] has been completed and [illegible]. N.D.R.C. [illegible] order [illegible] production with tooling. Delivery will start app. 10 July 1944 and be completed by 15 August 1944. N.D.R.C. plans to use the entire 100 for dispersion and ballistic data, but app. 75 of these could be made available [illegible] if the early tests of the production model are satisfactory and there is urgent need for the article in the theaters. The Union Switch & Signal Company is tooling for production. The tooling is financed by N.D.R.C. No production orders have been initiated by the AAF.

k. Razon - 1000 lb. (VB-3) and [illegible] lb. (VB-[illegible]). High Angle Bomb. N.D.R.C. have secured laboratory and shop models only. April drop tests have been deferred because of high priority for Felix. Probably [illegible] Razon drops will be made in July. Difficulty is being encountered in selection of proper radio equipment for the Razon. No production plans have been made.

l. GB-5 Series, 2000 lb. Glide Bombs, Light [illegible].

(1) GB-5A. Present experimental orders are for [illegible]. Five (5) have been delivered and balance are scheduled for July and August. Laboratory checks have disclosed faults in the first five that will have to be corrected in the later deliveries. Drops will probably start in July.

(2) GB-5C. Present experimental orders are for 25. Five orders have been delivered. Two of these have been used in unsatisfactory drops. (Failure [illegible] due to improper airframe assembly). One was used at laboratory and two are now at Tonopah for test. A new manufacturer had to be located for the 25 and orders have just been placed. Delivery starts app. 1 Sept. This delivery can be expedited if a high priority is established.

(3) GB-5D. The present experimental order is for [illegible]. Deliveries will start in early July 1944 and be completed [illegible] August 1944. Materiel Command estimates that if production orders were placed with the Fairchild Camera and Instrument Company on a high priority basis that deliveries could

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start in [illegible] 2 months at rates of 100 to 200 per month.

m. GB-5A - 2000 lb. Glide Bomb, Heat Seeking. The present experimental order is for 120. Deliveries have been made of 15 to AAF and 5 to [illegible]. Tests have been delayed, due to the construction of an artificial target, and are now expected to start in July 1944. Delivery estimate on remaining 100 is to start in August and finish in September. The wider angle viewer developed recently will probably be included in the remaining 100 items.

n. GB-7C Moth Glide Bomb. Twenty-five radar equipments are under order by ARL. These can probably be completed in a month after the receipt of final specifications. The NDRC tests with hand built models are still unsuccessful and the delivery date of the ARL models is therefore decidedly vague.

o. GB-9 Ground Skipping Bomb. The AYD (APN-1) altimeters have been [illegible] in [illegible] airplanes but results have not been satisfactory and ARL is making further study. It will probably be 2 to 3 months before completed models will be ready for test. As a separate investigation, a contract is being negotiated with The Hammond Company to develop a nose unit containing all the devices needed to change a GB-8 into a GB-9. Completion of the first models is probably two to three months away.

p. GB-10 Television Glide Bomb. Material Command has decided to concentrate on the [illegible] television equipment for this article. One has been delivered and is now being tested. The other types of equipment were tested and were not considered equal to the Block III.

q. ROC - Medium Angle Bomb (Douglas Project).
VB-9, 1100 lb. Radar Homing; VB-10, 1600 lb. Radar Homing;
VB-11, Heat Seeker. The first models of the new type of airframe will be completed in September 1944. The 25 on the N.D.R.C. order are being made to a production design. If the airframe is successful, airframe production could be secured by January 1945. Suitable homing or television equipment would also have to be secured. Investigations are continuing on suitable [illegible] and television.

r. Power Driven Bombs (XBQ). One XBQ-1, one XBQ-3A, two XBQ-3, and one XBQ-[illegible] have been delivered. Material Command have been asked for dates on each of these models for the completion of tests and readiness for use.

s. A-2 Motor Boat Targets. The two boats should be completed and accepted by July 1944. They will be turned over to the Office of Strategic Services as soon as they are completed.

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Union Switch and Signal Company
Pittsburgh 18, Pennsylvania

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August 16, 1944

Dr. Vannevar Bush, Director
Office of Scientific Research and Development
1530 P Street, North West
Washington, D. C.

Dear Dr. Bush:

With this letter I am sending you, by way of the Liaison Office, a copy of the diary of my recent visit to the United Kingdom as a representative of OSRD. That document is long and the following is an attempt to give the most important points in brief review.

The purpose of the trip was especially to study the application of Azon (VB-1), to discuss Azon and other dirigible bombs with our Air Forces and with British scientists who are interested in the problems, and to get acquainted with the work on dirigible bombs that is under way or contemplated in England.

It should be said at once that I had the most excellent cooperation from everyone. Nearly all my activities and appointments were directed and arranged for by Dr. H. G. Stever and Dr. D. P. Langmuir of Mr. Bennett Archambault's office. Major J.C.C. Williams of the Air Technical Section of USSTAF assisted with arrangements and accompanied me on a number of missions, and provided transportation on many occasions. The same spirit of interest and cooperation was evident not only in the London Mission but in all the groups with which I had dealings, both British and American.

Conferences were held with the following groups: (In each case the name of the principal representative is given)

AMERICAN

1. London Mission OSRD
   Mr. Bennett Archambault

2. USSTAF
   Headquarters - Colonel A.R. Maxwell
   Colonel [illegible]. Schwartz

   Air Technical Section - Major J. [illegible]. Williams

   Bovingdon - Major H. J. Ford

3. Eighth Air Force
   Major O'Neill - Commanding Officer of Azon Group of B-24s

4. Ninth Air Force
   Brig. General S. Anderson

5. Navy - Special Weapons
   Lieut. [illegible]. J. Nagel, USN

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1. Ministry of Aircraft Production (MAP)
   Dr. W. J. Richards, Deputy Director of Scientific Research
   Air Commodore H. Leedham, Director of Air Communications Research

2. Royal Aircraft Establishment (RAE)
   Dr. Scott Hall, Head of Armaments Section
   Dr. J. G. Wilson of Armaments Section

3. Scientific Research Department of the Admiralty ([illegible])
   Deputy Director J. Buckingham

4. Admiralty Gunnery Establishment ([illegible])
   Colonel A. S. Harrison, Director

5. National Physical Laboratory (NPL)
   Dr. W. S. Stiles of the Photometric Dept.

6. Cossors Ltd.
   Dr. I. [illegible] Bedford, Director of Research

There follows a resume of the discussions with these organizations [illegible].

1. AZON (VB-1)

Since the Azon was my principal interest it was discussed with [illegible] groups with which I had contact and information in regard to them [illegible] to be exceedingly interesting to all parties.

The operational groups and others who have had contact with the use of Azons were all loud in their praises of the performance of the [illegible] apparatus itself. They said that they could count on the apparatus to be reliable and on the controllability to be adequate [illegible] the most extraordinary conditions. The only difficulty that they had [illegible] were difficulties with the performance of the personnel. The personnel [illegible], not only in bombing procedure in combat zones, but inexperienced in navigation, in the use of the apparatus generally and, what is most important, were not sufficiently familiar with the geography of the theatre in which they were working. For these reasons many of the missions failed in whole or part. It is expected that the conditions will improve very rapidly and that then we shall get full benefit of the Azon performance.

In spite of the conditions described, it was stated to be the estimate of General Anderson, whom I did not meet but who was in charge of operations of the Eighth Air Force, that a group of bombers using Azon is six times as effective as a similar group of bombers using standard bombs.

I spent some time with Major O'Neill, who is the commanding officer of the Eighth Air Force group of B-24's that is using Azon, and with his bombardiers and the other men of this group. They gave the above picture and gave a detailed account of the missions that they had made. This account is given in my diary.

It was very gratifying to find in this group, as well as in the Ninth Air Force, that was just getting ready to use Azon with a group of B-26's that there was a consistent interest in a study of the best tactics to be used in the application of Azon. The Eighth Air Force had used new tactics in every one of their missions. It seemed to be a continuous topic of discussion with them. At the time of my visit, they had settled on a rather simple arrangement of

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planes and a limited assignment of targets as the [redacted]. Anything else seemed to be too complicated to result in successful operation.

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In the Ninth Air Force, and I believe this is true also in the Eighth Air Force, there was a group of mathematicians who are making a thorough statistical study of the bombing results. It is believed that from this group we shall get some very valuable information on the performance of Azons.

A few minor suggestions for improvements of Azon were made and they are all fully covered in the diary so that it is not worth while to discuss them further here. It was estimated that 10,000 Azons per month will probably be required when they come into full use.

The Ministry of Aircraft Production is interested in Azon and was just getting ready to study a considerable number of units that had been assigned to them.

The Anti-aircraft Gunnery Establishment was interested in Azons, principally on account of the possibility that the Azon apparatus might be useful for some of their projects. A great deal of time was spent discussing these possibilites with both [illegible].

2. Other [illegible] Azon Apparatus

During my visit I became acquainted with the following contemplated or already initiated [illegible] Azon apparatus.

(a) It was planned to try the use of P-38's for bombing with 1000 lb. Azons. For this purpose there was being equipped at Bovingdon a [illegible] P-38 with [illegible] racks for three 1000 lb. bombs and a fourth wing rack to hold a tank which would carry the control apparatus.

(b) Azon apparatus was being tried in bombers for simultaneous release of all the bombs in a formation by the bombardier in the lead ship. It is believed that this will give a better pattern of impacts.

(c) [illegible] we were at Bovingdon [illegible]-weary B-17's were being stripped of all their apparatus except that necessary for control and were being equipped with remote control apparatus consisting of Azon receivers and servo motors. The purpose was to use them as controllable bombs carrying a considerable explosive charge. At the time of my visit 5 or 6 ships were already equipped.

(d) The British and the Air Technical Section of [illegible] are cooperating on a project to equip a high explosive armor-piercing [illegible] with Azon tail structures for control. This bomb is equipped with a rocket to increase its velocity during the last few seconds of its flight. The plan was to attach the Azon tail securely behind the rocket and to try to direct the bomb so that it was going straight for the target at the time the rocket takes hold. It seems a very long shot but it was thought to be an easy thing to try and they were prepared to make some such experiments.

3. Razons and other Projects

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In many of our discussions the question of Razons came up and some of the British have a great deal of interest in the possibility of such a unit. The ability to steer in both azimuth and range appealed to them and all I could tell them at the moment was that we should know the answer in a month or two and should be in production shortly thereafter if the results were as anticipated.

[redacted]

[illegible] [redacted] 125

Members of the Royal Aircraft Establishment were especially interested in the Razon sight that we are trying. This consists of an attachment to the regular bomb sight which makes the image of the Razon and the image of the target coincide in the field of the bombsight telescope whenever the Razon is in the appropriate trajectory. This makes it possible to apply only the necessary corrections and makes unnecessary the violent maneuvers that have to be resorted to when such a sight is not used. That sight is being tested at the present time.

4. Dirigible Bomb Projects in the United Kingdom

(a) Further one in these projects is the study of Azon performance and Azon tactics.

(b) [illegible] and [illegible] were just beginning the study of plans and instrumentations for a guided anti-aircraft projectile. C[illegible] had progressed to the point of having developed pneumatic servo mechanisms which seemed very effective and able to provide great forces with a small amount of apparatus. The anti-aircraft projectile that they had in mind looks like a very difficult development. They wanted it to be controllable in all directions and to be able to provide accelerations as high as [illegible]. It looks like a long development.

(c) Another British project was the high explosive armor-piercing bomb with rocket, mentioned above, which they expect to equip with an Azon tail structure.

(d) The Admiralty Research Laboratory was especially interested in a radar target-seeking high-angle bomb for use against ships. This is also in the speculative stage. They were planning to use semi-armor piercing bombs but had not reached the stage where they had gone into any details, either of the radar of of the servo mechanisms to be used.

(e) The [illegible] members thought that television bombs should be very effective if television can be operated in a high angle unit. I told them that I thought our experiments indicated that it could be done, but that we still had some experimenting ahead in this field.

(f) There was interest in other target seekers, especially heat seekers, but nothing had been done and it did not seem that any work was being planned in these fields.

Apparently the study of controlled missiles and of development of such missiles was still generally in the speculative stage in England.

5. Study and Discussions of German Bombs.

(a) The flying bomb was foremost in the discussions and I spent a day at [illegible] studying it. This has been reported on fully in Loga J-3873 and need not be discussed here.

(b) [illegible] and HS 293. This is the German version of a Razon, and enough parts had been acquired to be able to get a complete picture of its construction. It is very carefully designed and apparently is effectively controlled. The same can be said of HS293 which is the German dirigible glide bomb. The most interesting thing that came out of the discussion on these two bombs was the reasons given [illegible] for the discontinuance of their use by the Germans. They say that since both of them have to be carried outside of the bomb bay they decrease the speed and maneuverability of the ship to such an extent that it becomes vulnerable and with [redacted] [illegible] protection in the German air force they cannot afford to use such

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equipment. In a supplement to my diary various reports on these bombs are listed, and rather complete information is available.

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6. Suggestions for OSRD Liaison

The liaison for Division 5 at the London mission did not seem to be entirely satisfactory to the men who are assigned to it. This feeling is entirely understandable because they COPY been assigned to represent special weapons activities x without having had an opportunity to study the work that is being carried on on this side. They get our reports but do not have time to read them thoroughly with the result that some of the British who do read them know more about it than our men do. I would suggest that Dr. H. G. Stever and Dr. D. P. Langmuir be given opportunities to come to the States every few months to spend a month or so each time. In this way, they can get thoroughly acquainted with what is going on in their field. They have a feeling that very little is being done and that the speculations that have been begun in England are of a more advanced nature than they really are. I believe this frequent return of our representatives would be very helpful.

7. Suggestions for the Military

In my diary there are several suggestions that should be passed on to our liaison office to the appropriate military personnel. Chief among these are the following:

(1) There were several suggestions by men in the field for the training of personnel for the use of Azon.

(2) Everywhere I went there was a request for an instruction book on Azon. This I believe is under preparation by the Army, but as far as I know it has not yet been completed. It is very much needed.

(3) There are many suggestions concerning the construction of Azon, most of which have been taken care of already but they should be passed on so as to make sure that everything has been considered.

(4) A satisfactory film descriptive of the preparation and use of Azon in the field is not available in the United Kingdom.

(5) It is suggested that Major J. W. C. Williams should also be given an opportunity to return to the States frequently to get acquainted with new developments.

All of these suggestions and others which are included in my diary have already been given to the appropriate personnel orally, but I believe they should also bepassed on formally by the liaison office in order to insure that they are handled as promptly as possible.

I hope that you will have time to read the diary because there are many details in which I think you will be interested, however, if you do not and if there are any questions brought up in this letter which you would like to discuss further, I am of course at your service.

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Sincerely yours,

[redacted]

/s/ L. O. Grondahl

Chief, Section 5.2, NDRC

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HEADQUARTERS ARMY AIR FORCES

ROUTING AND RECORD SHEET

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TALLY NO.	AC/M
FILE NO.	1

SUBJECT: Further Deliveries of Castor Type Equipments

TO: Air Communications Officer, Special Projects Section — DATE 5 Jul 44

FROM: AC/AS, MM&D, Materiel Division — COMMENT NO. 1

Major Stace/hms/6440

1. In confirmation of the conversation of 4 July with Lt Col Davis, the Materiel Command will not complete their study on further deliveries of Castor Type equipment until approximately 15 July 1944.

2. The Materiel Command states ~~that the~~ only delivery promise that could be made at the present time on Castor Type Equipment (after the first crash shipment to U.K.) would be 4 ~~to 5 months~~. Their study however, will include methods of expediting and securing substitutes in order to cut down the length of this potential delivery period.

3. The Materiel Command have been given no quantities on which to base their study. A schedule of potential requirements will be of decided value to them in determining how fast deliveries can be made.

4. It is understood that your office is sending a request to the theatres asking for monthly requirements and that these monthly requirements will be divided into the quantity of each type of airplane to be used as a missile and the quantity of each type of airplane that will be required as control airplane.

5. Information on the desired further procurement program for Castor type equipments and a procurement directive will be appreciated as soon as the necessary information is available to your office.

6. A copy of a teletype of 5 July 1944 to the Materiel Command is also attached. This request to check into the possible availability of equipments for the Navy Drone program is in accordance with conversation 4 July between Lt Col Davis and Major Stace.

R. C. Dunlev, Col. A.C.

R. C. WILSON
Colonel Air Corps
Chief, Devel Engr Br

1 Incl
Teletype to MC, 7-5-44

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HEADQU ERS ARMY AIR FORCES

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ROUTING AND RECORD SHEET

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TALLY NO.	
FILE NO.	

SUBJECT: Further Deliveries of Castor Type Equipments.

TO: AC/AS, OC&R, Bombardment Branch — DATE 14 Jul 44

FROM: Air Communications Officer, Plans & Tactical Applications, Special Projects Section — COMMENT NO. 2 — Capt Scripps/nd/5375

1. This office concurs in Comment No. 1, Paragraph 2, relative to future procurement on pilotless aircraft equipment. It is the function of the Air Communications Officer to authorize and procure Signal Corps equipment for pilotless aircraft projects.

William J. Scripps
W. J. SCRIPPS
Capt, Air Corps

1 Incl: n/c

R-11896

TO: Asst C/AS, MMD, Materiel Division — Date 17 July 1944
Attn: Maj Stace

FROM: Asst C/AS, OCR, Requirements Division — Comment No. 3 — Col Rothrock/bsf/71608

This office concurs and assigns a priority 2-A to this procurement.

1 Incl: n/c

AFRDB E. [illegible]

B&C J.H.R.

Mervin E. Gross
MERVIN E. GROSS
Brigadier General, U.S.A.

Ac-18401

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Ref: Capt. R. P. O'Meara
MR/70-2B - 36324

5 August 1944

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DEP. CH. STAFF	
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ADJ. GEN.	
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BUD. OFF.	
PERS. SEC.	
ENG. DIV.	
PROD. DIV.	McDowell, O'Meara, Price
INSP. DIV.	
PROC. DIV.	
OTHERS	

Chief, Production Division
Wright Field

AUTH: ORVAL R. COOK
Brig. General, U.S.A.
Date: 5 August 1944
Initial:

Castor Project Status Report -
B-17 and B-24 Airplanes.

Reference: CTI-1747, Addendum #3 dated 14 July 1944.

1. Pursuant to the request from higher echelon, the following status report is submitted on the Castor Project, which is covered in reference CTI.

2. In reference CTI, 500 Castor "M" and 100 Castor "C" airplanes and kits are directed for special modification. Castor "C" airplanes are to be modified at Modification Centers in the United States. Fifty of the Castor "C" airplanes are B-17Gs, and fifty are B-24Js. Cheyenne Modification Center was notified by a teletype from this Command of this proposed project on B-17 airplanes, and was sent an itemized list of parts to be furnished by the Modification Centers. Birmingham Modification Center was also notified in a similar teletype on B-24 airplanes, and sent an itemized parts list of the items which are to be furnished by them on this project. Recent information is to the effect that Cheyenne Modification Center is likely to go out of business before the available parts can be furnished for this project. Therefore, Cheyenne Modification Center was notified that they will not take any action on this project, and that the fifty B-17G airplanes will be modified at Birmingham, together with the B-24 airplanes.

3. In a conference held with the Signal Corps Officers associated in this project, it was found that due to critical availability of some of the Signal Corps items in the Castor "C" project, that production modification could not take place before 1 October 1944. At that time, it is believed that sufficient quantities of necessary parts will be available at Birmingham Modification Center to start installation on the Castor "C" program. Systems Engineering, Aircraft Radio Laboratory, Materiel Command will have a representative from this Command available at Birmingham Modification Center with the drawings to supervise the work, on or about 1 October 1944. At that time production installation will take place. The man-hours required per airplane in the Castor "C" project is estimated roughly at 200 man-hours for the first two or three airplanes, and man-hours required on subsequent airplanes should be considerably less.

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By
Signature and Grade
Date 10-1-45

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IOM, Chief, Production Division
Castor Project Status Report - B-17 & B-24 Aps.
5 August 1944

4. Items that are used in the Castor "C" project, and are being procured and shipped by Resources Control Section and Signal Corps, are in the process of delivery to Birmingham Modification Center. These items will be marked and stored upon delivery, and held for production on airplanes assigned to this project.

5. The Castor "M" project kits are being assembled at the Air Service Command. A directive is being sent from Washington to cover Air Service Command's action in the CTI initiated by Materiel Command. The fabrication required on certain items is to be done by the Air Service Command, and all items available to that Command that are required in the Castor "M" project are being shipped to their assembly point by Resources Control Section and Signal Corps Depot in Dayton, Ohio. In the Castor "M" project certain ordnance items are required, and these items cannot be shipped and stored with the kits due to their dangerous nature; therefore, provision is being made to supply these required items in England by the liaison ordnance Officer, Materiel Command.

6. In the Castor "C" project (control) the B-17 airplanes code number is CQB4; B-24 airplanes code number is CQB5; and P-38 airplanes code number is CQB6. In the Castor "M" project (missle) the B-17G airplanes code number is BQ7; B-24J airplanes code number is BQ8.

7. Reference is made to Materiel Command letter to Ass't. Chief of Air Staff, Materiel and Services dated 2 August 1944, reference Lt. Col. K. P. Royce:veh:90-C-30, a copy of which was forwarded your attention. This communication listed the critical items and their availability in both the Castor "C" and Castor "M" projects.

8. In conclusion, the earliest possible date for the completion of the Castor "M" project is estimated as sometime in September. Critical aspect is procurement of Signal Corps items to be diverted to this project, subject to establishment of adequate priority. A meeting is now being held in Washington with the Navy Department, who has frozen some of the critical Signal Corps items, to obtain their release on these parts. For the Castor "C" project, it is estimated that the B-24 and B-17 airplanes will be modified on or about 1 November 1944. This program is scheduled so that the Castor "M" kits will be available in England at the time of delivery of the Castor "C" airplanes.

[illegible]
Colonel, Air Corps
Chief, Production
Engineering Section

cc: Chief, Prod. Eng. Sec.
Asst Ch., Prod. Div.
Ch., Components Br., RCS
Ordnance Office, Col. Taber
Signal Corps, Mr. Greenebaum
ASC - Capt. Corliss
Res. Con. Sec., Airc.Br., Lt.Horton

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By Col AC
Date 10-1-45
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DEP. CH. STAFF
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ADJ. GEN.
EXEC. PROC.
AIR. INSP.
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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION

151290

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

FOR VICTORY BUY WAR BONDS AND STAMPS

10 July 1944

SUBJECT: Expedited Development of Altitude Control Device for Castor Aircraft and other Guided Missiles.

[redacted]
By Authority of
The Commanding General
Army Air Forces
10 July 1944 MCD
Date Initials

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

Attention: Technical Executive

1. With the degree of resolution secured from late trials with the Eagle Radar, representatives of the Radiation Laboratory have agreed that it is decidedly feasible to consider the installation of a radar beacon in a Castor type missile airplane, in a glide bomb, or in other guided missiles in order to follow this flight of the missile in the radar scope, and direct the missile to a target.

2. Preliminary studies by Radiation Laboratory have been started to determine the potential availability of such beacons for use with Eagle equipped control airplanes.

3. This procedure would enable the beacon equipped guided missiles to be used at night, through overcast, and at distances from the control airplane, probably equal to the range of the control equipment.

4. The difficulty of determining the altitude of the glide bomb in order to get accurate range results is still apparent. It is probable that the most accurate range results can be secured by using the GB-9 principle of a sudden dive of a missile approaching the target at a fixed known altitude.

5. It is directed that a study be expedited on:

a. Controlling missiles, including Castor type airplanes, to fly at a fixed known altitude above the ground level for an approach on a target.

b. Controlling these same missiles into a sudden dive into the target from the final approach level.

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10 July 1944

Subject: Expedited Development of Altitude Control Device for Castor Aircraft and other Guided Missiles.

c. Controlling these same missiles in a dive or comparatively high angle descent from high levels to the final approach level.

6. It is understood that the Navy has carried out a study similar to that directed herein. It is suggested that data received by the Navy from their study be obtained by the Materiel Command from the Navy.

7. It is further directed that a report be submitted by 1 August 1944 on the status of the study directed in paragraph 5 above, and that this report include information on the availability of the various items being considered to control this type of approach.

By command of General ARNOLD:

R C Wilson

R. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Branch
Office, Asst Chief of Air Staff
Materiel, Maintenance & Distribution

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AUTH: F. O. CARROLL
BRIG. GEN., U.S.A.
DATE 31 JUL 1944
INITIALS JGV

Address reply & ENVELOPE to:

Commanding General
AAF Materiel Command
Engineering Division
Reference: Dept. 54-TP: 151290
Wright Field, Dayton, Ohio

Castor
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Equip Lab

Lt. H. S. Hinley
hjb: Ext. 3-0114

Reg. no. M8-1050
24506

Expedited Development of Altitude Control Device for Castor Aircraft and other Guided Missiles.

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Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Development Engineering Branch, Materiel Division, AC/AS, M & S.

1. Reference is made to letter from your Office dated 10 July 1944 subject as above.

2. The status of the directed study for Glide Bombs and Castor Aircraft is as follows:

a. Glide Bombs.

(1) Two types of altimeter control devices are now under development by the Materiel Command. The first of these types, utilizing the radio altimeter AN-APN-1, is now undergoing active tests in its application to the radio controlled ground skimming glide bomb, type GB-9, Project MX-494. A formal report covering the results of these tests is not available, but the present test program is expected to be concluded by approximately 1 September 1944. At that time a comprehensive summary of the utility of this device and its application to functional control should be available for analysis.

(2) Experimental development of a mechanical barometric altimeter to be used in connection with range control of glide bombs was begun only recently. The advantage of the mechanical device over the electronic type of altitude control is its simplicity, lower cost, and freedom from jamming by the enemy. No models of this type are under procurement as yet, and consequently performance results and comparisons can not be submitted at this time. If high priority for

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Commanding General, Army Air Forces, Washington 25, D. C.
Attention: Development Engineering Branch, AC/AS, M & S.
"Expedited Development of Altitude Control Device for Castor Aircraft and other Guided Missiles."

3 1 JUL 1944

the continued development of the mechanical type of altimeter control is indicated, procurement data and experimental testing should be sufficiently advanced by 1 September to properly eval[illegible] this device.

b. Castor Aircraft.

(1) Remote controlled tests of a low altitude radio altimeter were made successfully about six months ago in an AT-11 airplane with a hydraulic servo. No tests of this altimeter have been conducted with the C-1 automatic pilot being used in Castor aircraft. It is believed possible to connect the AN-APN-1, 0-400 feet and 0-4000 feet, radio altimeter to the C-1 automatic pilot and control the aircraft through this control if such action is desired.

(2) For altitude higher than 4000 feet it will be necessary to use a barometric altimeter if automatic altitude control at such altitude is deemed necessary. The barometric altitude control device is now in an experimental stage, and is now being tested in PQ-14 target aircraft. It has not proved satisfactory as yet and no estimate on its availability can be given until tests are completed.

(3) The radio altimeter, type AN-APN-1, is available in quantities if it is taken from other projects. Three hundred of these altimeters are now in Dayton, but most of them are obligated for other projects which would necessarily be hampered if this equipment was diverted.

(4) The Navy Department was contacted concerning any studies that they have made on the subject, and although they indicated that little information

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Commanding General, Army Air Forces, Washington 25, D. C.
Attention: Development Engineering Branch, AC/AS, M & S.
"Expedited Development of Altitude Control Device for Castor Aircraft and other Guided Missiles."

31 JUL 1944

was available, any reports on the subject would be sent to the Materiel Command.

For the Commanding General:

H. Z. BOGERT,
Colonel, Air Corps,
Acting Chief,
Engineering Division.

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Lt. I.J.M. Gruitch/med
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rtn: 28 Sep 44

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29 SEP 1944

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON 25, D. C.

AAF 471.6 (28 Sep 44)

X38

SUBJECT: Pilotless Controlled Airplanes, "Castor" Project.

29 SEP 1944

TO: Chief of Ordnance, Research & Development Service, Washington, D. C.

THRU: Commanding General, Army Service Forces, Wash. 25, D. C.

1. The U. S. Strategic Air Forces in Europe have employed "war weary" B-17 and B-24 type aircraft by means of remote control as a power-driven bomb. The remote control equipment consists of control links that are installed in both the missile aircraft and the control aircraft.

2. The missile aircraft ("war weary" airplanes) are loaded with approximately 20,000-lbs. of explosive and are remotely controlled by radio and television from the control airplane that may be as much as 20 miles away from the missile. Take-off is made by a pilot who retracts the landing gear, synchronizes the engines, trims the aircraft, arms the explosive load and then bails out. The control equipment in the missile aircraft then operates the control surfaces and the television camera.

3. The television transmitting equipment (Block III) in the missile aircraft sends back to the control airplane a picture of the area towards which the aircraft is headed, which permits the control pilot to accurately control the missile aircraft into the target.

4. This project has been designated "Castor" and twelve (12) sets of equipment have been installed to date in modified B-17's, of which to date six (6) aircraft have been dispatched on missions. The Ordnance phases of this project to date have been split in responsibility, with the United States supplying the necessary destructor kits for the BQ (Missile) and CQ (Control) "Castor" kits, and the U. S. Strategic Air Forces in Europe supplying the major items, explosives, electric fusing, mechanical fusing, primacord, and exploders.

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5. The U. S. Strategic Air Forces in Europe were requested to forward all details connected with the type of explosive used, loading, and fusing principles involved so that their experience could be incorporated in the design of a kit which can be furnished to other theaters in the event a requirement arises for the use of missile aircraft loaded with large amounts of explosive.

452.1 Radio Control Planes

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Ltr.AAF 471.6 (23 Sep 44), to Ch/Ord thru CG, ASF, subject, "Pilotless Controlled Airplanes, "Castor" Project," (Cont'd.).

6. The attached inclosure furnishes blueprints and a detailed analysis of the explosive packaging, storage in planes, fuses used, and arming methods employed in the United Kingdom.

7. The Army Air Forces request that the Chief of Ordnance analyse the methods of loading and fusing employed by the U. S. Strategic Air Forces in Europe from the standpoint of meeting Ordnance safety requirements and simplification of fusing and arming methods. Upon completion of this analysis, the Chief of Ordnance is requested to prepare a suitable kit containing the necessary fuse, detonator, primacord and explosive box which can be shipped as a packaged unit to the theaters of operation. As this employment of bulk explosive might require the construction of a new type of explosive box, action is to be taken to incorporate in the design of the booster explosive boxes provisions for the attachment of standard M115 adapter boosters in order that standard mechanical fuses may be utilized.

8. Procurement of 550 sets of control equipment for missile aircraft has been initiated by the Army Air Forces. Reference attached copy of letter from this Headquarters to the Air Technical Service Command, Wright Field, file AAF 471.6 (23 Sept 44), subject, "Procurement of Castor Type Installation Kits".

9. To meet the anticipated usage of these control units in special operations in the near future, the Army Air Forces request that an equal quantity of Ordnance explosive kits be designed and procured, of which 500 are to be high explosive loaded, and 50 are to be inert loaded.

10. A priority of Emergency Urgent is to be assigned to this project.

For the Commanding General, Army Air Forces:

R. C. COUPLAND
Brigadier General, U. S. Army
Air Ordnance Officer

2 Incls:-
#1-Cy.ltr.to ATSC,Wright Fld., AAF 471.6 (23 Sep 44),fr.this Hq.
#2-Ltr.fr.USSAFE to CG,AAF,dtd.19 Sep 44,"Pilotless Control Planes", w/1 Incls.

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. . : F. O. CARROLL
Brig. General, U.S.A.

DATE: 9-- --

INITIALS:

DETAILS OF AAF GUIDED MISSILES PROGRAM

The purpose of this report is to give the details of all experimental guided missiles now under development by the Materiel Command. It will be noted that details of "standard" guided missiles are omitted except where those items are being employed in a special project.

1. Experimental Units Being Procured in Quantity (200 or more)

   a. GB-7A
   b. GB-7B
   c. VB-6 (Felix)

2. Experimental Units (less than 200)

   a. GB-5A
   b. GB-5C
   c. GB-5D
   d. GB-6A
   e. GB-7C
   f. GB-9
   g. GB-10
   h. VB-2
   i. VB-3
   j. VB-4
   k. VB-9
   l. VB-10
   m. VB-11
   n. A-3 Boat
   o. XBQ-3
   p. XBQ-7 and XBQ-8
   q. Towed Gliders
   r. JB-1
   s. JB-2

3. Special Projects

   a. Project "Castor"
   b. Project "Batty"
   c. Project "Campbell"
   d. Spazon
   e. GB-1 (European Theater)
   f. GT-1 (Southwest Pacific)

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1. Units Being Procured in Quantity of 200 or more.

a. GB-7A - (RHB) 2000-lb. Glide Bomb, Radar Target Seeking

(1) Description: This glide bomb is a radar homing bomb using a RC-171 radar receiver on a 2000-lb. Aeronca vehicle. This vehicle has an airframe similar to the GB-8 but has a special ply-wood nose and different control box. The RC-171 radar receiver is a Navy procured device (Radar Equipment Mark I, Mod. II) which will probably be used with a 500-lb. or 1000-lb. Dryden vehicle (Pelican). This device homes on radar pulses transmitted by a radar transmitter in the control airplane and reflected from the target. The target must be sufficiently isolated to prevent distraction from other sources of reflection that would be within the scanning range of the bomb receiver. (Note: There is a target selector device in the bomb receiver by which one of several targets can be selected before dropping. This device can not be used against enemy radar because of different frequencies and pulsing. (See GB-7C for this purpose.)

(2) Comments: This glide bomb is planned for use against marine targets or isolated large buildings. It can be used either night or day in all weather from a distance of 8 to 10 miles. (Further on larger ships.) Tests by NDRC indicate that the angle made with the ground by the target-to-bomb or target-to-airplane lines should not exceed 45 degrees when over water. After dropping the bomb the airplane can make a 180° turn.

A test base was secured at Bedford, Massachusetts for continuance of tests but is not being used at present. Tests will be conducted at Ft. Dix Army Air Base, Ft. Dix, New Jersey, inasmuch as this base is located approximately 25 air miles from the NDRC Warren Grove test area.

At present additional bombs are being set up to check the alternative accelerometer for pitch and rudder for azimuth control against pitch gyro for pitch and aileron for azimuth control.

b. GB-7B - (SRB) 2000-lb. Glide Bomb, Radar Target Seeker

(1) Description: This glide bomb is a radar homing bomb that is similar in principle to the GB-7A (RHB) except that it carries its own radar transmitter to illuminate the target (AN/APG-7 radar transmitting and receiving set). Previous plans were to use a Dryden 2000-lb. vehicle having a 12 feet wing spread but consideration is now being given to using the Aeronca 2000-lb. vehicle similar to GB-8 airframe with a special plywood nose. The radar transmitting and receiving set (AN/APG-7) is a Navy procurement (Mark XXXI Mod. I) which

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the Navy will probably use on a 1000-lb. Dryden vehicle. This glide bomb must have isolated targets similar to those used by GB-7A glide bomb.

(2) Comments: The GB-7B glide bomb is preferred to the GB-7A glide bomb during operation because after release this glide bomb may be forgotten as far as control is concerned. This bomb has the potential use of homing on a "corner reflector" that could be planted at the target by various means. NDRC tests indicate that the angle from the horizontal of the target and the glide bomb should not exceed 45° for effective results.

A mock-up of the GB-7B has been tested in the wind tunnel and the tests indicate controllability and superior glide characteristics over those obtained with the 2000-lb. Dryden vehicle.

"Radar Homing" equipment (RHB) has been installed in a GB-7B vehicle and will be dropped as soon as the B-17 airplane reports to Ft. Dix. "Radar Homing" equipment (RHB) has been installed in lieu of "Send Receive" equipment (RHB) inasmuch as "Send Receive" equipment is not available at present and it is desired to conduct tests of the GB-7B vehicle.

The B-17 airplane to be used for these tests has been equipped with production type of plane monitoring equipment. This airplane left Wright Field for Ft. Dix on 29 August 1944.

Preliminary tests of "Send Receive" equipment (SRB) by Bell Telephone Laboratories indicate satisfactory operation.

c. VB-6 - (Felix) 1000-lb. High Angle Bomb

(1) Description: This high angle bomb is a NDRC development consisting of a standard 1000-lb. bomb (AN-M-65) with a front compartment (False Nose) attached containing a target seeking device and a rear compartment containing gyro stabilization control servo mechanism operating attached aerodynamic controlling surfaces. A shroud or "lift ring" is provided around the body of the bomb and two types of control surfaces are provided as alternate, one being of cruciform type and the other being octagonal. The arrangement now favored utilizes the octagonal tail design with large control surfaces and without lift ring. The target seeking device is designed to home on strong heat sources with control in both range and azimuth. The estimated range is 10,000 feet to 15,000 feet and the extent of control will be 2000 feet minimum in a 15,000 feet drop.

(2) Comments: NDRC feels that the trail drops indicate sufficient possibilities of accuracy to warrant the crash program. Article cannot be used successfully when low overcast prevents sufficient infra-red radiation from targets, but the article can probably be used through high overcast with a radar bombsight. The

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Navy is very interested in heat-seekers of this nature and in countermeasures to them. In regard to potential targets, large marine moving targets give satisfactory homing signals, except in case of low overcast or cold wind with warm water. A Materiel Command heat survey on land targets indicates that steel mills, isolated power-plants, and factories give satisfactory signals. For uniformly accurate results, however, a heat survey of area surrounding target for distracting heat sources appears essential immediately preceeding the drop. Materiel Command has tried out land charting with promising results. Improvements are being made in the techniques of recording. Many targets can be picked very well without such a charting device but it is hoped that the charting device will be good for locating camouflaged or underground factories. Recent tests conducted at Tonopah, Nevada, indicate that a very substantial heat target is essential. In addition to the six preliminary drop tests conducted at Eglin Field, Florida twenty-eight drops at Tonopah Nevada were made. The first fourteen (14) drops at Tonopah were against aluminum foil reflector target and the latter fourteen (14) drops were against a heat target burning 500-lbs. of oil per hour. Of the first fourteen (14) drops no hits were within 200 feet of the target. In the latter fourteen (14) drops there were five (5) hits within 200 feet of the target in addition to one direct hit. Numerous failures among these test drops were due to faulty control equipment.

Work is progressing on an improved design of heat detector that indicates 10 times higher sensitivity and assures more accurate results.

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2. Experimental Units (less than 200)

a. GB-5A - 2000-lb. Glide Bomb, Light Seeking.

(1) Description: This glide bomb uses an airframe similar to the GB-8 but is equipped with a special plywood nose. Experiments are being conducted to determine the type control to be used. (Aileron or rudder.) A Fairchild photo-electric marine target seeker that will home on a light contrast will be installed in the nose to direct the vehicle. This device consists of a cylinder 10-1/2 inches in diameter and 11 inches long with a relay box 18 inches long by 12 inches wide by 2 inches thick plus a 12 volt battery. Five to six miles range was obtainable in the experimental models that were produced. The first of the quantity procurement of twenty-five (25) however had a range of only three to five miles.

(2) Comments: This type of glide bomb is particularly suited for marine targets. Operation will be effective when the visibility permits launching the bomb from a range of 5 to 20 miles. For ranges in excess of 5 miles the bomb is dropped preset until within operating range of the target seeking equipment.

At present the manufacturer of the target seeking equipment is conducting tests and making changes in the equipment to increase the range of the units being procured in quantity. It is anticipated that three (3) additional units will be delivered to this station by 15 September 1944. Preliminary arrangements are being made to conduct flight tests of this glide bomb at either Bedford Army Air Field or Ft. Dix Army Air Base.

b. GB-5B - 2000-lb. Glide Bomb, Light Seeking.

(1) Description: This glide bomb uses a vehicle similar to that used in the GB-5A glide bomb. A Hammond-Crosley photocell, scanning, marine-type, contrast light seeker is installed to direct this vehicle. This device homes on marine targets offering visible contrast against water and is considered accurate for ranges from 7 to 10 miles.

This glide bomb can be dropped at further distances than the GB-5A to fly initially as preset with the photocell "eyes" opening at the operating range. This device is approximately a 12 inch cube with an amplifier box 11 inches long by 8 inches wide by 4 inches thick.

(2) Comments: This glide bomb is suited for use in a manner similar to the GB-5A. The seeking unit is also suitable to detect aircraft at ranges up to 2 miles providing it is looking upward (no horizon) and the background is uniform (cloudy or clear).

Considerable difficulty is being encountered in obtaining a suitable manufacturer that is willing to produce an experimental quantity of 25 units. The reluctance of the manufacturer to accept a contract

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for these items is considered due in part to fear of cancellations should hostilities terminate before the work is completed. However, an attempt is still being made to obtain a suitable manufacturer for these devices.

c. GB-5D - 2000-lb. Light Seeking Bomb

(1) Description: This glide bomb uses a vehicle similar to that used by the GB-5A. A photocell type flare-seeker manufactured by Fairchild Camera and Instrument Company is installed to direct this vehicle. This detecting device can fit in a cylinder 8 inches in diameter and 10 inches long and can also be divided into the "eye" unit and an amplifier. The design of this device is similar to the device used by NDRC group under Dr. Klemperer with Douglas Aircraft. Although these units have been designed for the 2000-lb. glide bomb, they should be adaptable for smaller units designed for a 100-lb. bomb or larger. This device appears to be a very satisfactory flare seeker.

Flares have also been developed to place on land targets. These flares are 3 feet long, 7 inches in diameter, weigh 80 lbs. and burn 3 minutes at 100,000 candle then 3 minutes at 1,000,000 candle power. This device should also be effective against flares of the type used by the British with their Pathfinder or against saboteur type, radio-fired incendiary bombs.

(2) Comments: The flare seeker glide bomb is considered to have possibilities of point land targets such as block houses provided a flare can be planted at the target by an available means. The flare would be planted in front of the objective and the bomb coming in, due to its flat trajectory, should skip into the target. Although the enemy would probably find means eventually of extinguishing this flare, they would have to act very rapidly. A very important possibility of confusing the enemy, after several have been used successfully and they find out what the flares mean - would be to use the flares against various targets - even when a glide bomb was not going to follow in. Recently the European theater stated an interest in the possibility of bombing spots targets with heat or light seekers after the planting of a heat or light source. This technique for target spotting has been successfully used by the British on several occasions. The Office of Strategic Services is also interested in flare-seeking bombs. A statement of requirements has been asked on which to base a priority for further development.

The prototype seeking device was delivered to Wright Field during June 1944 and tests conducted by the Materiel Command to determine if this device is suitable for production indicated satisfactory results. The manufacturer, Fairchild Camera and Instrument Company, was given permission to continue manufacture of the additional 20 units under contract. Delivery of those twenty units is expected by 22 September 1944.

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Six of these devices will be delivered to Wright Field during the first week in September. It is anticipated that tests of these devices will be completed at Wright Field within two weeks and actual drop tests will be conducted at Tonopah, Nevada during the latter part of September.

Fairchild Camera and Instrument Company have estimated that with present facilities 100 of these devices can be constructed each month.

The priority of this project has been increased to 1-B by AC/AS, M & S.

d. GB-6A - 2000-lb. Heat Seeking Glide Bomb

(1) Description: This glide bomb uses a gyro stabilized vehicle similar to that used by the GB-5A. An Offner thermopile heat seeking device is installed to direct this vehicle. This device will home on a source of heat strong enough and isolated enough to keep the seeker from being distracted. The effective range is from 7 to 10 miles.

(2) Comments: The Materiel Command has 120 heat seeking devices under procurement from Offner Electronics Incorporation, Chicago, Illinois. Of this quantity approximately 20 units have been delivered and preliminary tests are being conducted at Tonopah, Nevada. Initial tests indicate that the GB-6A glide bomb is a promising heat seeking device for land targets that are sufficiently isolated and are warmer than the surrounding area.

Different types of heat mapping devices are under development by different organizations. Materiel Command is developing one for use with the heat seeking glide bomb. An alternative device is being developed by Bell Telephone Laboratories on NDRC contract. These developments are necessary so that a background check can be made before actual drop to ascertain sufficient thermal differential.

e. GB-7C - (Moth) Glide Bomb, Radar Target Seeking

(1) Description: This glide bomb is equipped with a radar target seeker (AN/APQ-14) for homing on enemy radar. This equipment is adjusted to enemy frequencies so that it will home on enemy radar antennas. Present tests have been conducted for use with the 1000-lb. Dryden vehicle.

(2) Comments: The development of the GB-7C glide bomb is an NDRC project. This device was planned to be effective against enemy radar stations if the station is close enough to the antenna. The

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8th Air Force has indicated interest in this project but progress has been slow and the 8th Air Force was advised by Air Communications Officer that progress had been unsatisfactory and that at least 6 months were required to complete this development. Both Aircraft Radio Laboratory and NDRC consider it doubtful whether a satisfactory weapon of this type will be developed. Consequently NDRC will terminate this development after completion of tests now under way.

f. GB-9 - Glide Bomb, Ground Skimming

(1) Description: This glide bomb is being tried using the GB-4 airframe with the addition of pull-out, stabilization, and altitude control equipment. This vehicle will use either flares or a smoke trail to enable the remote control operator to guide the missile to the target. Two types of altitude controls are under development. One is a modified radio altimeter, AN/APN-1, and is now undergoing tests at Tonopah, Nevada. The second is a barometric type of control altimeter and has not yet reached the flight test stage. Each has its own particular advantages. The radio altimeter will maintain the bomb at a constant distance above the ground irrespective of the actual altitude above sea level, however it can be affected by enemy radio jamming. The Aneroid altimeter is mechanical in its operation, is simpler, cheaper, and will maintain itself at a constant pressure altitude. The latter feature is a disadvantage when used over mountainous or broken country.

The glider is dropped in a steep dive of approximately 45°. It is leveled out at an altitude of approximately 1000 feet or less at a speed in excess of 400 mph. The vehicle then proceeds at a constant altitude for 3 to 5 miles where it is abruptly dived into the target.

(2) Comments: Tests are now being conducted at Tonopah, Nevada using the GB-4 type of airframe. This vehicle was chosen so that sufficient space would be available for additional equipment required. Preliminary tests have been conducted with the radio altimeter installation in the GB-4 airframe and the equipment has been made to function very well. Ballistic tests of this airframe with 10 degrees down elevator indicated that the trajectory had a "hump" in it and was not a smooth dive and pull-out. Additional ballistics tests will be conducted.

To date a total of five (5) bombs without the pull-out apparatus have been tested at Tonopah and the results indicate a considerable error in the actual impact point as compared to both theoretical and wind tunnel estimates. It is highly probable that this is due largely to the compressibility effect encountered at speeds in excess of 500 mph.

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Previous considerations were made for the use of the GB-9 glide bomb with solid fuel rockets similar to those developed by Monsanto Chemical Company, however this phase of development is being eliminated from this project.

g. GB-10 - 2000-lb. Glide Bomb, Television and Radio

(1) Description: This glide bomb is quite similar to the GB-4 in general principal except that the Aeronca airframe (GB-8) will be used and the television will be installed in a plywood nose instead of underslung as in the GB-4. This glide bomb will have a different type control system than that used in the GB-4 and it is anticipated using this device in a manner similar to that being developed for the GB-9.

(2) Comments: Tests of the Remington Rand television device have shown satisfactory operation and delivery of this unit is expected in February 1944. At present the image orthicon unit is being tested and minor difficulties have been encountered, however, satisfactory pictures have been obtained at sunset illumination levels. All tests on this glide bomb are being held up until satisfactory television equipment is available.

h. VB-2 - (Azon) 2000-lb. High Angle Bomb

(1) Description: This high angle bomb is similar to the VB-1 high angle bomb except that the 2000-lb. bomb is used instead of the 1000-lb. bomb. The same gyros and radio equipment as that used in the VB-1 is used in this device but the tail has been increased in size. This high angle bomb fits into the shackles used for the 2000-lb. bomb.

(2) Comments: Twenty (20) experimental units have been dropped recently and control was satisfactory on all but one. Control is more sluggish than with the VB-1 bomb. Maximum deflection is approximately 1000 feet when dropped from 15,000 feet. However this smaller degree of control is considered satisfactory.

A limited quantity of production models have been shipped to Tonopah, Nevada of which two have been dropped to date. Both bombs were dropped from 6000 feet altitude and both erected properly but failed to respond to any control whatsoever. Since numerous failures have recently been experienced with the Emerson type radio in the Spamon tests, failure of these bombs were contributed to radio trouble. The General Instrument Company model radio equipment have been forwarded to Tonopah to replace the Emerson model. Tests will be continued upon receipt of this equipment.

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i. VB-3 - (Razon) 1000-lb. High Angle Bomb

(1) Description: This device is a high angle bomb controllable in both range and azimuth by means of direct radio control. A flare is used for visual perception similar to the VB-1. The VB-6 type tail surfaces and servo equipment are installed on the rear of a standard 1000-lb. bomb. This development is being conducted by NDRC with flight tests by the Materiel Command.

(2) Comments: Tests of this high angle bomb are now being conducted at Tonopah, Nevada. Great difficulty has been experienced in determining proper range control for this weapon during preliminary tests. However a bombsight modification has been developed and is now being tested. Six VB-3 bombs have been dropped using the modified bombsight attachment. Two of these bombs experienced partial radio failures. Two of the successful drops were controlled well and landed within 45 feet of the target. The modified bombsight attachment has proven satisfactory to date. The VB-3 test program will continue for approximately one month at which time this missile should be ready for tactical and proof tests.

j. VB-4 - (Razon) 2000-lb. High Angle Bomb

(1) Description: This high angle bomb is functionally identical to the VB-3 with radio control available for both range and azimuth. It utilizes the standard 2000-lb. demolition bomb equipped with a controllable tail fin attachment of sufficient size to permit controllability and to retain stability. The control operator will guide the bomb to its target through the bombsight attachment as in the case of the VB-3 bomb.

(2) Comments: This device is a development of NDRC and as yet no experimental models have been constructed. Design work is temporarily suspended pending the results of the VB-3 test program now under way at Tonopah.

k. VB-9 - (Roc) 1000-lb. Medium Angle Bomb, Radar Homing

(1) Description: This device consists of a 1000-lb. general purpose bomb that was originally equipped with four stub wings. These wings have been replaced by a ring 48 inches in diameter in order to enable the device to fit inside the bomb bays of the larger airplanes. This ring is rocked about the yaw and pitch axes for directional control. There is also a fixed ring at the tail. The overall length is approximately 137 inches.

This device does not have to be stabilized against roll

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and actually rolls slightly in flight. The minimum radius of turn is 7000 feet and the glide angle is adjustable at anything above 34° from the horizontal. The maximum allowable speed at the maximum turn rate is 575 feet per second.

This device will be equipped with the RC-171 Radar Seeking Equipment.

(2) Comments: The angle of flight of this device is probably too steep for a successful radar target seeker unless a method can be obtained for flattening the glide angle. The vehicle is still experimental. Tests of several of these vehicles, without seeker installed, are planned for the month of September at Harpers Lake, California.

l. VB-10 - (1000 lb.) Medium Angle Bomb, Radio Controlled, Television

(1) Description: The vehicle planned for use with this device is similar to that used in the VB-9 except that a television unit will be installed in the nose.

(2) Comments: Development of the television equipment (miniature image orthicon) is being continued by Radio Corporation of America on an NDRC contract. Tests of this device rely on tests being conducted on the VB-9 vehicle.

m. VB-11 - 1000-lb. Medium Angle Bomb, Heat Seeking

(1) Description: The vehicle planned for this device is similar to that used in the VB-9 except that a heat seeking unit will be installed to direct the device into the target.

(2) Comments: Development of a heat seeker by Polaroid Corporation on an NDRC contract has been coordinated with Douglas Aircraft Corporation for use on the VB-11. This seeker is at present designed around Thermistor detector. The first model of the polaroid detector did not prove adequate and a new design is being built. The new design is using universal centering suspension of the heat seeker and precessing gyros for obtaining the first derivative of angular deviation. Tests of this unit are currently being carried out at Cambridge, Massachusetts.

n. A-3 Boat

See Project Campbell - "Special Projects"

o. XBQ-3 - Power Driven Bomb, Radio and Television Controlled

(1) Description: This controllable bomb is a twin engine aircraft

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designed for long distance remotely controlled flights through use of radio and television control. As a controllable bomb this aircraft has provisions for either two 2000-lb. bombs, one 4000-lb. bomb, or two torpedoes, and has a range of 1500 miles. This aircraft was designed to be flown into the target but has provisions for release of the torpedoes during flight.

(2) Comments: One XBQ-3 (serial no. 43-25252) has been delivered to Wright Field. This aircraft slightly damaged in a forced landing on 19 July 1944 during conductance of flight tests. Action has been taken to have this aircraft repaired by Fairchild after which the flight tests will be continued. The second XBQ-3 aircraft has not been delivered to Wright Field.

p. XBQ-7 and XBQ-8 - Power Driven Bomb

See Project Castor - "Special Projects"

q. Towed Glider Bombs

(1) Comments: There is no extensive Army Air Forces program on the development of towed gliders with automatic pilots, remote control, and/or television. The AAF has felt that the high angle bombs and the glide bomb fit in better with their tactical uses and carrying aircraft.

The Materiel Command has investigated the possibilities of stripping down large "war-weary" airplanes and using them as towed gliders. These would have a pilot make the take-off and then the pilot would bail out.

r. JB-1 - Power Driven Bomb, Preset (Jet Propelled)

(1) Description: This power driven bomb is one of Northrop flying wing design having a 28 feet wing span and powered by two General Electric turbo supercharger type jet engines (type B-1). This bomb is capable of carrying a 4000-lb. bomb load and has a range of 650 miles. This device will be launched from launching cars designed by Northrop that operate on a launching track, and will be controlled by preset devices in the vehicle.

(2) Comments: Thirteen (13) type JB-1 bombs are being procured from Northrop. The first unit is scheduled for test as a pilot flown glider (less engines) on 1 September 1944. Flight characteristics and proper control equipment installation will be determined in tests to be conducted at Muroc, California.

The General Electric Company is scheduled to deliver the

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first two engines on order approximately 10 September 1944 and the remaining engines will be delivered at the rate of two per month until completion of this contract. These engines are being developed from standard turbo supercharger units. Preliminary tests on laboratory models indicate that a thrust of 400 pounds can be obtained from each engine for a maximum operating time of ninety (90) minutes.

Tests of the launching equipment for the jet propelled preset bomb are scheduled to be conducted at Muroc, California approximately 1 September 1944. The launching cars and equipment are being engineered and built by the Northrop Aircraft Corporation. Preliminary calculations indicate a 10G loading on the bomb and associated equipment during take-off.

Design of the radio ranging equipment for this project is being conducted by the Aircraft Radio Laboratory at Wright Field.

Control equipment for the JB-1 is being developed by Hammond Instrument Company, Chicago, Illinois. Preliminary tests of the altitude control mechanism has been conducted during August and satisfactory results were obtained. The stabilization and directional control equipment being designed for this bomb will be of a type similar to the equipment used in the GB-4 Glide Bomb. One set of this equipment to be used in the pilot carrying glider model of the JB-1 has been delivered.

a. JB-2 - Power Driven Bomb, Preset, Jet Propelled

(1) Description: This power driven bomb is an American copy of the German jet propelled bomb V-1.

(2) Comments: There are 1000 JB-2 jet propelled bombs being procured from Republic Aircraft Corporation. The first unit will be ready for assembly and initial tests, with the control equipment and jet engine, during the early part of September 1944.

The jet propulsion units (copy of that used on the German bomb V-1) are being built by the Ford Motor Company. The first unit, less fuel system, has been delivered to Republic for mock-up purposes. One unit will be delivered to the Materiel Command approximately 1 September 1944. This unit will be used for test purposes.

A copy of the German control equipment using compressed air driven gyros and servos have been built by Jack and Heintz Corporation, Cleveland, Ohio. Tests of this equipment in a C-45 airplane to determine operation characteristics were started on 25 August 1944 at Cleveland. Approximately 30 hours of test flying have been completed.

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Results of these tests will be used to determine correct adjustments of the equipment in the JB-1 bomb by comparing the wind tunnel data of the JB-2 bomb with that of the C-45 airplane.

A site has been selected at Eglin Field, Florida, for launching of the jet propelled bomb (JB-1 and JB-2). The Corps of Engineers have started construction of a launching ramp, bomb-proof shelter, storage facilities, and messing and housing facilities.

Present plans are tentatively set to launch the first JB-2 power driven bomb during the latter part of September.

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3. Special Projects.

a. Project "Castor"

(1) Description: This project requires the development of equipment to accomplish the remote control of a B-17 and B-24 type aircraft as a power driven bomb. The equipment necessary consists of the control links to be installed in both the missile aircraft and the control airplane.

The missile aircraft (war-weary airplanes) will be loaded with approximately 20,000-lbs. of explosive and will be remotely controlled by radio and television from the control airplane which may be as much as 20 miles away from the missile. Take-off is made by a pilot who retracts the landing gear, synchronizes the engines, trims the aircraft, arms the explosive load, and then bails out. The control equipment in the missile aircraft operates the control surfaces, the television camera, and the detonation device (if required). Throttle control and altitude control mechanism are being developed.

The missile aircraft is equipped with television transmitting equipment (Block III) which sends back to the control airplane a picture of what the aircraft is heading for then allows the control pilot to accurately control the missile into the target.

(2) Comments: Tests have been conducted using the B-17 (redesignated BQ-7) and B-24 (redesignated BQ-8) as the missile aircraft and the B-17 (redesignated CQB-17), B-24 (redesignated CQB-24) and P-38 (redesignated CQP-38) as the control airplanes.

Twelve sets of control equipment (plus 3 spare sets) for the BQ aircraft and five sets of controlling equipment (plus 2 spare sets) for the CQ airplanes were shipped overseas during July 1944. Personnel of this Office arrived overseas on 18 July 1944 to install, adjust, and operate this equipment during initial tactical tests.

Installation of the equipment in the Twelve (12) BQ-7 (B-17 modified) have been completed in the theater and initial tests have been conducted. It is planned that the targets will be those requiring long flights over enemy territory. On these flights it is contemplated that the BQ aircraft will fly most of the way at 20,000 feet and will then drop at approximately 2000 feet per minute to an altitude of 300 feet above the ground and will continue the trip using altitude control equipment. This system is believed to be the one that will give maximum protection from anti-aircraft fire but requires several modifications in the control equipment.

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In test flights being conducted, radio interference has been experienced. This interference was finally traced to RAF automatic landing equipment which operates on frequency modulation. Arrangements have been made for these stations to be off the air during "Castor" flights.

Metal stick flights have been made with personnel of the 8th Air Force and they appeared to be satisfied with the operation of the equipment and progress made to date.

b. Project "Batty"

(1) Description: This project entails the tactical use of the GB-4 (television and radio controlled) bomb and the GB-8 (flare and radio controlled) bomb in the European Theater.

(2) Comments: In the early part of July seven (7) each GB-4 and GB-8 glide bombs were sent to the European Theater. Personnel of this Office were assigned to set-up, check, and conduct initial, tactical tests with these devices.

The GB's were set up in the theater for tactical use, however, higher authority decided that the NOBALL TARGETS were not suitable for these weapons, and three other targets were selected. The 3rd Bomb Division then decided to limit this project to two GB-4 bombs and assign the remaining five Block III television sets to the APHRODITE project, however, this equipment was later reassigned to project "Batty".

The first GB-4 mission was flown on 13 August 1944. Two Glide Bombs were released from 15,000 feet against E-boat pens at Le Havre, France. Both bombs were misses due to malfunctioning of the television receiving equipment in the control airplane. The bombs flew and controlled very satisfactorily.

After thoroughly rechecking and testing the television equipment and apparently having corrected the trouble encountered on the previous mission, a second GB-4 mission was made on 17 August 1944 against the submarine pens at La Pallice, France. Both glide bombs missed the target. On the first bomb dropped the block camera shutter did not open upon release and no picture for controlling the bomb was available. On the second bomb dropped, the block receiving equipment in the control airplane again did not function properly.

The aircraft assigned to this project were in poor condition upon leaving this country for the theater and a considerable amount of time has been spent trying to make these aircraft suitable for combat

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operation. This Office was not given a chance to fly any experimental GB missions in these aircraft to determine satisfactory operation of equipment prior to operational use.

c. Project "Campbell"

(1) Description: This Project entails the use of high speed target boats, loaded with explosives, against enemy targets. The boats are controlled by use of radio, radar, and television equipment and are controlled from an airplane.

(2) Comments: Two (2) type A-2 water borne targets were tested at Ft. Barrancas, Florida. One of these target boats was camouflaged at Ft. Belvoir, Virginia to simulate a fishing boat by the installation of a false superstructure and a mast. The camouflaged target boat was converted into a radio-controlled missile by being equipped with a load of explosives consisting of fourteen (14) 300-lb. depth charges having a hydrostatic fuse set to detonate at 25 feet depth. In addition, the missile was equipped with a primer charge which was to be set off with an impact fuse. The missile was equipped with a television transmitter SCR-549A in addition to the basic radio control equipment. Television receiving equipment SCR-550A with a monitor was installed in a type B-17F airplane which also contained the transmitting equipment AN/ARW-SX for remote control of the missile. Reception on the television receiver screen was clear at a distance of approximately 11 miles. The missile was guided by means of television into the SS San Pablo striking just aft of amidships on the starboard side. Upon impact the scuttling charge was set-off and twenty-five seconds later the main explosive charge detonated. The SS San Pablo sank within two minutes after the main charge went off. At the time of the actual collision between the guided missile and the SS San Pablo (stationary) the control airplane was approximately 6 miles from the missile and at an altitude of about 3000 feet. The SS San Pablo was anchored in the Gulf of Mexico approximately 15 miles from the Florida coast off Ft. Barrancas. Additional tests consisting of radar tracking and high altitude control if the target boats are to be conducted at Little Creek, Virginia on approximately 10 September 1944. Radar equipment SCR 717 is now being installed in the B-17F airplane at Wright Field.

d. Sponson

(1) Description: This project has been set up to eliminate the wide dispersion of the VB-1 (Azon) high angle bombs.

(2) Comments: Tests are now being conducted at Tonopah, Nevada and Orlando, Florida on anti-dispersion devices for the VB-1 when released in train. The method being tested at Tonopah, Nevada per-

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mits the bomb to spin (as a normal bomb) during the initial part of the flight before control is applied. During tests at both Tonopah and Orlando great number of radio failures have occured. Present action requires that the radio difficulties be determined and corrected prior to completion of tests.

e. GB-1 - Glide Bomb, Preset (In Tactical Use)

(1) Description: Aeronca glider structure having 12-foot wing span with approximately 12 feet overall length, including bomb. This bomb is gyro stabilised in azimuth and is preset with no control after leaving the airplane. A B-17 can carry 2 GB-1 bombs on external bomb racks. The B-25 can carry 1 GB-1 under the bomb bay. This bomb has a glide ratio of approximately 6 to 1. The accuracy from 15,000 feet is estimated to be 1/8 mile in azimuth and 1/2 mile to 1 mile in range.

(2) Comments: A recent report received from ETOUSA states that the recent Cologne raid proved the usefulness of the GB-1 glide bomb. It is believed that additional experience will reduce the size of the area bombed.

f. GT-1 - Glide Torpedo

(1) Description: This glide torpedo uses the GB-1 airframe and has a 6 to 1 gliding ratio. The GT-1 kit contains a special paravane that frees the torpedo from the wings by actuating other devices including explosive pins, when it contacts the water. This device solves the difficult problem of proper entry of an air borne torpedo into the water. The torpedo used does not have a "seeking" device or remote control but follows a zig-zag or expanding circle pattern. This missile was ordinarily dropped from 5000 to 6000 feet altitude in operational practice at Eglin Field and customarily landed within a 1000 feet circle with some drops landing within a 300 feet circle.

(2) Comments: Southwest Pacific theater commanders expressed the opinion that the range of the B-25 airplane with the GT-1 attached is too short for profitable use from the present bases. Unless the tactical situation warrants otherwise, it has been recommended that this project be closed out.

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HEADQUARTERS ARMY [redacted] FORCES
ROUTING AND RECORD SHEET

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TALLY NO.
FILE NO.

10/14 WLN
Date Initials

SUBJECT: Weary Willie Priority

DATE 11 Oct 44

TO: AC/AS, M&S, Materiel Division

FROM: Air Communications Officer, Special Projects Section

COMMENT NO. 1
Maj Rand/jo/5375

1. Pursuant to meeting at Eglin Field between the representatives of Air Forces Proving Ground Command, Air Communications Officer, Materiel and Services, Dr. Bowles' office, it is desired that the ground controlled weary willie program will take top priority in the Guided Missiles Program. It is contempl that this will go into action this winter in the ETO.

2. Other Guided Missiles Projects will drop down in priority accordingly, but will remain in the same relative priority to each other.

for WILLIAM L. NORVELL
Lt. Col., A. C.

Acc/m

TO: Air Communications Officer, Special Project Section

Date: 20 Oct. 1944

FR: AC/AS, M&S, Materiel Division

Comment No. 2
AFMMA-2C/Maj.Stace/lb/4308

1. Attached for your information is a copy of a letter of 12 October 1944 to the Air Technical Service Command, subject "New Nomenclature for Remotely Controlled War-Weary Aircraft."

R. C. WILSON
Colonel, Air Corps
Act.g Chief. Engr. Br.

1 Att.
Cpy. ltr. atd 12 Oct. 44

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Central Files

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION:

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON (AFDMA-2C)

SUBJECT: Project Willie and Effect on CTI 1747 and Addenda

SECRET
[illegible]
17 Oct 44 R.W.
Date Initials

TO: Director
AAF- Air Technical Service Command
Wright Field, Dayton, Ohio (TSGEM)

1. This confirms discussions and agreements of 14 October 1944 with representatives of Air Technical Service Command Administrative Office, Procurement Division, Maintenance Division, Supply Division, Aircraft Radio Laboratory, and Special Weapons Branch.

2. All projects for using surplus airplanes as robots are now called Willie projects. Control airplanes are called Mothers, missile airplanes controlled by Mothers are called Babies, and missile airplanes controlled by ground instead of Mothers are called Orphans.

3. Many plans of operation can be included in Willie project, each requiring different equipment.

4. The following plans are now under consideration for Orphan use:

a. Dead Reckoning: Radar tracking and plotting of approach course resulting in dead reckoning course with pre-set flight after pilot bail-out.

b. Radio Control: Tracking and plotting for complete flight with remote radio control after pilot bail-out.

c. Radar Control: Radar tracking and plotting for complete flight with remote radar control by SCR-584 after pilot bail-out.

5. The following plans are now under consideration for Mother and Baby use:

a. Visual Observation Operation: The same as the previous Castor. This involves remote radio control, television, altitude control and smoke dispensers for visual following of Baby.

b. Radar Bombsight Observation: Will probably contain all visual control equipment but will include radar equipment in Mother and Baby to permit continual determination of relative position of Mother, Baby, and area flown over through the radar scope. This plan can be used in overcast or darkness and will also permit dumping the Baby through overcast by radar determination of position if the television cannot pick up an adequate picture.

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Date 12-1-48

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Subj: Project Willie and Effect on CTI 1747 and Addenda (Cont'd)

c. Long Range Operation: Will probably include all equipment for visual or radar operation and will also include telemetering of Baby instruments and remote control of the further Baby controls considered necessary for long range flights and varying altitudes.

6. The airplanes now considered for Orphans and Babies are the war-weary B-17s and the B-24s having C-1 automatic pilots. Study has been directed on controls to permit other surplus combat aircraft to be used as robots. The airplanes now considered for Mothers are B-17s and B-24s. It is possible, however, that a variety of other aircraft, including B-29s may eventually be used. Study will also be directed on the further controls necessary for the Orphans or Babies for remote control take-off, in order to eliminate the necessity for a pilot take-off and bail-out.

7. It is evident that the six plans described here and other potential Willie plans will require a wide variety of equipment and that a number of components of this equipment will be used in some of the plans and not in others.

8. The following action is directed:

a. The establishment of a list of components for all Willie plans. This will include all presently known components for the Orphans, Babies and Mothers and other components are to be added as they are determined.

b. The grouping and packing of these components into sub-kits. The sub-kits are to be small enough units so that they can be used without waste for any of the present Willie plans or for known other requirements for the same equipments. Each sub-kit is to be assigned a number and a short descriptive name. As definite Willie projects are determined, shipping instructions will be directed for assembly of these sub-kits into the master kits required for the project.

c. The procurement of all components for the 550 missile kits and 110 control kits now directed under CTI-1747 and addenda thereto is to be continued for utilization in the Willie sub-kits. Further procurement directives will follow for the other components necessary for Willie projects.

d. The components procured under CTI-1747 and addenda thereto are not to be packed into any master kits until further instructions are issued.

e. All programs for actually installing control equipment in the airplanes formerly known as Castor control airplanes are to be cancelled. Any airplanes secured for the modification programs are to be released and any equipment shipped to the modification centers is to be returned for incorporation into the Willie sub-kits. Directives will be issued later on any necessary modification center programs.

Classification cancelled or changed to ... The Air Technical Service Command is to take coordinated action with AC/AS, Training, Washington, D. C., and the Army Air Force School of Applied

By CO 356 Signature and Grade

Date 10-1-45

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Subj: Project Willie and Effect on CTI 1747 and Addenda (Cont'd)

Tactics at Eglin Field and Orlando to determine necessary action on training for Willie projects and is to take necessary Air Technical Service Command action on these training programs.

g. The Air Technical Service Command is to take coordinated action with the offices of the Chief of Ordnance and the Chief of Chemical Warfare through the Air Ordnance Officer and the Air Chemical Officer to establish the Ordnance and Chemical items necessary for the Willie projects, including the explosive and incendiary loads and the Ordnance items necessary for "dumping" the robot, and is to request necessary delivery action for the Willie projects on the items that will not be furnished by the theatres. The Air Technical Service Command will design and procure any Air Force items or components required for use with the Ordnance or Chemical items.

h. An availability report is to be submitted prior to 1 November 1944 showing the components contained in each sub-kit and the following information on each sub-kit:

(1) Total quantity on order.

(2) Total quantity already shipped from stock.

(3) Total quantity in stock.

(4) Monthly delivery promises to stock for the next six months.

i. Further availability reports showing changes to the report requested in paragraph 8g are to be submitted twice monthly until further notice.

9. The priority of the Willie project is 1A.

10. The security classification of the Willie project is:

a. Confidential for the development, production, installation instructions, and shipping of components or sub-kits. Any sub-kit containing only items with a lower security classification can be stocked and shipped with the same security classification as the contents.

b. Confidential for the assembly and shipping of the master kit for any Willie plan.

c. Secret for complete installations for any Willie plan or for information, testing, descriptions or discussions of various Willie plans.

By command of General ARNOLD:

Classification cancelled or changed to
AUTH: CO-356
Signature and Grade
Date 10-1-46

S R Brentnall

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S. R. BRENTNALL
Colonel, Air Corps
Asst. Chief, Materiel Division
[redacted] Office, Asst. Chief of Air Staff
Materiel and Services

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HEADQUARTERS
ARMY AIR FORCES PROVING GROUND COMMAND
EGLIN FIELD, FLORIDA

General H. H. Arnold,
Commanding General, Army Air Forces,
Washington 25, D. C.

File

9/30/44

Dear General Arnold:

Although it may prove to be premature, I feel that I must suggest something on the radar control of war weary airplanes. The Proving Ground is poor in scientists and engineers, so we have blundered along pretty slowly trying it out. I am now quite confident, however, that by taking off with pilot aboard we can control these airplanes for as much as fifty (50) miles. This would be enough to take them from any of a variety of places in Northern France to Cologne, Duisburg, Dusseldorf, Gelsenkirchen, Essen and other places. If we can get them there, we will know their position within a few hundred feet, and I have in mind exploding the wings off and letting them go on in as if they were bombs.

After we get accustomed to operating them, we will undoubtedly be able to take them off, but I don't believe we had better wait until then to start using them as we might waste a lot of time. Also, we have television and other ideas for steering them to the target, but I am afraid we may waste more valuable time if we wait to perfect all those difficult things.

Steering flying bombs over will be an almost identical problem except that we do not need pilots and should be able to get most of them launched.

When bad weather stops normal flying this winter would be the proper time to launch these weapons, and zero visibilities will be ideal since fighters cannot destroy the bombs. Radar controlled artillery may get some, but in the particular populous area mentioned, any one that falls after crossing front lines has a good probability of doing considerable damage. The morale effect ought to be at least as great as that achieved by the German bombs on London.

My specific suggestion is that you call General Echols in to see if he can get some control equipment ready by the middle of November, and ask Dr. Bowles to arrange for enough radar scientists to help us. General Echols will also have to arrange for an exploder to blow the wings off. With General McClelland's help I will try to get a dozen or so trained operators ready to supervise the operations, and we may be able to get some of the weapons flying by the first of December.

Sincerely yours,

Gen. Echols
See Dr. Bowles
& them both here
tomorrow at 11:00 AM

GRANDISON GARDNER,
Brigadier General, U. S. Army,
Commanding.

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HEADQUARTERS
ARMY AIR FORCES PROVING GROUND COMMAND
EGLIN FIELD, FLORIDA

Major General O. P. Echols,
Assistant Chief of Air Staff, Materiel & Services,
Washington 25, D. C.

9/30/44

Dear Oliver:

I believe that without too much difficulty and confusion all around, we can manage to fly some of these Castor airplanes late this fall or during the winter and am making a suggestion to General Arnold (copy of letter attached) to that effect. I believe that the Wright Field people are already building some of this equipment and it will only be necessary to increase the quantity to carry out the program I have suggested. I think perhaps the Proving Ground Command can train some operating people, although we may have to call on Wright Field for some help in this phase of the program also. We will try to do as much of it ourselves as possible and bother them as little as possible.

I am sure that if we get this started on a short range basis it will just naturally extend itself to longer ranges, and I feel pretty sure that we can expand so as to include take-offs and some final, more positive method of getting the missils onto the target. The take-off and getting the missile onto the target, however, are bound to involve a lot of difficulties, so I thought we had better plan to evade these two problems in starting. At the present time we do not have means of controlling altitude, but I believe the Wright Field people have already devised a pressure altitude control, and there is a possibility that we could use this radar that the Air Forces Board has talked a lot about which they call the V Beam.

I will try to arrange to come in and talk to you about this program if General Arnold wishes to have it pushed.

Sincerely yours,

Grandison Gardner

GRANDISON GARDNER,
Brigadier General, U. S. Army,
Commanding.

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Gardner to Gen.
Arnold, 9-30-44.

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3 October 1944.

MEMORANDUM FOR: General Giles.

SUBJECT: Combat use of war-weary aircraft.

A letter was recently sent to General Arnold by General Gardner asking for assistance on the control problem associated with his study of the applicability of war-weary aircraft to controlled bombardment.

Today a conference was held with General Echols, General McClelland and others concerned. It was agreed to bring together at Eglin Field a balanced group of men from the Materiel Command, the Air Communications Office, and my own office to meet with General Gardner on Sunday, October 8th to outline what it is we can do in the shortest possible time to carry out area bombing by means of pilotless, war-weary aircraft and, secondly, to lay out the second step in the program for more elaborate control and greater precision. The second stage in the program is not to interfere with the first. It is understood that this effort will be directed toward the application of these aircraft to the European Theater problem.

I have asked Mr. Collbohm of the Douglas Aircraft Company, who is now attached to my office, to assist in this program. He will also act as my representative on all matters relating to controlled missiles. He will attend the Eglin conference. I am asking Dr. Getting of the Radiation Laboratory to be present and also a tip-top man from RCA, from which I am sure we shall need to draw radio and television talent.

I shall ask Mr. Collbohm to monitor the work insofar as my own office is concerned, and shall make it a point to give General Gardner whatever outside assistance appears to be necessary to collaborate with the Army personnel involved. The importance of speed has been emphasized and we shall do our best to apply the heat by giving General Gardner the best support we can find.

I believe Mr. Collbohm can be particularly helpful because of the study he is making of controlled missiles in connection with the Special Bombardment Project recently approved by General Arnold and yourself.

cc: Gen. Echols
Gen. Craig
Gen. Gardner
Gen. McClelland

Edward L. Bowles

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MONTHLY SUPPLEMENT TO DETAILS
OF
EXPERIMENTAL GUIDED MISSILES PROGRAM

The purpose of this report is to give the monthly status of experimental guided missiles now under development by the Air Technical Service Command, Engineering Division. It will be noted that details of standard guided missiles are omitted except where these items are being employed in a special project.

1. Experimental Units Being Procured in Quantity (200 or more)

   a. GB-7A
   b. GB-7B
   c. VB-6

2. Experimental Units (less than 200)

   a. GB-5A
   b. GB-5C
   c. GB-5D
   d. GB-6A
   e. GB-9
   f. GB-10
   g. VB-2
   h. VB-3
   i. VB-4
   j. VB-9
   k. VB-10
   l. VB-11
   m. VB-12
   n. XBQ-3
   o. XBQ-7 and XBQ-8
   p. Towed Glider Bombs
   q. JB-1
   r. JB-2

3. Special Projects

   a. Project "Castor"
   b. Project "Batty"
   c. Project "Campbell"
   d. Spazon

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1. Units being Procured in Quantity of 200 or more.

a. GB-7A

(1) The fifth unit was dropped on 11 September 1944 on a beacon located at Warren Grove, New Jersey. This missile passed eighty (80) feet over and one hundred forty (140) feet to the right of the target. This glider utilized production type of RHB equipment and a Hammond gyro control system employing an accelerometer for pitch control. Two (2) rates of turn control were used; a slow rate during the early part of the flight and a much higher rate during the last part. The data from this flight, upon being analyzed, indicated that the optical axis of the RHB spinner was located too far below the axis of the glider. Future drops will be made with the optical axis changed by 3°. Two drops will be made during October 1944 on the beacon at Warren Grove, New Jersey and if satisfactory a drop will be made using the Navy's "James Longstreet" freighter as a target.

b. GB-7B

(1) The first GB-7B unit equipped with RHB target seeking equipment is awaiting a gyro control unit before dropping. The outcome of tests on GB-7A will dictate to great extent the type of gyro control equipment needed for GB-7B. A Hammond control unit is being built now and it is expected that the GB-7B will be dropped soon after the series of GB-7A's are dropped this month.

c. VB-6

(1) Two (2) VB-6 (Felix) drops were made 26 September 1944 against the heat target at Tonopah Army Air Field. Points of impact were 75 feet to left of target and 75 feet to right of target. Range miss was very small in both cases. The unit which landed to the right apparently received no control and its good score was only coincidental. The other unit gave a very satisfactory demonstration. Twelve (12) units will be dropped at Tonopah Army Air Field of an older modified type and approximately 12 newly designed units will be dropped at Wendover Army Air Field during the month of October 1944. A "Felix" heat unit is being tested in an Army Air Forces plane at Bedford Army Air Field. This detector indicates higher sensitivity and is an improved design. These tests will continue through the month of October 1944.

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2. Experimental Units (less than 200)

a. GB-5A

(1) The first of the pre-production group of twenty-five (25) units on order with the Fairchild Camera and Instrument Corporation have been delivered to this station for laboratory tests. Indications from the first tests point to a range of three (3) to four (4) miles. Plans are being formulated to test these devices against Marine targets using Fort Dix Army Air Base as headquarters.

b. GB-5C

(1) A manufacturer has been found that is willing to manufacture these units. An order for twenty-five (25) units is being placed with the Raytron Incorporated of Jackson, Michigan. Delivery of the first units can be expected by 1 April 1945.

c. GB-5D

(1) The first of six (6) units on the order for twenty (20) have been delivered to this station. Tests are being made to determine the sensitivity and field pattern of each device. The average sensitivity is below .001 foot candles and correct signals are obtained from this value through 100 foot candles. The field of view is approximately a twenty (20) degree circle. This field pattern can be distorted by a strong signal out of this twenty (20) degree circle. This point is being investigated as to its importance. Plans are being made to drop test five (5) of these units at Tonopah beginning 15 October 1944. This will give the Offices of Strategic Services fourteen (14) units (one remaining at this station) for tactical use.

d. GB-6A

(1) The fifth GB-6A was dropped on 15 September 1944 against the heat target at Tonopah Army Air Base. Point of impact was four thousand (4000) feet short but correct in azimuth. On 19 September 1944 GB-6 number six was dropped against the heat target and the point of impact was three quarters (3/4) mile to left and approximately correct in range. It is felt that relay trouble caused these failures. However, the analysis of data from these drops indicated the "triple" pick-off on the pitch gyro excited a natural period of the gliders and caused large pitch oscillations. Future drops will eliminate the triple pick-offs. Drops will continue at Tonopah Army Air Field until the heat target is constructed at Wendover Army Air Base.

e. GB-9

(1) Tests are being continued at Tonopah, Nevada, using the GB-4 type of airframe. Results show this type of airframe to have a marked tendency

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to roll over before pull-out can be achieved, and make advisable the use of ailerons to maintain level wings in the steep dive. Hammond altimeter control preliminary tests show only partially successful results.

f. GB-10

(1) This glide bomb is similar in general principle to the GB-4. It differs in that the television conversion unit is mounted in an extended nose section instead of in a suspended appendage below the bomb structure and the Aeronca type airframe is used. The television conversion unit will incorporate built-in attitude adjustment to compensate for variable angle of attack. The Farnsworth "Diane" equipment was developed for use on this project. Preliminary models were tested and certain defects detected. Owing to greater progress in the development of other equipment the "Diane" development was dropped. Until completion of the several conversion unit developments, notably the Remington Rand packaged equipment and the RCA "Mimo" device, the further development of this project is of necessity dormant.

g. VB-2

(1) Ten (10) VB-2 units were dropped from the external racks of a B-17 airplane from 21,000 feet at Tonopah, Nevada, in September. All units stabilized and controlled, indicating that aerodynamically the VB-2 is satisfactory. However, these units had neither short flares nor tail fuses and it is expected to drop additional complete units at Orlando, Florida, early in October.

h. VB-3

(1) The September series of tests conducted at Tonopah, Nevada, have shown the pre-production model of the Razon to be satisfactory. It is now planned to incorporate into this model the changes necessary for mass production and have sufficient units made for a final acceptance test. The bomb sight modification for this project is satisfactory.

i. VB-4

(1) Design work is continuing, however, this unit is still on a drawing board status.

j. VB-9

(1) The angle of flight of this device is too steep for radar homing. The radar research group of N. D. R. C. Division 5 found that at angles steeper than 45° homing is not reliable in the "S" band.

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k. VB-10

(1) The vehicle planned for use with these devices is similar to that used in the VB-9 except that it will be radio controlled missile, either with television or direct sight intelligence. Tests are being conducted on this vehicle without television or radio control equipment installed. These tests are conducted to determine the characteristics of the vehicle itself. Remote control tests are being planned for 15 October 1944.

l. VB-11

(1) Infra-red homing is believed applicable to this vehicle as soon as a system can be developed which yields a quantitative output. The Polaroid Corporation is undertaking the development of a heat seeker which operates only on the rate of change of the error angle. It proposes to reduce this rate to a constant, of such a value that a collision course must ensue. This device has given moderate satisfaction in laboratory tests, being limited by the lack of sensitivity of available bolometers.

m. VB-12

(1) During the early stages of testing the homing properties of "Roc" light-seeking devices were used. The usefulness of light seekers was limited only to that of testing. However, interest in light seekers is being reactivated since the Services now find application of this device to homing on flares planted on targets. A flare seeker for use as intelligence with "Roc" is difficult to construct in that a proportional signal is required. Fairchild Camera and Instrument Corporation developed a system which gives a proportional signal. Modification of this unit and further development may lend this device to the "Roc" vehicle.

n. XBQ-3

(1) Vibration tests of the main gas tank for the XBQ-3 have been completed and the tank accepted. The new tank will be installed and repairs made to the XBQ-3 now at Wright Field in approximately one (1) month. Upon completion of these repairs and installation, flight tests will be resumed.

o. XBQ-7 and XBQ-8

(1) See Project Castor - Special Projects

p. Towed Glider Bombs

(1) A study is being made to determine the performance characteristics of the "War Weary" P-39 airplane when towed as a Glider Bomb by the P-38 and B-25 airplanes. Data from this study is expected to be completed by

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7 October 1944 at which time a detail memorandum report of the status of the "Towed Missile" program will be completed by this Office.

q. JB-1

(1) Thirteen type JB-1 bombs, with airframes similar to the flying wing type aircraft developed by Northrop, are being procured from that Company. Preliminary test flights of a towed man-carrying version showed good controllability but somewhat difficult landings. Preliminary tests of launching sled at Muroc, California, are being conducted at the present time. Launching cars and equipment were engineered and built by the Northrop Aircraft Corporation. In one test a speed of 170 mph was obtained, using partial sled power and partial loading of the vehicle. Launching site at Eglin Field, Florida, for the JB-1 and JB-2 will be completed on or about 5 October 1944 according to present estimates. Design of radio ranging equipment for the JB-1 is being conducted at Wright Field by the Aircraft Radio Laboratory. Control equipment developed by Hammond Instrument Company for stabilisation and direction is being tested in the man-carrying version at present.

r. JB-2

(1) Mass production of 1000 units of control equipment for the JB-2 bomb has begun, and the first units have been delivered to the Republic Aircraft Corporation for installation in the JB-2 bombs prior to shipment to Eglin Field. The first production units of the JB-2 bomb will be delivered to the launching site at Eglin Field, Florida, during the week of 1 October. As soon as wind tunnel data have been obtained the first launchings will be accomplished. Preparations to run wind tunnel tests are presently being made at the Wright Field 20 foot tunnel. The launching site with its facilities will be ready for occupancy on or about 5 October.

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3. Special Projects

a. Castor

(1) Two (2) B-24D aircraft were equipped as CQB-24 control airplanes, and two (2) were equipped BQ-6 missile aircraft. These were flown to Eglin Field, Florida, on 31 September 1944 and 14 September 1944 for operational suitability tests. Following completion of these tests the aircraft will be given tactical suitability tests by the AAF Board, Orlando, Florida. Radio control and Block equipment personnel accompanied these airplanes to assist and instruct personnel conducting tests in the operation and maintenance of this equipment. Information received from Eglin Field, indicates equipment is operating satisfactorily. The Castor production quantity is being delayed approximately six (6) weeks for incorporation of altitude control equipment, smoke dispenser, and increase in bank. These improvements will be made and tested on Castor airplanes at Eglin Field. No further change will be made to production contract. Flight tests have been made on altitude control equipment and increased bank and Production Division notified of desired equipment necessary for these improvements. Investigation of smoke dispenser still being made. A remote turn and altitude control adaptor for the C-1 automatic pilot and Block equipment (improvement of trim Board) has been received from Minneapolis-Honeywell Regulator Company and flight tested satisfactorily. Five (5) more units are being procured for test in B-17 and B-24 aircraft at Wright Field and at Orlando, Florida. These will not be substituted in present production. Latest information indicates that the development of telemetering of flight instruments, and H2X radar for tracking and targeting of missile will be directed for use in Castor Aircraft.

b. Batty

(1) This Office has no information concerning the latest developments in this project. No reports have been received for the last month from personnel conducting the tactical test in the theater of operations.

c. Campbell

(1) One type A-2, Water Borne Target is being shipped to Wright Field by Office of Strategic Services in order that an initial installation be made of specialized equipment consisting of 28 V generator and miscellaneous radio equipment. This target boat will arrive at Wright Field on or about 2 October 1944. Complete installation data will be furnished to OSS in order that duplicate installations can be accomplished in the remaining boats.

OSS has obtained six (6) 85 foot Army Air Forces crash boats for which remote control installations are to be furnished by this Office. A study of the boat design and control equipment was made on 27 September 1944 in New York. Action is being intiiated to Army Service Forces, Office Chief Transportation, Cincinnati, for a complete set of drawings of this boat design No. 379.

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Recent high altitude and range tests conducted at Little Creek Mine Base, Virginia, revealed that the maximum effective range of the radio control equipment boat to control airplane was approximately forty (40) miles. (Altitude had little effect on the range.) The range of the Block equipment exceeded that of the control equipment. At eighty-five hundred (8500) feet altitude a usable picture was seen on the screen up to approximately forty-seven (47) miles. At twenty thousand (20,000) feet this range extended to about sixty-five (65) miles over a ten (10) mile sector at rear of the boat. At twenty-five thousand (25,000) feet a usable image was seen at a distance of eighty-five (85) miles over a twenty (20) mile sector. Tests indicated that the Block transmitting antenna was highly directional and for operational use would have to be modified to eliminate directional discontinuities.

d. Spazon

(1) September drop tests of the VB-1 indicate that Spazon version of the VB-1 cannot be practical until the reliability of the unit is improved. An increase in the radio reliability will affect that improvement. It is expected to continue with the Spazon tests about the middle of October.

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OFFICE FOR EMERGENCY MANAGEMENT
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P STREET NW.
WASHINGTON, D. C.

VANNEVAR BUSH
Director

October 12, 1944

Headquarters of the Army Air Forces
War Department
Washington, D. C.

ATTENTION: Lt. Col. William L. Norvell

Dear Colonel Norvell:

I have your letter of October 11 requesting certain assistance from NDRC in exploring application of the SCR-584 equipment to the control of war weary aircraft. You have outlined in your letter the specific aid which the Air Forces requests NDRC to extend to it at this time.

Pending completion of the study which I understand is now under way for bringing together the entire guided missiles program into one coordinated whole, I am perfectly willing to approve the extension of this assistance by NDRC and have so advised the Chairman of NDRC and Dr. DuBridge. As I have indicated previously in my correspondence with Professor Bowles and General Borden, I feel that I should know what the broad Army program is and the ways in which the Army desires that OSRD collaborate in this general field of guided missiles before approving any long-range development work in this Office. I understand that the present case merely involves exploring the adaptation of equipment which is almost entirely developed at this time. I hope that the SCR-584 will answer the immediate need for this remote control.

Very sincerely yours,

V. Bush,
Director.

cc Prof. E. L. Bowles
Brig. Gen. W. A. Borden
Dean E. L. Moreland
Dr. Irvin Stewart
Dr. L. A. DuBridge
Col. Ralph M. Osborne

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION:

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

(1)

22 DEC 1944

MEMORANDUM FOR GENERAL ARNOLD: (Information)

Subject: Status of Weary Willie Orphan Project

Radio Controlled Planes

1. A cable from General Eisenhower (CM-IN 20190, 21 December 1944) and a letter from General Spaatz dated 10 December 1944 have been received, which, together, sum up the attitude of the ETO concerning the use of Weary Willie Orphan aircraft.

2. General Eisenhower stated that he did not consider the safety factor a major problem because experience with previous operations of Weary Willie aircraft (Baby--Castor) indicates that, with proper maintenance of equipment (particularly the AFCE), there is very little danger of the Orphan aircraft getting out of control. He further stated that he is prepared to initiate small-scale operations from bases on the Continent against military targets of appropriate size and that approximately 100 war weary aircraft are now available, with approximately 20 additional aircraft becoming available per month hereafter for this purpose.

3. General Spaatz indicated that he is contemplating a program of 25 Weary Willie Orphan launchings per month and that he desires to employ Orphan aircraft against specific targets only and not as an uncontrolled terror weapon.

4. General Spaatz has requisitioned nine radio control ground stations, 50 radio control kits for installation in Orphan aircraft, and a project team of 24 enlisted men and nine officers to assist in organizing this program. Major Rand, from the project party, departed by air for the ETO on 20 December 1944. The remainder of the project party and the equipment will be shipped by water approximately 15 January 1945. The AAF Proving Ground Command is now conducting further tests on ground radio and radar controlled Orphan aircraft. There are presently nine Special Weapons teams trained and organized at the Special Weapons School at Fort Dix. These teams will be available, if needed, within approximately three weeks of the time asked for.

370 Project

5. This Office, in conjunction with the Office of the Air Communications Officer, will continue to monitor tests at Eglin Field, transmit all available information to General Spaatz, and expedite this project in every way possible.

Central Files to

NWD

Classified files

Donald Wilson
DONALD WILSON
Brigadier General, U. S. Army
Asst. Chief of Air Staff
Operations, Commitments & Requirements

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON (AFDMA-2C)

28 November 1944.

SUBJECT: Code Words for "Willie" Program.

[redacted]
By Authority of
The Commanding General
Army Air Forces
28 Nov. 1944 MCD
Date Initials

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio (TSGEN)

1. The following code words have been approved by the Joint Chiefs of Staff for use in lieu of certain words in use at present:

Present Word	Approved New Word
WILLIE	ABUSIVE
WILLIE MOTHER	BLUEFISH
WILLIE BABY	CORTICATED
WILLIE ORPHAN	COTTONGRASS

2. This information should be disseminated to all agencies under your jurisdiction directly interested in the "Willie" Project.

3. For your information, two copies of War Department letter AG 311.5 (29 Feb.44) OB-S-E-M, dated 16 March 1944, subject " Policy and Procedure Concerning the Proper Use of Code Names" is attached.

4. A check is now being made to determine whether the "Willie" nomenclature can be used for other than operational projects and messages to overseas.

By command of General ARNOLD:

for R. C. Sanders, Col. A.C.
D. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engr. Br., Mat. Div.
Office, Asst. Chief of Air Staff,
Materiel and Services

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Controlled Missiles Gen.

ARMY AIR FORCES

AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND

ENGINEERING DIVISION

MEMORANDUM REPORT ON

Colonel S. R. Stewart:me
Ext. 2-0155

Date 28 February 1945

SUBJECT: Special Weapons Deuelopment Program.

OFFICE Equipment Laboratory

Contract or Order No.

SERIAL No. TSEPL-3-673-37-I

Expenditure Order No. 673-44

A. PURPOSE:

1. To report on a conference held at Wright Field on 22 and 23 February 1945.

B. FACTUAL DATA:

1. A conference was held at Wright Field on 22 and 23 February 1945 for the purpose of reviewing all guided missile projects; to reestablish priorities for these projects; to eliminate as many projects as possible which might interfere with the successful completion of those of high priority; and to define a program for future development in this field. The AAF Board was requested to send a representative to this conference but failed to do so.

2. The following personnel were present:

Air Technical Service Command

Colonel S. R. Stewart, Equip.Lab.
Lt. Colonel C.O.French,Jr. Equip.Lab.

Lt. Colonel W. G. Eaton, Radio & Radar Lab.
Lt. Colonel G. L. Haller, " "
Captain E. V. Cousey " "
Mr. P. R. Murray " "

Colonel W. S. Roth, Aircraft Projects Sect.
Major Jack Leet " " "
Major E. Kotcher " " "
Captain D. W. Pearsall " " "
1st Lt. E. C. Lovejoy,Jr. " "

Major J. F. AuWerter, Research Projects Br.

Major M. A. Sirbu, Aircraft Laboratory

Lt. Colonel H. B. Grow, Aircraft Laboratory, Jet Branch

Captain Jon Ober, Office, Technical Executive.

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Memorandum Report TSEPL-3-673-37-I
28 February 1945

Headquarters, AAF, Washington, D.C.

Lt. Colonel W. L. Norvell, ACG
Major H. J. Lavery "

Colonel W. H. Tetley, M&S
Lt. Colonel V. A. Stace "
Major T. A. Kuhn "

Colonel J. L. Travis, OC&R

Lt. Colonel D. H. Maury, Plans
Captain W. G. Paine "

3. Each project now under development by the Special Weapons Branch, Equipment Laboratory, Engineering Division, was carefully reviewed and a decision made to either drop the project or assign a new priority. The establishment of new priorities was based on the new system recently adopted in which Priority 1 is reserved for equipment for which a commitment date has been set.

4. The discussion of each project was preceded by a session of briefing in which representatives of the Special Projects Laboratory, Engineering Division, and the Special Weapons Branch outlined in general the present status of the development program of guided missiles.

5. A list of all the projects reviewed, together with pertinent comments, priority established, and decision as to future development is shown in Appendix 1.

C. CONCLUSIONS:

1. That there is no requirement for glide bombs in the present form. A requirement might exist if the bombs could be carried internally and employ a perfected heat seeker or radar seeker of the SRB type.

2. The top priority in the guided missile program should be given to the JB-2 in order to meet the commitment date.

3. That the picture on methods of remote control by radio or radar appear promising for distances up to 75 or 100 miles. Accurate control for distances beyond 100 miles appear to be some years away.

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Memorandum Report TSEPL-3-673-37-I
28 February 1945

D. **RECOMMENDATIONS:**

1. It is recommended that the following action be taken by the organization designated below:

a. Engineering Division, Air Technical Service Command

(1) That the decisions reached on each project as shown in Appendix 1 be used as a guide by the Engineering Division in its development program of pilotless aircrafts. (Action to be initiated)

Concurrence:

Prepared by S. R. STEWART, Colonel, Air Corps
(Name)

Approved by G. V. HOLLOMAN, Colonel, Air Corps
Chief, Equipment Laboratory

Approved by F. O. CARROLL, Brig. General, USA
Chief, Engineering Division.

Distribution: Asst. C/AS, MAS, Materiel Div (5) 3,4,5,6,7
Airc.Proj.Sect, Maj.Kotcher
Airc.Lab., Lt.Col.Grow 8 TSELA-2 8 MAR 1945
Res.Proj.Br., Maj.AuWerter 9 TSEST 13 MAR 1945
Tech.Exec, Capt.Ober 10 TSEXT 13 MAR 1945
Radio & Radar Lab, Col.Heller 11 TSERR3
Eval.Br., Tech.Data Lab. 12
TSERL 13

TSESE 2 3

TSEST Maj. AuWerter

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Memorandum Report TSEPL-3-673-37-I
28 February 1945

APPENDIX 1

JB-1 - This missile is to have relatively low priority (2A). No special radio equipment is to be developed for this missile. This project will be re-examined after the expenditure of the ten (10) units now under construction. Colonel Travis indicated that development work on all missiles of this type should be for the purpose of increasing distance, improving launching methods, complete the development of air-launching methods, work toward development of radio control to the full range of the missile and toward improving accuracy and increasing the speed. It was indicated that there is a definite requirement for air-launching of jet-powered bombs.

JB-2 - Priority 1A. This project has top priority over all other guided missile projects. It was stated that nothing must be permitted to interfere with meeting the theatre commitment date. First priority is to be given to completing the missile with the present rocket launching system and control by means of AN/APW-1. All other improvements, methods, etc., are secondary to completing this particular version. Same comments made above for JB-1 are applicable to JB-2 for future development.

JB-3 - Tests have shown that the RHB Azsa target seeker for use against airplanes is not too promising and would take two (2) years to develop. However, it was shown that there is a definite need for this type missile but due to the time required for development, the priority was lowered to 2A.

JB-4 - Colonel Travis stated that there is no requirement for this missile. Therefore, this project is to be dropped.

JB-5 - It was decided to change the designation of this missile since it is not jet-powered. It was stated that a requirement does exist for a missile of this type if it will improve dive-bombing accuracy and permit diving at shallower angles. However, the development of this missile is to revert to a study and development of control methods only, and no specific missile will be developed until satisfactory control to secure straight-line operation has been developed.

JB-6 - Project to be abandoned since 4-1/2 inch rocket will no longer be used. This will be joined with the previous project in the study of controls to secure straight-line operation.

JB-7 - It was questioned whether this missile has sufficient increase in speed to warrant its completion. Also, the engines required for this missile are urgently needed by the Navy. Therefore, this missile will proceed on a low priority for development purposes only.

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Memorandum Report TSEPL-3-673-37-I
28 February 1945
Appendix 1

JB-8 - The urgent requirement for a missile of this type was emphasized. It was shown that both the Ordnance Department and the Navy have extensive development programs to develop an anti-aircraft missile. It was stated by Colonel Tetley that the project had sufficient importance to justify duplication by all concerned organizations. It was pointed out that the AAF have several research projects now in existence which will serve as a foundation for this project. Therefore, it was decided best to do nothing further on this project until results of the existing projects are obtained other than work in the Equipment Laboratory toward the development of controls for this missile. Priority 2A.

JB-9 - No requirement. Project to be abandoned.

VB-1 - Since this equipment has proved itself in combat the priority will remain 1A for all improvements indicated.

VB-2 - Priority 1A.

VB-3 - Priority 1A.

VB-4 - Priority 2B. In connection with this equipment, it was indicated that there was a requirement for a 12,000 pound bomb to be controlled in the manner of the Razon. It was stated that steps are being taken to set up this project. For this purpose, a conference will be held either at Wright Field or Washington, D.C. on 8 March 1945. Representatives of the following organizations will be present:
ATSC - Special Weapons Branch, Equipment Laboratory; Aircraft Laboratory; Ordnance or Armament Laboratory; Special Projects Laboratory.
HQ.,AAF - OC&R; ACO; and M&S, also Mr. Spencer of NDRC will attend. This project will have 2A priority.

VB-6 - 1A Priority.

VB-9 - VB -10 - VB-11 - VB-12 - It was stated that this project has sufficient interest aerodynamically to continue development, however, efforts should be concentrated on the VB-11 which will have 2A priority. VB-10 and VB-12 will be used for engineering development only. The VB-9 is to be dropped. Inquiry will be made of the Douglas Aircraft Company to determine the feasibility of pursuing the development of a design using the original crossed-wings but modifying them so they can be folded and the missile carried internally.

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Abusive Project - Priority for development of this project is to continue 1A but procurement is to be held up. It was pointed out that no priority exists for the development of a secure radio link to replace that now being used and which has been compromised. Colonel Travis stated that a re-study of this project will be made in Washington and a definite statement of requirement and priorities will be issued shortly.

Glide Bombs - Colonel Travis stated that there is no requirement for any glide bomb as long as it is carried externally. The only bombs in which interest might be shown are the GB-6 and the GB-14, but these only if a method were developed of carrying them internally, such as by the use of folding wings or a much smaller wing. The GT-1 has no requirement other than for the organisation presently set up. It was stated that SRB might possibly have a requirement if perfected, but probably not in a glide bomb. It was stated that no requirement for any of the remaining types of glide bombs existed. Thus, glide bombs on which work is now being conducted should be closed out as soon as practicable and then all glide bombs carried on a low priority status to provide for the possibility of a requirement arising in the future.

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HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Auth: Dir.ATSC
Date: 12 Apr.45
Initials: TAS

Wright Field, Dayton, Ohio

12 April 1945

SUBJECT: War Weary Aircraft as Guided Missiles

TO: Commanding General,
Army Air Forces,
Washington 25, D. C.

Attn: AC/AS, M&S, Materiel Division
Brig. General J. F. Phillips

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1. Reference is made to the latest directives received by this Command concerning the "Abusive Project Sub-Kit Requirements", from Chief, Engineering Branch, Office Assistant Chief of Air Staff, Materiel and Services, and teletype WAR-61788 dated 31 March 1945, from Chief, Engineering Branch, Office, Assistant Chief of Air Staff, Materiel and Services. These directives, issued as CTI-1862, Add. No. 13, 6 April 1945, require in brief that procurement of equipment for this project, except that required to complete the Abusive Cottongrass Master Kits and to continue the development program, be cancelled immediately.

2. It is noted in the Minutes of Materiel & Services Staff Meeting of 6 April that COSR has advised M&S to go ahead with plans to employ war weary fighters as guided missiles. This Command has already initiated a study to determine the practicability of launching and controlling such fighter aircraft, modified as missiles, against area objectives in support of ground objectives in accordance with letter of 15 February 1945 from Engineering Branch, Materiel Division, AC/AS, M&S.

3. In view of the fact that any directive to this Command to procure equipment for use with fighter aircraft would entail the re-procurement of such equipment now being cancelled or cut back in accordance with latest directive on "Abusive Project Sub-Kit Requirements"; it is recommended that this Command be advised as soon as possible of the final action to be taken with respect to

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Page Two - Ltr to CG, AAF, AC/AS, M&S, Mat. Div., dtd 12 Apr 45,
Subj: "War Weary Aircraft as Guided Missiles".

procurement of equipment for use with aircraft as guided missiles in order to eliminate unnecessary expense and delay which would be encountered in re-procuring equipment.

For the Director:

/s/ T. A. SIMS
T. A. SIMS,
Colonel, Air Corps
Chief of Administration.

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Captain Jon H. Ober
ces/TSTEX (5-6147)

SECRET
AUTH: Dir, ATSC
DATE: 2-22-45
INITIAL: HO

TECHNICAL INSTRUCTION

Wright Field, Dayton, Ohio
22 February 1945

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SERIAL NO: TI-2003, Addendum No. 19.

SUBJECT: Use of Fighter Aircraft as Pilotless Guided Missile.

TO: Engineering Division.

1. Problem Presented:

a. To determine the practicability of launching and controlling war weary fighter aircraft, modified as missiles, against area objectives in support of ground operations.

2. Factual Data:

a. Interest has been evidenced in the possible use of war weary fighter aircraft as controlled missiles.

3. Authority:

a. CG, AAF. By letter dated 15 February 1945, subject as above, received from Chief, Engineering Branch, Materiel Division, AC/AS, M&S.

4. Action Desired:

a. That which is stated under paragraph 1, Problem Presented.

b. Since it is not considered advisable to have pilots bail out of these fast aircraft, and since remote control of take-off of tail-wheel type fighters offers a difficult control problem, the investigation should include both adaptation of:

(1) Launching methods tested or proposed for the JB-2 program (with the landing gear removed from the aircraft).
(2) Catapult methods used by the Navy (Any Navy inquiries should preferably be made through Lt. J.H. Wakelin, USNR, Office of Coordinator of Research and Development, Office of the Secretary of Navy).

c. The degree of control required after launching should be the minimum necessary for striking area targets and probably could be an adaptation of the "Cottongrass" system for the "Abusive" project.

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SERIAL NO: TI-2003, Addendum No. 19, (continued)

SUBJECT: Use of Fighter Aircraft as Pilotless Guided Missile.

TO: Engineering Division.

d. The use of a junior automatic pilot, similar to those installed in the A-24 airplanes, should be considered for the control system.

e. This project carries a 1-B priority.

f. Report of progress on the above subject is to be submitted to Chief, Engineering Branch, Materiel Division, AC/AS, M&S, by 15 March 1945.

By command of Lt. General KNUDSEN:

T. A. SIMS,
Colonel, Air Corps,
Chief of Administration.

cc: Procurement Division
Supply Division
Maintenance Division

Ltr fr HAAF dtd 2/15 for CAFees

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
TECH. CONT. (TSESD-2G)
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV. Fletcher
PROCUREMENT DIV.
READJUST DIV.
OTHER

TSESD-2G:DMTreat

16 March 1945

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SECRET

AUTH: DIR., ATSC
INITIALS: E A
DATE: 16 March 1945

FI-2003, Addendum No. 19
Use of Fighter Aircraft as
Pilotless Guided Missile

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: AC/AS, M&S, Materiel Division, Engineering Branch.

1. In accordance with subject directive, a study has been initiated to determine the practicability of launching and controlling war weary fighter aircraft, modified as missiles, against area objectives in support of ground operations.

2. The following types of aircraft are being considered, P-38, P-39, P-40, P-47 and P-51.

3. For the purpose of this study, the required range of the aircraft has been set as the maximum control range obtainable with the ground control equipment being developed for use in phase 3 of "Cottongrass". This is considered to be approximately 100 miles.

4. All unnecessary furnishings, non-integral armor plate and communication radio equipment are being removed from the aircraft. The maximum load of explosive will be considered as limited by the maximum permissible amount which may be added without exceeding the design load factor for the aircraft. Retention of this load factor is considered desirable in order to preclude the possibility of structural failure during take-off or catapult of war weary aircraft.

5. The controls proposed for the aircraft consist of a modified gyro tray from the model A-4 remote flight control equipment, now used in the PQ-14 radio controlled airplane target, and the servo assembly from the junior automatic pilot, as suggested in subject directive.

6. The radio control equipment being procured for installation in the JB-2, is being considered for use in the war weary missile.

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AUTH:
By C.D -356
Signature and Grade
Date 10-1-45

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TI-2003, Addendum No. 19
Use of Fighter Aircraft as Pilotless Guided Missile

7. For the purpose of a preliminary study, the launching speed has been set at 50 per cent of the difference between stalling speed, as launched, and the high speed of the aircraft. This is only a tentative figure, which is subject to flight check. The higher speed appears necessary in order to compensate for the maneuverability of the airplane and to insure satisfactory control immediately after launching.

8. Preliminary study indicates that, with certain increases in size, the launching devices being developed for the JB-2 might be applicable to the launching of war weary fighter type aircraft. In addition, request is being made to the Navy for information on additional methods for launching.

9. It is anticipated that the study will be completed before 15 April at which time a complete report will be forwarded.

For The Director

J. H. OEER
Captain, Air Corps
Office, Chief of Administration

Copy to:
Tech Executive - TSTEX

[redacted]

X-73178

ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

Use this form for inter-office correspondence within headquarters.
Use entire width of sheet, both sides.
Use authorized office symbols to designate addressor and addressee.
Number all comments consecutively.
Place initials of dictator and typist, telephone number and location to right of signature.
Separate comments by horizontal lines across page.

SUBJECT Use of Fighter Aircraft as Pilotless Guided Missiles

TO TSEAL-2 (Chief, Aircraft Lab.)
FROM TSESE-2G (Pilotless Aircraft Br.)
DATE 3 Apr. '45 COMMENT NO. 1

1. Technical Instructions No. 2003, Add. 19, has directed that the Engineering Division make a study to determine the practicability of launching and controlling war weary fighter aircraft, modified as missiles against area objectives in support of ground operations.

2. For the purpose of this study, it has been suggested that the following aircraft be examined: P-39, P-38, P-40, P-47, and P-51. It is noted that because of the preliminary nature of this study, it is not considered necessary to make differentiation between the different revisions of the same model airplane. It is therefore suggested that any convenient airplane of a particular model be used as a basis for the study.

3. The weight of the remote control equipment will be considered as equivalent to the weight of the pilot plus parachute, namely 200 lbs. It will further be considered that all this equipment can be located in the pilot's cockpit after removal of the seat and miscellaneous furnishings.

4. The instruments installed in the aircraft will remain unless an appreciable saving can be attained by removal of flight instruments. The engine instruments will necessary for checking the equipment before launching of the missiles, unless a great saving can be shown by the design of an auxiliary instrument cart such as used by the Germans for ground checking of the V-1 before launching. It is further noted, however, that the modifications to the airplane are to be kept as low as possible.

5. The range desired will be considered as approximately 85 miles at an altitude of 5000 feet or less, with the engine operating continuously at normal rated power. In order to provide some margin, a head wind of 40 m.p.h. will be assumed. All fuel in the airplane, other than that required for the above range, may be eliminated.

6. In general, the items to be removed are fuel, furnishings, non-integral armor plate, communications, radio and supercharger and intercooler equipment.

7. The size and type of explosives to be used will be left to the discretion of the engineer conducting the study. It is suggested that the Ordnance Department be requested to furnish information as to the size of blocks of explosive now available.

8. It is requested that within the limits of practicability all available space be used for explosives. If by so doing the design gross weight of the airplane is exceeded, it is requested that the reduced load factors permissible under the overload condition be indicated. There is a possibility that the landing gear may be removed for catapult purposes, and it is requested that the increase in explosive load gained be indicated.

SECRET
AUTH: D.R., ATSC
INITIALS
DATE 4-2-45

Classification cancelled
or changed to
AUTH: CD-356
By
Date 10-1-45

M-X-741

X-74555 Fighter Jen Secret

WF. Area B-10-20-44-1 MC
CONTINUE ON OTHER SIDE

43 (773)

TO	FROM 975	DATE 2 Apr. '45	COMMENT NO. 2 Continued

[redacted]

9. It is requested that the Aircraft Laboratory study the airplane listed in paragraph 2 and determine the maximum amount of explosives which may be carried in each under conditions listed above. It is anticipated that this will be a preliminary design study and not merely a weight estimate.

10. The CTI states that the study will have a 2B priority and the Office of AC/AS, M & S has been advised that it is anticipated that the study will be completed on or before 15 April 1945. In the event that this date is too optimistic, it is requested that the Pilotless Aircraft Branch be so advised.

11. An Expenditure Order is being initiated to authorize this study and the number will be forwarded as soon as it is received.

for E. Hotcher Maj AC

VICTOR R. HAUGEN,
Colonel, Air Corps,
Chief, Aircraft Projects Section,
Service Engineering Division,
Engineering Division.

DMT:as Ex. 36391
Building 126

APR

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[redacted]

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

IN REPLY REFER TO:

216

(AFDMA-2G)
17 May 1945

SUBJECT: Use of War Weary Fighters as Pilotless Guided Missiles

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: Office, Chief of Administration (TSTEX)

5/31/45 879-

1. Reference is made to a letter from this office dated 15 February 1945, subject as above, directing an investigation of the practicability of launching and controlling pilotless fighter aircraft modified as missiles, against area objectives.

2. It is directed that this project be continued to:

a. Prepare and test P-38 type aircraft as a pilotless guided missile capable of 130 miles range and take-off from conventional airfield runways.

b. Prepare and test P-47 type aircraft as a pilotless guided missile capable of 130 miles range and launched from a ramp or track with the aircraft landing gear removed.

c. Develop the following control systems:

(1) To control either missile directed in 2(a) or 2(b) above from a control aircraft.

(2) To control either missile directed in 2(a) or 2(b) above from a ground control station.

(3) To incorporate controls to permit very low level operations over water or very level land areas to a minimum of 25 feet elevation for collision attacks against ship and shore targets. It is envisaged that for the final run to the target with air to air control, the low altitude control should be an automatic limit type control and with ground-to-air

[redacted]

ADDRESS REPLY TO: COMMANDING GENERAL, ARMY AIR FORCES, WASHINGTON 25, D. C.

X-140184

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[redacted]

217

control the final descent and low altitude run to collision with the target must be automatically controlled after positioning the missile in space.

3. The following should be considered in the development program:

a. The components or systems designed should be directly applicable to other types of war weary fighter aircraft (P-39, P-40, P-51).

b. The control systems should be designed to provide maximum security from jamming.

c. All installations and components should be designed for all weather operations.

d. Installations should be designed to accomodate the maximum explosive load capacities of the various aircraft for both high explosive and incendiary loads.

4. The development of the missiles and their air to air control system are assigned a 2c priority and the ground to air control system is assigned a 3c priority, although both types of control systems should be developed as nearly concurrently as possible.

By Command of General ARNOLD:

J. F. Phillips
J. F. PHILLIPS
Brig. General, USA
Chief, Materiel Division
Office, Asst. Chief of Air Staff
Materiel and Services

[redacted]

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COPY NO. 48

G.M.C. Sub 3/4

1 May 1945

JOINT COMMITTEE ON NEW WEAPONS AND EQUIPMENT

GUIDED MISSILES COMMITTEE

SUBCOMMITTEE NUMBER 3

SPECIAL WEAPONS FOR OPERATIONS AGAINST JAPAN

45

References: a. G.M.C. 3/D
b. Memo from Secy, JNW, to Chairman, GMC, subj: as above, dated 7 Apr 45.
c. J.N.W.E. 331

Note by the Secretary

The enclosed report of Subcommittee Number 3 is circulated to the members of the Guided Missiles Committee for their consideration and disposition at the 7th meeting of the committee to be held 2 May 1945.

L. T. FLOOD

Secretary

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b. Blind aerial operation.

(1) Plan. Heavy bombers bombing target area round-the-clock in all weather, operating from airfields some 750 miles distant from the target, with take-offs and landings by instrument when necessary, and bombing by radar (SHORAN, H2X, or other) when necessary.

(2) Quantities. It is assumed that 30 successful sorties by B-24 airplanes each day would deliver 50 tons of explosive at the target. Replacements at the rate of 5%, due to enemy action and flying conditions, would require one and one-half replacement airplanes per day. Allowing for 100 per cent reserve, the total requirement is approximately 60 airplanes and 35 sorties per day when allowance is made for abortives and other ineffective sorties due to causes other than enemy action. The usual personnel required for air operations of this type would be required and the total tonnage of bombs required would be approximately 6000 tons.

c. Willie-Orphan.

(1) Plan. B-17 airplanes operating from airfields within radar control range of the target area. The crew would take the airplanes off the ground, bail out, and the airplane would then be under radar control from the ground, which would be used to guide the airplane to the target and cause it to crash.

(2) Quantities. Since each Willie could carry ten tons of explosive, it would be necessary to have only five crashes in the target area to deliver an explosive load equivalent to 50 JB-2. It is estimated that two of each seven Willies would fail to reach the target either through enemy action or other cause, so that seven Willies would be used each day. There would then be required for the sixty-day period: 420 Willies, 4200 tons of explosives, 420 electronic control equipments, and two SCR-584.

d. Controlled JB-2 from ship.

(1) Plan. It is assumed that the JB-2 equipment and personnel will be procured and trained before shipment to the staging area at Manila, and similarly for the ships (LST or CVE) and ship crews. The ships

Enclosure

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demands will be made on conventional bombing forces.

b. Blind aerial operation It is probable that special crews could be trained in the use of GCA equipment so as to make blind landings with 0/0 visibility entirely feasible. Blind operation is not popular and may lead to heavier losses due to enemy action because of the difficulty met in flying formations under such conditions.

c. Willie-Crashing. It seems doubtful that five or six crashes per day with ten tons of explosive each time would give a harrassing effect as great as a much larger number of hits over the same area each with smaller explosive load. Since it would generally be necessary for a parent airplane to guide the Willie to the operational area from a distant airfield, there seems little to be gained by crashing the Willie rather than by conventional bombing by the parent airplane, except that in the latter case the parent airplane is more liable to loss by enemy action.

d. Controlled JB-2 from ships. It is not expected that preset control will be satisfactory for JB-2 launched from shipboard because the magnetic compass could probably neither be set in advance of loading nor on shipboard just before launching. It is also unlikely that radar control of JB-2 will be accomplished easily from shipboard and it appears necessary, therefore, that each JB-2 launched from shipboard be controlled by a radar station on the ground. The need for ground station radar control of JB-2 launched from LST or CVE implies that JB-2 cannot be used for beach bombardment in preparation for an amphibious operation. It is possible that JB-2 may be launched more successfully in rough weather from beached LST, but in this case a stretch of beach in front of the LST would need to be kept clear because of danger from the falling sleds.

e. JB-2 launched from beach. It appears certain that JB-2 can eventually be launched successfully from ground ramps round-the-clock in all weather, except for some very small fraction of the time when excessive tail winds would make launching impossible. Preset control should provide adequate accuracy for area bombardment for JB-2 so that electronic control equipment may not be necessary for this application.

 Enclosure 76

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CONCLUSIONS

13. It is concluded that:

a. Five weapons could possibly be made available for operational use against Japan during 1946 to provide round-the-clock area bombardment of a target, at a distance of from thirty to sixty-five miles inland from a beach, at a rate of fifty tons of explosive per day for sixty days.

b. The five weapons could probably be placed in operation according to the following estimated schedules:

	Optimistic	Realistic	Pessimistic
Blind aerial operations	1 Oct 45	15 Oct 45	1 Dec 45
Conventional bombing, delay fuzes	15 Nov 45	15 Dec 45	1 Feb 46
Willie-Orphan	1 Feb 46	1 Mar 46	1 Jun 46
JB-2 from LST or CVE	25 May 46	15 Aug 46	15 Dec 46
JB-2 from beach	1 Jun 46	1 Sep 46	1 Feb 47

c. There will be no assurance that JB-2 can be launched successfully from LST or CVE until tests have demonstrated this to be possible.

d. Weather will not seriously limit conventional aerial bombing of area targets in Central Honshu provided radar aids are available for flying and bombing.

e. The JB-2 could probably be placed in operation two months sooner if 1,500 rather than 3,000 effective hits over a sixty-day period were required.

f. It is expected that the problem could be best met by combining conventional bombing using delay fuzes and a reduced beach preset JB-2 program according to the following optimistic schedule (assumes airframe and rockets are only critical items) for theater operations:

First launching	JB-2 hits
1 February 1946	1,300
1 March 1946	1,600
1 April 1946	2,100
1 May 1946	2,600

g. Willie-Orphan is operationally unsuited to the problem unless airfields within radar control range of the beach are available for the Willie take-offs, or unless the Willie could be flown from more distant airfields to the operational area before the Willie is turned over to ground radar control.

h. JB-2 and Willies would eventually provide weapons which could be useful to supplement bombardment by more conventional methods. See Appendix "B" for a discussion of importance of supplementary bombardment.

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G.M.C. 9th Mtg

JOINT COMMITTEE ON NEW WEAPONS AND EQUIPMENT

GUIDED MISSILES COMMITTEE

Minutes of Meeting held in Room 236,
The Combined Chiefs of Staff Building,
on Wednesday, 18 July 1945, at 1030

MEMBERS PRESENT

Mr. Bradley Dewey, Chairman
Dr. E. R. Gilliland, Deputy Chairman
Dr. P. M. Morse (OSRD)
(Representing Dr. Warren Weaver)
Dr. J. C. Hunsaker (NACA)
Dr. G. W. Lewis (NACA)
Major General G. M. Barnes (ASF)
Brig. General J. F. Phillips (AAF)
Colonel M. B. Lampl (AGF)
(Representing Brig. General R. W. Crichlow, Jr.)
Colonel J. S. Mills (NDD)
Colonel A. Ashman (G-4)
Captain F. I. Entwistle, USN (BuOrd)
Captain V. L. Pottle, USN (Cominch)
Captain W. T. Rassieur, USN (OPR)
(Morning session only)
Captain J. F. Mullen, USN (OPR)
(Afternoon session only, representing
Captain Rassieur)
Captain R. D. Conrad, USN (OR&I)
Captain R. V. Kleinschmidt, USN (BuShips)
Commander G. Merrill, USN (BuAer)
(Representing Captain R. S. Hatcher)

ALTERNATES PRESENT

Colonel J. L. Travis (AAF)
Colonel H. P. Van Ormer (NDD)
Captain W. M. Sweetser, USN (Cominch)
Colonel G. C. McDowell (G-4)

ALSO PRESENT

Captain L. W. McKeehan, USNR (JTG)
Lt. Colonel V. A. Stace (AC/AS MES AAF)
Lieutenant P. V. Reichelderfer, USNR (JTG)

46

SECRETARIAT

Dr. D. B. Langmuir
Major J. P. Taylor (AAF)
Lieutenant S. D. Cornell, USNR
Captain E. L. DuBois (AGF)
Captain J. E. Anderson, Jr. (ASF)

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(e) BAT - 1000 and 2000 lb. types -- weapons of proved value on which work should proceed at full speed.

(f) KINGFISHER - a weapon rather far in the future, for which target requirements are vanishing.

The program indicated by the above would be to push AZON, RAZON, FELIX, DOVE, and the BATS.

THE CHAIRMAN proposed that the committee determine a list of weapons which it judges to be desirable for this war, and that it recommend the transfer to these weapons of usable manpower and facilities now devoted to other guided missiles projects.

(2) Other comments.

(a) Close ground support program: ABUSIVE.

Commenting upon the tentative program shown in paragraph 4 b (1) above, several members expressed active interest in continuing work on ABUSIVE in connection with close ground support.

COLONEL LAMPL stated that experience on Okinawa, where casualties were as high as [illegible] of ground gained, indicated a need for a new means of reducing Japanese entrenched positions including caves. He felt that if 10 to 20 ABUSIVES could have been made to hit [illegible] Drop Hill, most of the 700 lives expended there might have been saved.

COLONEL MILLS said that tests of ABUSIVE, GB-4, and RAZON [illegible] priority to test their applicability for close support. A new pattern of control, in addition to the new target requirements, provided the basis for reviving the first two projects. It is planned to have the missiles guided visually to the targets by observers at two ground control stations, spaced so that one controls azimuth and the other elevation. It was felt that tests of ABUSIVE would provide useful experience in connection with ground control of AZON and RAZON.

GENERAL BARNES expressed doubts as to the feasibility of hitting objectives of the type named with ABUSIVE. He believed that artillery would provide a more satisfactory method of solving the problem.

COLONEL McDONELL doubted that there would be an adequate supply of war-weary aircraft in the Pacific.

(3) Concentration of effort on a small number of desirable projects.

THE CHAIRMAN, reiterating his feeling that manpower and facilities should be reallocated so as to give all possible speed to projects which would be of clear value if put into operation, emphasized that the time is running out during which the benefits accruing from theater operations of guided missiles can be realized. He felt that those now working in the guided missiles field should capitalize to the maximum the opportunities which will vanish at the end of the war. He pointed out that an effective contribution to the war by a few missiles would be of inestimably higher value than abortive or inefficient trials of a larger number. He therefore felt that there should be concentrated upon a small number of picked projects all possible personnel, not merely personnel from interfering projects.

During a discussion doubts were expressed as to the feasibility of transferring men from one project to another. COLONEL TRAVIS believed adequate manpower to be available for RAZON and FELIX. DR. LANGMUIR said that two matters had come to the attention of the

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
[redacted]-(TSESE-20)
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV. D.M. Thunker
PROCUREMENT DIV.
READJUST DIV.
OTHER

TSESE-20:DMTreat

25 June 1945

[redacted]

AUTH: Director, ATSC
INITIALS: E.A.
DATE: 21 June 1945

Use of Abusive Missiles in Direct Support of Ground Operations.

Commanding General,
Army Air Forces,
Washington, 25, D. C.

Attention: AC/AS, M&S, Materiel Division.

1. It is noted that recently great interest has been evidenced by the Army Ground Forces in determining practicability of employing OQ and PQ type targets modified as missiles for direct support of ground operations.

2. These requests are based upon the need for a guided missile which may be directed from a position in the front line in direct support of ground operations. Such a missile would be used against a pillbox or other heavily defended position, the reduction of which demands the placing of an explosive load directly in a cave or other small aperture.

3. Examinations of both the OQ and the PQ type radio controlled target airplanes indicate that they possess several inherent limitations for employment in the manner proposed. The OQ, for example, would carry at a maximum only approximately 65 pounds of explosives. Both the OQ and the PQ possess such limited range that the take-off would have to be made from a point close to the front line. In the case of the OQ, which is launched from the catapult, this limitation should not be too severe unless the nature of the terrain made the transportation of the catapult difficult. In the case of the PQ type, some form of prepared runway would be required. Both aircraft possess the basic limitation of being so small in size that it is impractical to install television equipment for controlling the missile to a pin-point target.

4. It is noted, however, that under the Abusive program, heavy bombardment aircraft have been modified for use as missiles against pin-point targets. Such missiles, with reduced bomb load or when loaded with jell gas and white phosphorous, might be used directly in support of ground operations. During a recent demonstration for the Guided Missiles Committee, a PQ type target was controlled from a ground station. This same control

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By [redacted]
Signature and Grade
Date 10-1-45

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Use of Abusive Missiles in Direct Support of Ground Operations.
23 June 1945.

equipment is entirely adaptable to the control of the abusive missiles against pin-point objectives. All of the ground control equipment, including the power supply and television receiver, could be carried in two jeeps to a position where the target area could be viewed. The missiles might be brought in from distances up to fifteen hundred miles or more by air control and turned over to the ground control in the identical manner that the target was turned over to the ground station during the previously mentioned demonstration for the Guided Missiles Committee.

5. The above remarks on the possibility of the employment of Abusive missiles visually controlled from the ground, with FM radio link and television aid, against pin-point targets in direct support of ground operation, are forwarded for transmission to the interested services for the purpose of evaluation. Suitable equipment for installation in the aircraft and for the ground control station is available for a demonstration along the lines mentioned above if such is desired.

FOR THE ACTING DIRECTOR:

for Fletcher Maj AC
B. S. KELSEY,
Colonel, Air Corps.,
Chief, Aircraft Projects Section,
Service Engineering Subdivision,
Engineering Division.

Copies to:
Systems Engineering Lab.
Equipment Laboratory.
Att: Special Weapons Br.
AGF Liaison Officer - TSXGF.

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Signature and Grade
10-1-45

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2 Jul 1945

9 JULY

AFRDB

Use of Guided Missiles in Close Cooperation with Ground Operations

Commanding General
Army Air Forces Center
Orlando, Florida

Attn: AAF Board

1. The attached correspondence proposes the use of guided missiles in close cooperation with ground operations. Considerable study and effort is being directed toward finding a means to destroy the cave-type entrenchments now being employed by the Japanese. It appears that the proposed ground control of guided missiles might offer a possible solution to this immediate problem. Further needs for this type of weapon may develop in the future. The Air Technical Service Command has been directed to monitor a project for developing and thoroughly testing the proposed system against the cave-type entrenchments now being faced by our troops on Okinawa. Due to the immediate need it is felt that the tactical suitability of such a weapon should be determined concurrently with its development. The Army Air Forces Center, therefore, will act as the collaborating agency with the Air Technical Service Command on this project. The "Abusive" facilities now under the control of the Center should be made available for this test and development program. Liaison with the Air Technical Service Command should be established immediately to facilitate the early completion of this program.

2. It should be borne in mind that the success of such a weapon will necessarily lie in its flexibility and maneuverability. Any system of control that requires extensive preparation and involves complicated control equipments will not be satisfactory. The proposed visual system, as described in the attached correspondence, appears to be quite simple and maneuverable. The use of radar for this control will probably complicate the equipment to such a point as to make it undesirable. It is desired that the radar proposals not be considered in this particular test at this time.

Noted
[illegible]

[redacted]

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[redacted]

3. The guided missiles that might be used for close cooperation should be tested in the following order: (1) War Wearies (2) Azon and Razon (3) Glide Bombs.

4. This is a no priority project.

BY COMMAND OF GENERAL ARNOLD:

3 Incls
#1 - Ltr ATSC dtd 21 June 45
#2 - Info on Range and Azimuth Control
#3 - Comments on Advantage of
Use of Guided Missiles

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[illegible]

[illegible] August [illegible]

[illegible]

[illegible]
Massachusetts Institute of Technology
77 Massachusetts Avenue, Building [illegible]
Cambridge 39, Massachusetts

Dear Sir:

Air Technical Service Command has [illegible] a Project known as [illegible] in [illegible] attempt to use [illegible] airplanes against [illegible] installations. Vertical bombs, [illegible] controlled airplanes will be ground controlled [illegible] attempt to knock out these [illegible].

It is requested that [illegible] program for steering Vertical Controlled bombs from the ground. The sighting apparatus required for ground control is without a doubt the most difficult [illegible] this development. The plan at present is to [illegible] the bombs to the target from two ground stations, [illegible] the line of the bombing run of the dropping [illegible] and the other on a line approximately [illegible] of flight, each approximately three [illegible] from the target. Air Technical Service Command will modify a BC artillery spotting scope for [illegible] A wire frame sight designed from pre-determined trajectories will be used for the range station. [illegible] realized that these sights are crude and will [illegible] as an expeditious means for carrying on the [illegible]. It is requested that your division [illegible] with the Air Technical Service Command program [illegible] mind.

[illegible]

[redacted]

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NDRC, 2 August 1945

Another phase of the Air Technical Service Command program includes the use of television as an auxilary sighting air on the radio controlled airplanes. The NDRC "ROC" being a television bomb may have possibilities for similar use. It is therefore suggested that the "ROC" missile be investigated for use in this manner.

Very truly yours,

H. Y. SMITH
Colonel, Air Corps
Chief, Engr. Standards
Service Engr. Subdiv.
Engineering Division

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Written 16 Nov 45
AFDRA-?/Gen Crawford/?/or/2100

By Authority of
The Commanding General
Army Air Forces
11/20/45 .... ?
Date Initials

NOV 2 6 1945

MEMORANDUM TO THE CHIEF OF STAFF,
(Attention: Chief, Strategy Section, Operations Division).

SUBJECT: Army Air Force Guided Missiles Development.

1. Reference is made to the attached request of 6 November 1945, for information on the Army Air Force guided missiles development program.

2. The following appendices cover the information requested in paragraphs 1b and 1c:

a. Appendix I includes information on the portion of the guided missiles development program of the Army Air Forces that either resulted in operational missiles, or missiles that could have been made operational within six (6) months.

b. Appendix II includes information on the military characteristics now planned for future Army Air Force development and estimates of advancements in the development field within the next two (2) or three (3) years.

3. The future guided missiles development program is expected to change comparatively frequently and radically as development progress is made in the highly developmental fields of: supersonic propulsion and airframe design, warheads and fusing, remote and self navigation, control systems, and launching systems. Estimates of probabilities beyond the requested two to three year period have not been included in this report.

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For the Commanding General, Army Air Forces:

Signed

3 Incls:
Incl 1 - Lo fm WDGS dd
6 Nov 45 to CG, AAF
Incl 2 - Appendix I
Incl 3 - Appendix II

REUBEN C. HOOD, JR.
Brigadier General, U. S. Army,

[redacted]

DISPATCHED
20 NOV 1945
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WAR DEPARTMENT
War Department General Staff
Operations Div
Washington 25, D.C.

[illegible] 194[illegible]

MEMORANDUM FOR COMMANDING GENERAL, ARMY AIR FORCES:
Attention: Lt. Colonel [illegible], [illegible]

SUBJECT: Guided Missile Development.

1. The following information is requested:

a. Characteristics of presently accepted and proven guided missiles by type. Included should be data on Air to Air, Air to Ground, Ground to Air, and Ground to Ground missiles.

b. Such information as to range, accuracy, weight, capability of mass production and operating characteristics should be included.

c. What advancements in this field can be anticipated in the next two or three years.

ROBERT J. WOOD
Colonel, GSC
Acting Chief, Strategy Sect

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APPENDIX 1

SUBJECT: Operational or Near-Operational Guided Missiles Development by the Army Air Forces.

1. The following Army Air Force missiles are considered operational at the present time, or close enough to operational, that development could be completed within six (6) months, if required.

a. Air-to-Surface:

(1) VB-1 (Azon), Azimuth Vertical Bomb: A 1,000-pound G.P. bomb fitted with a specially designed tail assembly containing a roll-stabilizing system and a control system, including a 47 channel radio receiver, through which azimuth control is accomplished by transmitting radio control signals from the carrying aircraft, another aircraft, or a ground control station. An 800,000 candle-power flare on the bomb assists in sighting it. Tests indicated approximately 2 mils controllability can be expected when dropped from 15,000 feet. The 7th Bombardment Group, India-Burma Theater, used a total of 1,357 VB-1 between 27 December 1944 and 24 August 1945 "with spectacular success" against communications targets. Twelve per cent were direct hits. Overall average errors were: azimuth 131 ft., and range 201 ft. Forty-one bridges were destroyed and 12 damaged. Approximately 15,000 VB-1 tail assemblies and approximately 200 control systems have been produced.

(2) VB-2 (Azon), Azimuth Vertical Bomb: Uses a 2,000 lb. instead of a 1,000 lb. bomb, with a larger tail. It has been engineered and tested, but not produced in quantity.

(3) VB-3 (Razon), Range and Azimuth Vertical Bomb: A 1,000 lb G.P. bomb fitted with a specially designed tail assembly permitting both range and azimuth control through a control system (with components largely identical to Azon-components). One addition to the Norden Bombsight, a mirror to superimpose the bomb image, is required to control Razon and an additional device, a computer, has been developed to improve range accuracy. Accuracy is expected to be consistently within 50 ft in range and 20 ft in azimuth, when dropped from 15,000 ft. The VB-3 was about to be used operationally when hostilities ceased. Three thousand VB-3 assemblies are currently in production with approximately 1,000 of this quantity delivered.

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Appendix I (Cont'd)

(4) VB-6 (Felix), Heat Seeker Vertical Bomb: A standard 1,000 pound bomb with a special nose section added, containing a bolometer heat seeking unit and amplifier unit which feeds control to a special tail assembly (similar to Razon). A standard bombsight is used in dropping the bomb, and homing control is automatically switched on at 10,000 ft. Targets are limited to those radiating sufficient infra-red or heat in contrast to its surrounding area. These are determined by special infra-red survey instruments. One thousand bombs and approximately fifteen survey instruments have been produced. Probable errors from test data is 73.6 ft in range and 14.3 feet in azimuth. A mass test drop of 18 bombs from 20,000 feet against an oval shaped island target approximately 1,000 by 800 feet resulted in thirteen hits concentrated in three spots. The loose aircraft formation employed caused the target to be outside the view of the eye of two bombs, two seekers burned out by seeking the flare on bombs ahead and one bomb suffered an equipment failure. The VB-6 was also about to be used operationally when hostilities ceased. An effort is being made to conduct test drops against actual German Targets scheduled for destruction.

(5) GB-1, Preset Glide Bomb: A preset glide bomb, overall weight of 2,338 pounds, with a 2,000 pound bomb and no remote or homing control after leaving the launching airplane. Intended for area bombing of targets heavily defended by antiaircraft. Glide ratio is approximately 6 to 1; speed 220 to 240 m.p.h.; average error, when released 14 miles from the target, about 3,000 to 5,000 feet in range and 700 to 1,000 feet in azimuth. Only use in war was a successful use of 116 against Cologne. Two thousand one hundred were left in stock at end of war. Extensive use was unnecessary due to the relative ineffectiveness of German and Japanese antiaircraft defense.

(6) GT-1, Preset Glide Torpedo: A preset glide bomb overall weight of 2,455 pounds with a 2,120 pound Mark 13 Mod. 2A Pattern Type: Naval Aerial Torpedo. Special devices freed torpedo from airframe and permitted proper water entry. Intended for use against ship concentrations in harbors. Glide ratio is approximately 6 to 1; air speed approximately 209 m.p.h.; radial error from 5,000 feet dropping altitude is approximately 2,000 feet. The GT-1 was not used until the latter phase of the Pacific war due to the lack of targets within the limited range of the launching aircraft (B-25). It was used very successfully in several missions. This missile would be far more effective if equipped with remote radio control or seeking devices plus a seeking type torpedo.

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Appendix I (Cont'd)

(7) Glide Bombs, Radio Controlled or Seeker Type: In general, these missiles were designed for precise attacks against heavily defended targets. They had a 12 ft wing span, carried a 2,000 pound bomb, and two were carried by a B-17 and and one by a B-25. By the time they were reaching the operational stage, theater commanders had secured control of the air, and were able to successfully attack most targets by conventional means. Since the glide-bombs were carried externally, they had an adverse effect on performance of the carrying aircraft, including the reducing of cruising speed by 10 - 20 miles per hour. The glide bombs also required special assembly crews and differences in bombing techniques. The glide bombs became unpopular with operating personnel, therefore, and development work on a large scale stopped before complete readiness for operations. A large number of airframes (approximately 2,000) were completed and could be modified for use with most of the control devices. The glide bombs have contributed in a major way to the guided missiles development, however, in the development or remote control techniques, television, radar seekers, heat seekers, flare seekers, and light contrast seekers. Since ships are good radar, heat, and light contrast targets, most of the glide bombs would have been particularly effective against shipping. Information follows on several of the glide bombs that had approached the operational stage:

(a) GB-4 - A radio-controlled glide bomb, gross weight 2,536 lbs., carrying a 2,000 lb G.P. bomb, controlled by an operator in the parent airplane who watches a television picture of the target area as viewed by a television camera under the glide bomb. Glide ratio is approximately 8 to 1. Six (6) GB-4's were dropped on an ~~successful~~ un successful test in combat. Over 2,000 television equipments were produced and are available. Radar navigation with television for only the final approach, television improvements, and the addition of ailerons to the vehicle (as in the target seeking vehicles), show considerable promise for a missile of this type, specially designed to remove the present penalties to the carrying aircraft.

(b) GB-6, Heat Seeking Glide Bomb - Employs the same basic airframe used on other glide bombs, to which is fitted a false nose section containing a thermopile heat seeking and amplifier unit. Marine targets, refineries, steel mills, blast furnaces, power plants, etc., reflecting or radiating sufficient heat energy are promising targets. Reliable seeker ranges from four to five miles for isolated targets to 10 to 20 miles for targets included in a large heat area such as cities. The missile can also

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Appendix I (Cont'd).

be set to fly a preset course with the seeker taking over automatically when within seeker range. Seeker and control systems have been procured only in experimental quantities. Experience with the Heat Seeking vertical bomb VB-6 and the 14 experimental drops, completed with the GB-6, indicates good accuracy can be expected if reliable heat survey information is available and experienced operators are employed. None were used in combat.

(c) GB-8 - A radio controlled glide bomb, gross weight 2,555 pounds, carrying a 2,000 lb. G.P. bomb, controlled by an operator in the parent airplane through observation of flares on the missile. Glide ratio is approximately 6 to 1. Army Air Force Board tests showed that this missile had unsatisfactory accuracy (mean circular error of 1,000 ft from approximately 15,000 ft altitude).

(d) GB-11 - a Chemical Spray Glide Bomb - consists of the basic glide bomb airframe with a 12 foot wingspan, carrying a standard M33-A smoke tank for dispensing smoke or chemical agents. Controls are preset and several successful tests indicate that when released from 10,000 feet, from a distance of four miles, this device will dive, attain a speed of approximately 350 m.p.h., pull out at a predetermined altitude, and fly level for a distance of two miles. Although only a few test missiles have been built, all the components are production items of which limited quantities are available. Remote radio control systems are also available for addition to this bomb should a radio controlled missile be desired.

(e) GB-12, a Marine Light-Contrast Seeker Glide Bomb - Standard GB airframe fitted with a false nose structure which contains a photo-electric light-seeking unit, which through an amplifier and control system, directs the missile on a "collision" course with moving boat targets. With good visibility, the scanning seeker head responds to the light contrast of a 500 ft. boat at 10 miles range. Experiments are still continuing to further develop the seeker equipment, however, it is believed sufficiently tested to be of early tactical value. The seeker units have only been produced in experimental quantities.

(f) GB-13, a Flare Seeking Glide Bomb: consisting of a standard airframe carrying a 2,000 lb. bomb fitted with a nose section containing a photo-electric target seeking unit, specially adapted for use against burning targets or flare illuminated targets. Actual seeking range is about six

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miles against a 1,000,000 candlepower flare, with good visibility. Several very successful drops have been accomplished, one hitting the flare, and three others hitting within 60 feet in range and 15 feet in azimuth. Only experimental quantities of the seeker and control system have been procured. The Office of Strategic Services planned to use this missile in a special theater project against "planted" flares. The success of British and American flare-marking operations in E.T.O. makes this a potential weapon.

(c) GB-14, Radar Homing Glide Bomb - consisting of the basic airframe and 2,000 lb bomb, with additional fairing added, and equipped with a combination radar transmitter (which illuminates the target), and receiver (receives the echo) seeking unit for use primarily against marine targets or large isolated buildings. The target selected must be 500 ft. distant from any other target which would reflect an equally strong radar signal. A similar Navy glide bomb, "BAT", with a 1,000 lb bomb, was being tested operationally in the Pacific when the war ended. Army Air Force tests were held in abeyance until the results of the above mentioned Navy tests were complete. It is expected accuracy can be reduced to a mean circular error of less than one hundred feet. Both airframe and Navy seeker unit have been produced in production quantities.

(3) JB-2 Jet Propelled Bomb: The JB-2 (copy of German V-1), normally used as a ground-to-ground weapon (described later), has also been used as an air-to-surface missile, without remote guidance. Successful drops were made of the JB-2 from a B-17 aircraft (one under each wing). No program was established to determine ranges or accuracy.

b. Surface-to-Surface:

(1) The JB-2 is a copy of the German V-1 Buzz Bomb propelled by an intermittent jet engine. It is a 5,023 lb. pilotless aircraft, carrying 1,860 lbs of explosive for a maximum range of 150 miles at speeds of 400 m.p.h. ± 10%. This missile constitutes an all weather harrassing weapon, which depends upon blast effect for destruction of targets, such as cities, assembly areas, and other congested areas. The original German V-1 was a preset missile, the American version, however, has been equipped with an AN/APW-1 radar beacon, and control equipment, which enables a modified SCR-584 ground radar station to track and control it throughout line of sight distances, up to 100 miles. From that distance on to 150 miles, the missile can continue on preset control. The last three radar controlled JB-2's that

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were launched at Eglin Field, Florida, at an 80 mile target buoy hit one mile at 270°, 450 yards at 270°, and 1 mile at 200° from the target. As the equipment is further developed and the ballistics of the final trajectory are further determined, it is estimated that the bomb will hit consistently within an area ½ mile square at 100 miles. The probable error would increase to approximately 2 miles at 150 miles range. While the Germans used a launching system employing hydrogen peroxide and potassium permanganate, this was discarded by the Air Forces as too dangerous. An improved system using seven simple ballistite powder cartridges, spaced along the ramp and set off in succession was developed. A successful steam flash-boiler system was also developed. Another great advancement in launching devices is the 50-ft portable trailer using a launching sled propelled by four 11,000 lb thrust rockets. In 1944, there were 7,050 JB-2's under production contracts, for potential operational use in early 1946. This contract was terminated September 15, 1945, after 1,391 bombs were delivered.

(2) JB-10 - A jet bomb with the JB-2 intermittent jet engine included within the body of a flying-wing type airframe. Over-all weight of 7,213 lbs, with explosive load of 3,209 lb., a range of approximately two hundred miles, and speed of approximately 400 m.p.h. This missile reached the flight test stage, but a number of difficulties are apparent and the value of continuing with this subsonic missile is questionable.

(3) Conventional Type Aircraft: During the early stages of the war, development was pushed on twin-engine, radio controlled, conventional type airplanes, carrying bomb loads of 2,000 to 4,000 lbs. The XBQ-1 and XBQ-3 were completed, but were not considered efficient weapons. A large scale project (Aphrodite) was developed during the war, however, to use remotely controlled war-weary combat aircraft for expenditure against enemy cities and strong points. This project included several major phases:

(a) Control by another airplane. This was used with limited success in Europe with the earlier items of equipment developed. Improvements such as radar navigation to the target with television for final approach, strafing protective rockets, and others were becoming available at the close of the war.

(b) Radar control from the ground to distances of 75 to 100 miles was developed and made available for use during early 1945 against German cities. A combined Chiefs of Staff policy decision was made, however, to the effect that this weapon would not be used.

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Appendix I (Cont'd)

(c) Visual ground control against strong points visible or invisible from the air, "Hermit Project", was a procedure developed in July 1945, and proved very successful in tests. This procedure would have enabled precise hitting of Japanese strong points with explosive concentrations of up to 50,000 lbs. Included in the test expenditures for this projectwas a remote controlled pilotless take-off of a B-17, with guidance to the target area by a parent aircraft, and final ground guidance to a precise hit on an 8' X 8' target, invisible from the air. The ground control points were approximately 3 miles from the target and took control of the airplane approximately 8 miles from the target. The same "Hermit" control technique is now being tested with air launched guided missiles.

(4) Remote Controlled Boats (Javaman) - A project was on the way to the theater to use surface craft, with television, to be remotely controlled from the air or surface. This project had been successfully tested in this country. Thirty-four and thirty-seven ft speed boats (Target Boats) and an 85 ft A-5 Army Rescue Boat were used. The A-5 could carry up to 50,000 lbs. of explosive.

c. Air-to-Air:

(1) JB-3 (Tiamat) - A 625 lb, rocket propelled missile with a 150 lb fragmentation bomb and a radar seeker. Speed is approximately 600 m.p.h., and range approximately 10 miles. Flight tests are underway on the airframe, and tests will start within several months on the seeker. This is now considered an interim development and results of tests will be used in other air-to-air and surface-to-air developments.

(2) PQ-12 - This was a radio controlled target type airplane. It was directed by another airplane against a PQ-14 in a demonstration of November 1942. The demonstration was successful in that both airplanes were destroyed. The difficulties of visual or television guiding of an air-to-air missile became so apparent, however, that it was obvious other guiding means and far greater speeds would be necessary.

d. Surface-to-Air: The Army Air Force has completed a study contract with Boeing Aircraft Company, and a joint Ordnance-Army Air Force study with Bell Telephone Laboratories. Bids are now being secured from all the major aircraft companies on a specific missile contract.

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ATSC 9-804 (19 OCT 44)

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SAFE

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

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IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL:
TSESA (TSESA-7)

TSESA-7/RTM/jt
WRIGHT FIELD, DAYTON, OHIO
10 December 1945

SUBJECT: Application of Glide Bombs to the "Hermit" Project, MX-711

TO: Commanding General
Army Air Forces
Washington 25, D.C.

Attention: AC/AS-4, Lt. Col. V. A. Stace

1. The "Hermit" technique of ground control has been tested with powered aircraft (Project MX-709), with vertical bombs (Project MX-710), and with glide bombs (Project MX-711) as directed by letter dated July 1945 received from AFDMA-2G, Materiel Division, AC/AS, WAS, subject: "AAF Use of Guided Missiles in Close Cooperation with Ground Operations". Priority was specified in the order listed above.

2. Project MX-709 has already been considered successful after scoring a direct hit on a small target with a B-17 War Weary Aircraft. Project MX-710 is still in the development stage pending modification of a sighting device. Project MX-711 has established a probable accuracy, using an easily modified glide bomb and sighting devices considered adequate for this missile, of a circular error of 250 feet.

3. It is recommended that no further consideration be given to glide bombs on the "Hermit" Project for the following reasons:

a. The circular error specified in paragraph 2 cannot be reduced without further redesign of radio controlled glide bombs. This would involve the design and outside purchase of 50 three-axis control units with pitch gyros modified for radio control, 50 sets of special cables and 50 special receiver-selector mounting brackets. Even with these modifications it is estimated that the circular error would not be reduced below 200 feet. With only this small gain in accuracy, and with the reasons for not continuing the development, expressed in subparagraphs b, c, and d below, it is believed that expenditure of time and materiel on further development is not warranted.

b. Project MX-709 has already provided a satisfactory solution to the problem presented, so that it would seem reasonable to discontinue work on an allied project which offered no indication of being as accurate.

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Commanding General, AAF, Washington 25, D.C.
Application of Glide Bombs to the "Hermit" Project, MX-711
10 December 1945

c. The latest specification issued for Air-to-ground Pilotless Aircraft includes requirements for speeds, ranges and maneuverability that would be impossible to accomplish with a non-powered aircraft or missile such as a glide bomb. This fact would indicate that the glide bomb principle is obsolete and that further development would be impractical.

d. All of the present office personnel available for the development and testing of Pilotless Aircraft are assigned to the study and design of the higher performance missiles referred to in paragraph 3c above. Any work by this personnel on glide bombs would be at the expense of these more recent projects.

4. It is requested that the use of glide bombs on the "Hermit" Project be reviewed with the above statements in mind. It is recommended that the tests of glide bombs on the "Hermit" Project be considered complete without further development and that Project MX-711 be closed out without standardization. Any further consideration of glide bombs to hit targets on the reverse sides of hills would, of course, be dropped.

FOR THE COMMANDING GENERAL:

George E. Price

GEORGE E. PRICE
Colonel, Air Corps
Chief, Aircraft Projects
Service Engineering Subdiv.
Engineering Division

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Subject: Application of Glide Bombs to the "Hermit" Project, MX-711

Basic dd 10 Dec 45 1st Ind AFDRE-3/V

Hq AAF, Washington 25, D. C., 18 January 1946

To: Commanding General, Air Technical Service Command,
Wright Field, Dayton, Ohio Attn: TSESA-7

1. Concur in your recommendation to discontinue further tests of Glide Bombs as applied to the Hermit Project, MX-711.

2. For your guidance, the Army Ground Forces have informally restated that their interests in the Hermit Project lies chiefly in missiles incorporating:

a. High speed to reduce vulnerability to enemy counter-fire.

b. Pin-point accuracy for both visible targets and reverse-slope targets.

c. Great maneuverability for attack of maneuvering surface targets.

These requirements obviously eliminate the further consideration of Glide Bombs for the Hermit Project.

3. The Hermit Project is now being reviewed and a new statement of military characteristics will be forwarded at an early date.

BY COMMAND OF GENERAL ARNOLD:

W H [illegible] Col AC
for.
ALDEN R. CRAWFORD
Brig. General, U. S. A.
Chief, Research & Engineering
Division
Office, AC/AS-4

1 copy handed to Capt Thompson 1-24-46 } MX-709
1 " typed for Maj. Evans file 1-28-46 } MX-710

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON, D. C.

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WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON, D. C.

AFDRE-3/C

11 JAN 1946

Subject: Guided Missiles

To: Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: TSTEX

1. It is directed that ATSC undertake immediately to launch a demonstration model of a long-range guided missile.

2. The purpose of the project is to impress upon the public mind the fact that the Army Air Forces have, and can use immediately, some form of guided missile.

3. It is desired that the range should be 3,000 miles or better; which would seem to indicate a B-29 airplane. However, if technical difficulties prohibit this range a shorter range is acceptable provided your reasons are submitted to and approved by this Headquarters. If possible the missile should be directed from a ground base, but time must not be lost in the development of new equipment. If no other means of guidance is available, a "mother ship" will serve the purpose for control in this demonstration.

4. It is desired that this project be undertaken at once and that the demonstration be held with appropriate publicity not later than 1 August 1946. Priority will be assigned accordingly.

By command of General ARNOLD:

John G. Moore

JOHN G. MOORE
Colonel, Air Corps
Deputy Asst. Chief of Air Staff-4

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Major Jon H. Ober
TSTEX/ced (5-6147)

Wright Field,
Dayton, Ohio
16 January 1946

TECHNICAL INSTRUCTIONS

SERIAL NO: TI-2003, Addendum No. 53

SUBJECT: Long-Range Guided Missile Demonstration

TO: Engineering Division

1. Problem Presented:

a. To launch and demonstrate a long-range guided missile.

2. Factual Data:

a. The purpose of the project is to impress upon the public mind the fact that the Army Air Forces have, and can use immediately, some form of guided missile.

3. Authority:

a. CG, AAF, By letter dated 11 January 1946, subject: "Guided Missiles", received from AFDRE-3/C, Deputy, AC/AS-4.

4. Action Desired:

a. That the Engineering Division accomplish the necessary development and engineering to fulfill the requirement of the Problem Presented, paragraph #1.

(1) It is desired that the range should be 3,000 miles or better; which would seem to indicate a B-29 airplane. However, if technical difficulties prohibit this range a shorter range is acceptable provided reasons are submitted to and approved by AC/AS-4. If possible the missile should be directed from a ground base, but time must not be lost in the development of new equipment. If no other means of guidance is available, a "mother ship" will serve the purpose for control in this demonstration. It is desired that work be started on this project immediately with demonstration to be held with appropriate publicity not later than 1 August 1946.

b. This project carries a 1-B priority.

By command of Lieutenant General TWINING:

Jon H Ober Maj AC

JOHN W. SESSUMS, Jr.
Colonel, Air Corps
Chief of Administration

cc: Procurement Division
Supply Division
Maintenance Division
Flight Test Division
Public Relations Office

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416 - Guided Missile

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ATSC Form No. 10-808 (3 Jan 46)
(Old ATSC Form No. 45)

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
TSDEC(TSESE)
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

8 Feb. 1946

Guided Missiles

ORIG. FILE COPIES TO:	INITIALS
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Commanding General
Army Air Forces
Washington 25, D. C.

Attn: Deputy Chief of Air Staff

THRU: AC/AS-4

REFERENCE: Hq. AAF, Washington, D. C. (AFDRE-3/C) letter dated 11 January 1946, subject as above.

1. In connection with the above-referenced letter, the following plans for the demonstration directed are submitted.

2. Targets. The target selected is the Island Nihoa, approximately 300 miles Northwest of Honolulu (160 degrees 56 minutes West Longitude, 23 degrees .05 minutes North Latitude). The Island is an uninhabited rock projecting from the water more than 850 feet, affording a good radar target. It is 2,810 statute miles from Muroc Army Air Base. Prior to definite selection of Nihoa Island, consideration was given to targets on the East and West side of the Panama Canal but were abandoned as being unsuitable for various reasons. It will be necessary for Headquarters, AAF to obtain authority from the Department of Interior to use this Island as a target, inasmuch as it is a bird sanctuary.

3. Methods. Several methods of control were considered prior to the selection of the type mentioned below but were not feasible due to the lack of development. The method finally selected is an improved Azusive method in which one mother airplane controls two missile airplanes which under the most favorable conditions of weather and development is anticipated to be controlled at a distance of 75 miles. In the event of bad weather, this distance would be reduced to the prevailing optical limits of the target from the missile airplane plus 50 miles. Enroute to the target area,

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Ltr to C.G., AAF, subject: Guided Missiles
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where it becomes impossible to guide the missiles visually, because of clouds or poor weather, two means will be provided to locate and satisfactorily control the missiles to their destination. First, through the use of radar and, second, through the use of telemetering and the radio compass

4. Take-off. Take-off of the missile airplane will be accomplished either by the "Hermit" method or by a pilot who will later parachute after take-off A problem is presented in the remote control take-off which has never been accomplished in an aircraft of this weight class. Prospects of its becoming a reality are favorable, but in the event remote take-off proves unsatisfactory, the only means of making the missile airborne is for a rated pilot to perform the task. Prior to leaving the ship, he will set up the remote control equipment and be sure that the mother has positive control.

5. Equipment. Seven B-29's divided into four missile airplanes and three mother airplanes will be required which includes one spare mother airplane in case of emergency. In addition to the normal radio and navigation equipment in the mother aircraft, special control equipment will be added. The missile aircraft will be stripped completely of all equipment and only the necessary remote control equipment added The missile aircraft will carry 10,000 lbs. of standard general purpose bombs which will be remotely armed at a suitable time

6. Range The distance from Muroc Air Base to Nihon and back to San Francisco is 5570 statute miles. To provide for this range plus time for run-up, plus one-half hour to assume control of the missile airplane, plus one hour's delay at the target, plus 5-1/2 hours' reserve, it will be necessary to install in each of the mother airplanes, four bombay tanks The over-all gross weight of the airplane will then be 139,000 lbs. Computations were based on a stripped B-29 aircraft with only the necessary crew, equipment, fuel and oil.

7. Schedule. In order to insure adherence to the directed date of 1 August 1946 for demonstration, the following schedule is tentatively set up:

a. 1 March 1946 to 1 April 1946. Delivery of two mother airplanes and two missile airplanes to Wright Field for installation of prototype equipment and preliminary flight tests.

b. 1 April 1946 to 30 April 1946. Delivery of remaining 3 airplanes to Depot for strip down and installation of equipment. Accelerated flight tests and establishment of operational procedures. Crew training

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c. 1 May 1946 to 31 May 1946. Completion of modification to aircraft, continuation of crew training.

d. 1 June to 15 July 1946. Continuation of crew training, staging and shake-down tests.

e. 15 July 1946 to 1 August 1946 Demonstration.

This schedule is predicated upon the delivery, as previously mentioned of four stripped airplanes to Wright Field with all safety Technical Orders accomplished for installation of the prototype equipment by ATSC. Immediately upon installation of the equipment, or approximately the 1st of April, the airplanes and personnel will be moved to Muroc Army Air Base where better flying conditions prevail for continuance of the project.

8. Personnel. It is noted that the schedule in the preceding paragraph is very limited and adherence to this schedule is entirely dependent upon being provided by Headquarters, AAF, with qualified ground and flying personnel. This Command is not in a position to supply more than a handful of the personnel required, which would be principally technicians. The following schedule for personnel is set up: Present time to 1 April 1946 - personnel supplied by the Laboratories of ATSC. 1 April 1946 to 1 August 1946 -

7 B-29 pilots, MOS 1035
7 B-29 co-pilots, MOS 1093
7 B-29 engineers, MOS 1028
3 B-29 radio operators, MOS 2756
3 B-29 navigators, MOS 1034
4 radio control pilots, MOS 1050
4 radio mechanics, MOS 754
3 radar bombardiers, MOS 1031
3 television operators, MOS 380 (Radar Mechanic)
7 crew chiefs, MOS 750
45 aircraft & engine mechanics, MOS 747
4 auto pilot mechanics, MOS 574
4 propeller mechanics, MOS 687
3 radar repairmen, MOS 955
2 supercharger repairmen, MOS 964

9. Quarters, rations and maintenance facilities are available for these personnel at Muroc Army Air Base, but whether or not the essential housekeeping personnel are available is yet to be determined.

10. It is desired to point out that if this project is successfully completed on time, that action should be initiated immediately

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Ltr to C.G., AAF, subject: Guided Missiles
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by Headquarters, AAF, to obtain the required personnel and aircraft for assignment to this project. The highest priority required to meet the schedule must be authorized by your Headquarters to all Commands and personnel interested in the project. Your office will be continually advised and kept up to date of significant difficulties and of any changes in the equipment or schedule that may occur.

FOR THE COMMANDING GENERAL:

B. W. CHIDLAW
Major General, U. S. A.
Deputy Commanding General
Engineering (T-3)

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AAD
6 FEB 1945

COM. GEN.
CH. STAFF
DEP. CH. STAFF
TECH. EXEC.
ADJ. GEN.
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COMPTROLLER
C. O.
BUD. OFF.
PERS. SEC.
ENG. DIV.
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS

Major R. L. Mayrath:hjb
Ext. 3-0114

6 FEB 1945

TSEMG (TSEPL-3I8)

Use of Offner Heat Seeker on Abusive Aircraft.

Commanding General,
Army Air Forces,
Washington 25, D. C.
Attention: Engineering Branch, Materiel Division, AC/AS, M & S.

1. In accordance with your telephone conversation of 25 January 1945 with personnel of this Office the following information is submitted on the subject development.

2. One (1) of the Offner heat seekers was installed in a B-17F airplane and connected to the automatic pilot through the remote trim control board. The first flight test was made on 18 January 1945 with very poor results. The seeker showed a tendency to lock in turns, both to the right and left.

3. The next flight test was made on 20 January 1945 with a new seeker head installed and much better results were obtained. When started into a dive the seeker would maintain the same general course and would give course corrections without locking in the turns. On this flight the delay relays which are incorporated in the seeker were adjusted for shorter delays than on the previous runs. Five (5) test runs were made on the coke plant at Middletown, Ohio. On these runs the control of the airplane was turned over to the seeker when approximately three (3) miles from the target, with the airplane pointed toward the slag pile of the coke plant. The airplane maintained this heading on three (3) of the runs. On one (1) run it veered to the left and would have landed in a pool of cooling water and on another run it veered to the right and would have landed in the river.

4. Inspection of both seeker heads after the test flights disclosed that the salt crystal window in the seekers had fractured. Ground tests are now under way to determine the cause.

EPL-3I8
EPL3I8

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or changed to
AUTH [redacted] RD-312
By MX-541
10-1-45
MX-23006

AAFMC-190-WF-5-12-44-375M

CENTRAL FILES

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[redacted]

Commanding General, Army Air Forces, Washington 25, D. C.
Attention: Engineering Branch, Materiel Division, AC/AS, M & S.
"Use of Offner Heat Seeker on Abusive Aircraft."

6 FEB 1945

5. It is planned that a series of test dives shall be made at various industrial installations in this area, both with and without the seeker. A camera will be mounted on the airplane so that the probable points of impact may be determined. These tests will be started on or about 15 February 1945.

For the Director:

[redacted]

X-23006

THIS PAGE IS DECLASSIFIED IAW EO 13526

central files
MX 541
1/1

979 [redacted]

SAVE

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

IN REPLY REFER TO:

(AFDMA-2G)
5 July 1945

SECRET
By authority of
The Commanding General
Army Air Forces
7/6 [initials]
Date Initials

SUBJECT: SRB Seeker for Abusive Aircraft

TO: Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: Pilotless Aircraft Branch (TSESE-2G)

1. At a meeting between representatives of ATSC, the US Navy and this Headquarters held at Wright Field on 23 June 1945, Commander Merrill suggested a gimbal mounted SRB seeker unit for use in Abusive missiles. Commander Merrill further suggested that a pick-a-back arrangement might be very feasible for use in the Abusive Program.

2. In a project under Commander Taylor's direction at the Naval Aircraft Modification Unit, the Navy has equipped a C-45 aircraft with a gimbal mounted SRB Seeker Unit for studies in connection with their BAT missile. They have successfully homed on many land targets with this aircraft by selecting a target and locking the Seeker on it.

3. It is understood that ATSC is investigating the feasibility of employing the SRB seeker as suggested above and it is desired that a report of this investigation be forwarded to this Headquarters.

By Command of General ARNOLD:

Fred R Dent Jr Col AC
J. F. PHILLIPS
Brig. General, USA
Chief, Materiel Division
Office, Asst. Chief of Air Staff
Materiel and Services

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By CD-356
Signature and Grade
Date 10-1-45

CENTRAL FILES
Project MX-541
RLM/set/TSESE-2G

W-5661 [redacted]

ADDRESS REPLY TO: COMMANDING GENERAL, ARMY AIR FORCES, WASHINGTON 25, D. C.

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Central Files
No. 541
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ATSC Form No. 10-508 (3 Jan 45)
(Old ATSC Form No. 43)

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COORDINATION
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AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
[illegible]NT. DIV.
SUPPLY DIV.
ENGINEERING DIV. Maj R.L. Mayrath
PROCUREMENT DIV.
READJUST DIV.
O[illegible]ER

TSESE-2G:RLM:eat

TSESE-2 (TSESE-2G)

1 August 1945

SRB Seeker for Abusive Aircraft. [redacted]

Classification cancelled
or changed to
AUTH: CD-356
(Signature and Grade)
10-7-45

AUTH: CG, ATSC
INITIALS: [illegible]
DATE: 8-1-45

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: AC/AS, M&S, Materiel Division.

Reference: Headquarters, AAF, Washington, D. C. letter dated 5 July 1945, subject as above.

RLM

MX-541

1. An investigation of the feasibility of employing the SRB seeker on abusive aircraft has been completed and has indicated that this device is not suitable for use on these aircraft.

2. The navigation system for the SRB seeker and the interconnection between the seeker and the C-1 pilot, as developed and tested by the Navy, are believed to have great merit and should control any type of aircraft to the target selected by the seeker with good accuracy. It has been found with this system that only about 15 seconds are required for the aircraft to change from a chaser course to an interception course after the seeker is given control.

3. The weak link in the system, for use on Abusive missiles, is the repeat-back from the SRB to the control airplane. At the present time the reliable range of this equipment is estimated to be 5 miles or less. This equipment has been mocked up experimentally by the Navy but has not been flight tested.

4. In operational use of the "Bat" the Navy has had much difficulty with target selection by the SRB, even though search radar has been used on the airplane carrying the missile to assist in interpretation of the SRB scope. This scope indicates only the range to all targets in a 60° cone in front of the seeker. Even though the carrying airplane pointed the missile with SRB directly at the desired target before release, in many instances the operator watching the SRB scope locked the seeker on the wrong target. In use on Abusive aircraft this problem would be multiplied may times due to the fact that the control pilot has only a

CENTRAL FILES
Projects MX-541
RLM/eat/TSESE-2G
7-30-45

[redacted]

WF, Area B-1-1-45-600M

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[redacted]

SHB Seeker for Abusive Aircraft.
1 August 1945.

general idea of the location and heading of the missile, and consequently the operator watching the repeat-back of the SHB scope could not identify any target unless it was the only target which could possibly be in the field of view of the scope at that time. For identification of a target with this system the exact range from the missile to the target must be known and the missile must be pointed directly at the desired target before the seeker is locked, if more than one target is in the field of view of the seeker.

4. Reports from the Navy indicate further that this seeker frequently will pass between two targets if they are approximately the same size, and that occasionally it will jump from a large target and will select a much smaller target which happens to be at a shorter range. It is therefore not planned that any further work will be done on the installation or test of this type of seeker until the seeker itself has been developed with a higher degree of usefulness. It is believed that before this seeker can be used successfully on Abusive it will have to be developed to a point that the presentation on the repeat-back scope will be similar to that on the scope of APS-15 or APQ-13 radar.

FOR THE COMMANDING GENERAL:

Leck

MARCUS F. COOPER,
Colonel, Air Corps.,
Chief, Aircraft Projects Section,
Service Engineering Subdivision,
Engineering Division.

5 AUG 1945

10:50

[redacted]

W-21461

C.C.F. MX 416

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178

ADDRESS REPLY TO
HEADQUARTERS OF THE ARMY AIR FORCES
WAR DEPARTMENT
WASHINGTON, D. C.

[redacted]

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

[redacted]
By Authority of
The Commanding General
Army Air Forces
8/4/45 G.
Date Initials

AFDMA-2F/2
3 August 1945

2217

SUBJECT: Radar Control for Guided Missiles

TO: Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: Chief of Administration, (TSTEX)

1. A requirement exists for equipment which will permit an operator in an aircraft to control missiles by remote means under all weather conditions and also while the aircraft is taking evasive action. Such a system could use for tracking a Bombing Through Overcast set in the aircraft and a radar beacon in the missile.

2. It is directed that under a 3-B priority a system or systems be developed which will enable an operator in an aircraft to:

a. Guide through an overcast a remotely controlled missile to a target on the ground;

b. Control a missile from an aircraft taking evasive action.

3. The number of systems developed must be kept to a minimum in order to permit single type installations in as many of the various types of guided missiles as possible. The development work for existing remote control systems is to be carried out in accordance with the following relative development priority.

a. Azon - Razon - Tarzon.

b. Abusive aircraft.

c. Jet propelled missiles.

d. Glide bombs.

4. The possibility of guiding a controlled missile from an aircraft other than the aircraft that dropped the missile should also be considered.

BY COMMAND OF GENERAL ARNOLD:

11:35

[redacted]

for J. F. PHILLIPS
Brigadier General, U. S. A.
Chief, Materiel Division
Office, Asst. Chief of Air Staff
Materiel and Services

W 26134

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ATSC Form No. 80-602 (2 NOV 44) e.e.F. mx 416 179

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Major J. H. Obor JAN 45-3400
jcs/TSTEX/5-6147

SECRET
AUTH: CG, ATSC
DATE: 8 August 45
INITIALS:

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Wright Field
Dayton, Ohio
8 August 1945

SERIAL NO: TI-2217, Addendum No. 3

SUBJECT: Radar Control for Guided Missiles

TO: Engineering Division

1. Problem Presented:

a. A requirement exists for equipment which will permit an operator in an aircraft to control missiles by remote means under all weather conditions and also while the aircraft is taking evasive action. Such a system could use for tracking a Bombing Through Overcast set in the aircraft and a radar beacon in the missile.

2. Authority:

a. Commanding General, Army Air Forces, by letter dated 3 August 1945, subject as above, received from Chief, Materiel Division, Office, Asst Chief of Air Staff, Materiel and Services.

3. Action Desired:

a. That the Engineering Division develop a system or systems which will enable an operator in an aircraft to:

(1) Guide through an overcast a remotely controlled missile to a target on the ground

(2) Control a missile from an aircraft taking evasive action.

b. The number of systems developed must be kept to a minimum in order to permit single type installations in as many of the various types of guided missiles as possible. The development work for existing remote control systems is to be carried out in accordance with the following relative development priority:

(1) Azon - Razon - Tarzon.

(2) Abusive aircraft.

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SERIAL NO: TI-2217, Addendum No. 3 (cont)

SUBJECT: Radar Control for Guided Missiles

(3) Jet propelled missiles.

(4) Glide bombs.

c. The possibility of guiding a controlled missile from an aircraft other than the aircraft that dropped the missile should also be considered.

d. This project has a 3-B priority.

By command of Major General KNERR:

K. H. BITTING
Colonel, Air Corps
Chief of Administration

cc: Supply Division
Maintenance Division
Procurement Division
Tech. Liaison Office
Flight Test Division

[redacted]

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364

Major Jon H. Ober
TSTEX/ced (5-6147)

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Wright Field,
Dayton, Ohio
29 November 1945

TECHNICAL INSTRUCTIONS

VALUE OF PAPER CHECK ONE
PERMANENT ☐ TRANSITORY ☐

SERIAL NO: TI-2217, Addendum No. 7

SUBJECT: Control Equipment for a Remotely Controlled Missile.

TO: Engineering Division

1. Problem Presented:

a. Requirement exists for the development of equipment to navigate a remotely controlled missile to a target by means of radar, with use of television for the precise final approach to the target.

2. Authority:

a. CG, AAF. By letter dated 20 November 1945, subject: "Cancellation of T.I. 2003, Addendum 36", received from Chief, Production Division, Office, AC/AS-4.

3. Action Desired:

a. That the Engineering Division develop the equipment required under Paragraph 1, Problem Presented, above.

b. This TI supersedes and cancels TI-2003, Addendum No. 36.

c. This project carries a 2-B priority.

By command of Major General KNERR:

Jon H Ober Maj CE

C. E. THOMAS, Jr.,
Brigadier General, U.S.A.,
Chief of Administration

cc: Procurement Division
Supply Division
Maintenance Division

[redacted]

W-67789-A

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COM. GEN.
CH. STAFF
DEP. CH. STAFF
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INSP. DIV.
PROC. DIV.
OTHERS

TSESA-7/JFH/eat

13 February 1946

SECRET

AUTH: C.G., ATSC
INITIALS:
DATE: 2-1-46

TSESA (TSESA-7)

Corrections and Additions, Summary Handbook of Guided Missiles.

Guided Missiles Committee,
Joint New Weapons Committee,
Joint Chiefs of Staff,
Munitions Building,
Washington, D. C.

THRU: AC/AS-4, Major J. P. Taylor.

1. The following are submitted as corrections and additions to the Summary Handbook of Guided Missiles, from your office, dated 1 July 1945.

a. RAZON

General Description

To be added after the third sentence: It has been determined by the AAF Center that both range and azimuth control can be accomplished by the bombardier.

Status of Development, Production and Availability

The second sentence should read: The Union Switch and Signal Company was under contract for 23,000 units, currently scheduled for delivery beginning in August 1945 and terminating in April 1946; however, production has been reduced to a total of 3,000 units.

b. FELIX

Status of Development, Production and Availability

Delete last sentence.

c. TARZON

Status of Development, Production and Availability

Third and fourth sentences should read: First experimental

CENTRAL FILES
Guided Missiles
JFH/eat/TSESA-7
2-11-46

[redacted]

CENTRAL FILES

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drop is scheduled for 1 April 1946. Gulf Research and Development Company has fabricated one unit, Bell Aircraft will fabricate ten additional units.

d. GB-11

Status of Development, Production and Availability

Delete all after first sentence and substitute: Development has been discontinued.

e. GB-12

Status of Development, Production and Availability

Delete paragraph and substitute: Further development has been discontinued.

f. JB-2

Status of Development, Production and Availability

Delete paragraph and substitute: JB-2 has been standardized.. On 1 September 1945 all contracts for JB-2 procurement were terminated. The final production quantity is 1,382 units. Work is continuing on radar control and improvements in the accuracy.

g. JB-10

Performance Characteristics

In second sentence, substitute "minutes " for "seconds".

Status of Development, Production and Availability

Delete paragraph and substitute: Project closed out. Eleven JB-10 units were produced, of which ten were used for experimental tests. The one remaining unit was shipped to Freeman Field, Seymour, Indiana, for use in historical aircraft display.

h. ABUSIVE

General Description

For seventh sentence substitute: Lack of training

[redacted]

V-6629

3/3 357 [redacted]

Corrections and Additions, Summary
Handbook of Guided Missiles.
13 February 1946.

of personnel has thus far decreased the usefulness of CORTICATED, however.

Performance Characteristics

Add to fifth sentence: but a ceiling of 7,000 to 8,000 feet and a visibility of 2 to 3 miles are required for good operation of the television in CORTICATED.

Technical Characteristics

Next to final sentence should read: In Phase II and III, SCR-729 navigation equipment and a radio compass in the parent, and a beacon and liaison transmitter in the missile are used.

i. LONG RANGE HIGH SPEED PILOTLESS AIRCRAFT

Prime Contractor: None. Proposal from Consolidated-Vultee received.

Status of Development, Production and Availability

Delete paragraph and substitute: No procurement is contemplated for this missile at this time.

j. CONDOR

Substitute GAPA for CONDOR wherever found.

Second paragraph: In first sentence, substitute 60,000 feet for 50,000 feet. In second sentence, substitute: Mach No. 2 for Mach No. 3 in parentheses.

k. TIAMAT

Technical Characteristics

In last sentence substitute "air pick-off" for "electrical pick-off".

10:52 ... FEB 48

2. Above corrections and additons do not bring up to date the information on projects listed.

12 ... 10 33

FOR THE COMMANDING GENERAL:

GEORGE E. PRICE,
Colonel, Air Corps.,
Chief, Aircraft Projects Section,
Service Engineering Subdivision,
Engineering Division.

Copy to:
AC/AS-4 - Major J. P. [redacted]

V-5629

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(2-B3)

February 8, 1941.

MEMORANDUM FOR: Foreign Liaison Officer, G-2.

SUBJECT: Aerial Gliding torpedoes, gliding bombs, and aerial mines.

The Air Corps is anxious to receive information on the subject of aerial gliding torpedoes, gliding bombs, and aerial mines. With this in mind, it is requested that a cablegram substantially as follows be sent to the Military Attache, London:

"It is desired that Colonel Hatcher and Major Moore be detailed to contact Ministry of Aircraft Production and Air Ministry with view of obtaining detailed production, technical and operational data covering aerial gliding torpedoes and gliding bombs as well as similar data on aerial mines for use on land and water. EXPEDITE".

For the Chief, Intelligence Division:

(2-B3)
732
ERQ:bh

E. R. QUESADA,
Major, Air Corps,
Air Corps Liaison Officer.

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ROUTING AND RECORD SHEET

SUBJECT: Request for Information from British with reference to Glide Torpedo and Glide Bomb.

(4-J)
1. Mat.Div. Intel.Div. 2-10-1941

1. It is requested that any descriptive data, drawings, or sketches available on both the glide torpedo and glide bomb, be obtained from the British Commission and forwarded to the Materiel Division, Wright Field, Dayton, Ohio.

2. It is understood that the British have completed the development of the above items and intend to begin production immediately on the glide torpedo. Any data concerning the above two items will be of any great value in the prosecution of studies now underway at the Materiel Division.

3. It is further requested that an attempt be made to obtain any motion pictures, which might be available from the British Commission, showing the actual operation of the glide torpedo. Should this latter request be granted, it is further requested that permission be obtained to make a copy of this film at Wright Field.

O. P. E.
Chief, Materiel Division.

---

2. Intel.Div. Mat.Div. 2/12/1941
CWS:bh
(2-B3)

1. With reference to Comment No. 1, please refer to our R&R sheet dated February 11, 1941, subject, "Showing of Film "Torpedo Bombs', Wright Field, Wing Commander Bruce.

R. C. CANDEE,
Colonel, Air Corps,
Chief, Intell. Div.

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By Signature and Grade
Date 11-1-45

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To "Restricted"
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ROUTING AND RECORD SHEET

732

SUBJECT: Aerial gliding torpedoes, gliding bombs and aerial mines

1. Intel.Div. Plans Div. 2/11/41
(2-B3)
ERQ:reJ

1. Reference is made to your R&R of February 7, on the subject of Aerial Gliding torpedoes, gliding bombs and aerial mines.

2. G-2 advises that the Navy is in receipt of complete information on the subject of aerial mines. They further advise that the Navy probably has information on the subject of aerial gliding torpedoes and gliding bombs. Should you so desire, the personnel of your office who are particularly interested in the subject may be placed in communication with personnel of the Navy Department familiar and informed on the subject.

3. Wing Commander Bruce of the British Air Commission is in this country, and is reputed to have considerable knowledge on the subject. On Wednesday, February 12 Wing Commander Bruce will be at Wright Field and is expected to return the following day. If it is so desired Wing Commander Bruce could be requested to come to this office to discuss the subject with Officers of your Division.

R. C. CANDEE,
Colonel, Air Corps,
Chief, Intell. Div.

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Wright Field 10-12-39-30M

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WAR DEPARTMENT

AIR CORPS, MATERIEL DIVISION

GVH:dr:51

MEMORANDUM REPORT ON

SUBJECT: Report of Visit of Wing Commander James D. Bruce of the British Air Commission to the Materiel Division, Regarding Dirigible Bombs.

Date: February 18, 1941.

SECTION: Experimental Engineering

SERIAL No.: EXP-M-54-655-209.

Contract No. 655-1

Expenditure Order No.

Purchase Order No.

MX-108 - Dirigible Bomb

X-336 - British

A. Purpose.

1. To report on a conference held between personnel of the Materiel Division and Wing Commander James D. Bruce of the British Air Commission, regarding glider torpedoes and dirigible bombs.

B. Factual Data.

1. On February 13, 1941, Wing Commander James D. Bruce of the British Air Commission arrived at Wright Field, and spent the entire day discussing various types of glider torpedoes, glider bombs and dirigible bombs. He brought with him a motion picture film showing the operation of a glider torpedo developed by the British. This film showed the various phases of the development as well as the completed article in actual use.

a. This torpedo consisted of a standard aircraft borne torpedo on which had been installed glider wings. The wing span was approximately 11-1/2 feet and the chord approximately 3-1/2 feet. The wing loading approximated 48 lbs. per square foot. The glide angle used in the actual operation was approximately 1000 feet altitude for every mile of horizontal distance.

b. This torpedo was launched from an altitude of about 2000 feet, and the horizontal distance before striking the water was about 1000 yards from the objective. A very necessary requirement was that the torpedo enter the water not less than 400 yards from the objective in order that the missile might obtain the desired depth before striking the objective.

c. A small paravane, carried on a wire about 15 feet in length, caused the wings to leave the torpedo when the paravane struck the water. This allowed the wings to be completely clear of the torpedo before it struck the water. Should the wings be released after the torpedo itself had struck the water, injury to the water propelling mechanism of the torpedo could be expected.

d. During flight, a gyro, set at a 45° angle and operating one aileron, controlled the air flight both in yaw and roll. No propelling equipment was used during the air flight. Upon entering the water the torpedo then functioned as a normal water torpedo dropped from an aircraft.

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Memorandum Report No. EXP-M-54-655-209.
February 18, 1941.

e. The purpose for which this torpedo was designed is to enable the carrying aircraft to launch the torpedo at increased altitudes and from positions beyond the range of the small arms anti-aircraft fire of the objective.

f. It was understood from Wing Commander Bruce that the British are now beginning production of these torpedoes.

g. A number of officers and interested engineers of the Materiel Division witnessed showings of the motion picture film. For future reference, and with the permission of Wing Commander Bruce, a copy of the film was made and is on file at the Technical Data Branch.

2. During the remainder of the day, a general discussion was carried on between Wing Commander Bruce and personnel of the Materiel Division regarding the whole subject of radio controlled dirigible bombs and torpedoes. The radio equipment now used in the small aerial targets, power driven, was shown to Wing Commander Bruce, and he stated that he would request complete data on this equipment through the required channels. He appeared very enthusiastic about this equipment, and its possible use in the glider torpedoes and bombs already developed by the British. This would allow the deflection of the torpedo to be changed during air flight to compensate for any changes in the direction of movement or the position of the objective, as well as for any errors in aiming the missile.

3. Wing Commander Bruce appeared extremely favorable toward a dirigible bomb which would be radio controlled, and which would contain equipment for obtaining information to be transmitted back to the controlling personnel. This latter equipment might possibly be television, sound pick-up, or infra-red detection equipment.

4. Present at the conference were:

Materiel Division	British Air Commission
Major G.V. Holloman	Wing Commander James D. Bruce
Captain Rudolph Fink	
Mr. C. L. Paulus	

C. Conclusions.

1. That continued effort should be made in obtaining television and/or related equipment, of suitable operating characteristics and size, to be placed in a dirigible bomb or torpedo.

Prepared by G.V. HOLLOMAN, Major, A. C.

Approved by RANDOLPH P. WILLIAMS, Major, A.C.
Chief, Equipment Laboratory.

Approved by F. O. CARROLL, Lt. Colonel, A.C.
Chief, Experimental Engrg. Sec.

Distribution, Ch. Mat. Div.; Central Files; Aircraft Radio Lab.; 2 cys. Asst. Ch. of Staff, G-2; Classified Data Branch; Foreign Dev. Projects, OCEES; Aeronautical Board.

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CCF AX/02 R-V (1/c)

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ROUTING AND RECORD SHEET

Subject: Gliding Torpedoes and Bombs for use from Aircraft.

1	Plans	1. Exec. 2. Mat.	1941 2/25

1. Transmitted herewith are two copies of a memorandum on standardization in connection with torpedo dropping from the air as prepared by Wing Commander J. D. F. Bruce of the Royal Air Force.

2. It is understood that General Arnold is very much interested in creative action being taken by the Air Corps to make this an active project. In considering this subject, it is believed advisable that the following points be borne in mind:

a. Initially it may be appropriate to consider that the torpedo is not the monopoly of sea borne aircraft or the Navy.

b. All short cuts in time-saving should be adopted by obviating unnecessary experimental work and promptly taking advantage of developed features of the apparatus, standard torpedoes, bombs, etc.

c. More positive and accurate means of controlling the gliding torpedo and bomb is desirable. Adapting a sensitive radio control may place it in the precision class of bombing.

d. Wing Commander J. D. F. Bruce is of the opinion that British research and development of sights for the gliding torpedo and bomb is in an advanced state. It was suggested that in the event the Air Corps should undertake this project jointly with the British that the British would endeavor to furnish the type sight required while the Air Corps would furnish the type sensitive radio controls required.

e. Adopting the gliding torpedo and bomb should permit operations against selected targets

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Subject: Gliding Torp[illegible] and Bombs for use from Aircraft

1 (Cont.)	Plans	1. Exec. 2. Mat.	1941 2/25	from a range outside that of effective antiaircraft artillery fire.

c. It is understood that Wing Commander Bruce has been R.A.F. project officer and pushing the active development of gliding torpedoes and glide-bombs in England. His most recent assignment seems to be a campaign of salesmanship to induce the United States Army and Navy, jointly, to take over this project. Wing Commander Bruce has made the positive statement that as yet he has not received authority from England to release detailed drawings, specifications, and production data on this weapon.

3. In view of General Arnold's active interest and the apparent promise of the gliding feature of torpedoes and bombs as outlined above, it is recommended that this be approved as current project with high priority.

/s/ C. S.
U. S.
Chief, Plans Division.

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or [illegible]
Auth CD-352
By [illegible] Signature and Grade
Date 11-1-45

Classification Cancelled
To "Restricted"
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-lmf
Wright Field, Dayton, Ohio
March 7, 1941

Record of Long Distance Telephone Conversation between Major B. W. Chidlaw, Office Chief, Material Division, Washington, D. C., and Lt. Col. F. O. Carroll, Wright Field.

Chidlaw: General Echols talked to General Arnold and Arnold wanted to know all about this glide torpedo that George Holloman is working on. I teletyped out there on the 27th of last month for a report and I never got it. I have found out that George has been away for several days and that is probably the cause of the delay.

Carroll: That report was mailed yesterday.

Chidlaw: Well we will have that story in here then. General Echols talked with General Arnold and the gist of it was that General Arnold, with his customary hammering on the table, stated that action wasn't happening fast enough and insisted that we get a gray-bearded scientist and start working on it. I don't know what we can do; I think we are going along alright.

Carroll: What we are planning now and have been talking it over for two or three weeks, is to set up a special Unit or organization within the Equipment Laboratory to take care of that and these aerial torpedoes, targets, etc. We are going to have to get some more people some place. We are looking around for suitable people for that Unit. It may be that if we can find somebody from the outside with specialized experience suitable for this, we will take them on.

Chidlaw: That apparently is what General Arnold had in mind but he wanted some particular person put on that glide torpedo; that seemed to be foremost in his mind at the moment. Gran Gardner is here with me now. Echols said to shop around and get somebody. Well, you can't just reach out and pluck a guy like that off a tree. Gran and I were talking it over here and wondering whether the man should be primarily an aerodynamist, a physicist, or what.

Carroll: I have just got hold of a man who wants a Reserve Commission; his name is Nyman. We have sent his papers in. If you could do anything to get that through, he will be the very man for this; in fact that is what I picked him for.

Chidlaw: What is his background?

Carroll: He was a Fin; had a very good technical education in Europe and Russia before the war; he was an officer in the American Signal Corps during the war; is now working for Frigidaire in their Research Department, and he is a man who just wants to get back and help in the Army. He has a fine technical background on radio and all the stuff we are interested in on this project. If we can get him on active duty, he will be a good research scientist for that project.

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[Chi]dlaw-Carroll Telephone Conversation - March 7, 1941.

Chidlaw: Well we can put that proposition up to General Echols and see about expediting those papers if you are sure he is the right man for the job.

Carroll: No matter whom you pick, you have to bring them in and educate them to a certain extent.

Chidlaw: Gren was talking about somebody out of the industry right now who might be on the loose.

Carroll: Well we keep our eyes pealed for people like that but, as you say, they just don't grow on bushes any more.

Chidlaw: How about Seversky?

Carroll: No.

Chidlaw: To sum this up - the story on the glide bomb was mailed yesterday?

Carroll: Yes.

Chidlaw: Alright. I have some papers on my desk that apparently Kettering sent direct to Knudsen; all about the $250,000 project. How is that progressing?

Carroll: That is going alright. The contract is signed and they are really doing something about it.

Chidlaw: As to aerial targets, what is the status now?

Carroll: Well, we bought two or three experimental targets and we have the 75, you know, from Culver. We also have those B.G's all modified and sent out. We are buying a 200 m.p.h. experimental one from Vega - the high speed one. Culver also has a proposition for a much higher speed one than we now have from him. We have that one Fleetwings built for us and that didn't fly but we are going ahead with the work on that.

Chidlaw: I thought that was going to be cancelled.

Carroll: We cancelled it with the Company but we are still going ahead with the airplane. We have all the equipment for installation in a P-39 for a real high speed airplane. We will probably have to use a B-25 or B-26 as a controlling airplane and throttle the P-39 down some. We will operate it around 325 m.p.h. We have the control equipment for that on hand. You know they washed out the P-39 we had intended using for this and we haven't been able to arrange for another one.

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Chidlaw-Carroll Telephone Conversation - March 7, 1941.

Chidlaw: Regarding the glide torpedos. Do you have a glide bomb and glide torpedo project both going?

Carroll: Yes, they are two different things. For one of them we want to use the standard torpedo like the British did and put wings on it. On the glide bomb we were going to put some other experimental equipment in it. We may eventually wind up with the same stuff in the torpedo, but the torpedo could be used without it.

Chidlaw: What kind of a ship do you visualize this torpedo might go on?

Carroll: I think we could mount it on a B-25 or -26 or some ship like that.

Chidlaw: The British used an old slow biplane.

Carroll: We can probably fix up an airplane.

Chidlaw: We will stall off until your report on the project gets in - probably today or tomorrow by mail. As to this man Nyman, when are you going to submit the papers?

Carroll: They should be in there now.

Chidlaw: What are you going to call that Unit, Frank?

Carroll: I haven't named it, but we can call it the Aerial Torpedo and Bombing Unit. In all of this we are always cramped on account of having to go through the Signal Corps for anything that has a radio tube in it. What we were planning to try to get done was to get some Signal personnel assigned to this Unit so that any time we wanted a radio tube we didn't have to go through the Chief Signal Officer.

Chidlaw: Are there radio controls on that torpedo?

Carroll: Yes.

Chidlaw: It is not a free glide?

Carroll: No, eventually it will have radio controls.

Chidlaw: How about television?

Carroll: No, but that is part of the scheme on the dirigible bomb. It is all tied in with the Signal Corps and it takes forever to get anything done. If we could get some scheme worked out where we could do some experimentation in this Unit with radio equipment, we could go three or four times as fast. Suppose I send you in a proposed organization and functions for a Unit like this?

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Chidlaw-Carroll Telephone Conversation - March 7, 1941.

Chidlaw: Alright, when can we have that?

Carroll: Some time next week.

Chidlaw: Alright. I think we have enough to hold them off until we get squared away; at least we will let them know we are going asleep on the thing.

Carroll: Nobody thinks we do anything unless we get a high powered professor out here. As usual we have to educate them and bring them up to date where we are.

Chidlaw: Arnold remarked to Echols that if we were not moving fast enough hire in an eight to ten thousand dollar a year man and get some action. That was the gist of General Arnold's remarks.

Carroll: That is alright to get people in in an advisory capacity, but we can't get somebody who is willing to come.

Chidlaw: I understand; I am working with four of them on this N.D.R.C. If there is anything further I will send you a teletype. I hate to bother you with calls like this, Frank.

Carroll: That is perfectly alright, Benny; is that all?

Chidlaw: Yes. Thanks.

F. O. CARROLL,
Lt. Colonel, A. C.,
Chief, Experimental
Engineering Section.

cc: Equipment Lab.

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CH-P11 -- HYDROBOMB
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NAVY DEPARTMENT
BUREAU OF AERONAUTICS
WASHINGTON

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CONFIDENTIAL

APRIL 18 1941

Report of Informal Conference
to discuss
"Development of Gliding Bombs".

Reference:
(a) C. N. O. letter serial 038912 of 9 April, 1941.

1. Reference (a) states that the Joint Air Advisory Committee has recommended "that the War and Navy Departments initiate immediately a joint project to develop and determine the effectiveness of gliding bombs for the use of both services and make available for this project the personnel and material needed". Reference (a) further states, "It is requested that the Bureau confer with the appropriate agencies in the War Department and initiate the project as recommended. It is desired that the Navy Department cooperate thoroughly with the War Department in this development".

2. In accordance with the foregoing, an informal conference was held on 16 April, 1941. Those present were

U. S. Army.

Col. Gardiner (U.S. Army Air Corps).
Col. Coupland (U.S. Army Ordnance Corps).

Major Chidlaw (U. S. Army Air Corps).
Major Fink (U.S. Army Air Corps).
Wright Field

U. S. Navy.

Comdr. Schaffel (Bureau of Ordnance)
Comdr. L. C. Stevens (Bureau of Aeronautics)
Comdr. D. S. Fahrney (Bureau of Aeronautics).

3. It was agreed that the context of reference (a) implied that the action desired was primarily concerned with certain special bombs or torpedoes so designed that they could be carried by conventional aircraft. Discussion was limited

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CONFIDENTIAL Report of Informal Conference to Discuss Development of Gliding Bombs.

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4. It was apparent that much confusion can be avoided by agreement to certain nomenclature. It was agreed that the following terms should be utilized in the future by both the Army and the Navy.

(a) Torpedo - This term should only be applied to a weapon carried by aircraft or surface vessels which weapon is intended to travel horizontally under water to effect its final contact with its target. (This restriction in usage is intended to eliminate the phrase "aerial torpedo" as applied to many proposals which are not intended to be employed in a manner similar to marine torpedoes.)

(b) Bombs - This term should be utilized for all other explosive weapons dropped from aircraft, intended to be controllable in flight beyond the usual gravity or parachute borne types.

These two major classifications should each be further divided into two other classes.

(a) Gliding, (Depending on gravity for descent).

(b) Power driven, (in addition to gravity).

5. In the conference it was determined that the following development work was underway.

U. S. Army Air Corps

(a) Gliding bomb with radio control and television direction. (This development is intended to be applicable to both bombs and torpedoes with no alteration of standard Ordnance weapons.
(b) Power-driven bomb.

U. S. Navy

(a) Gliding torpedo. (Gravity type with no remote control, under development by the Bureau of Ordnance).

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CTI-811--HYDRO BOMB
AS, JEB-27--(Y3PP)

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~~CONFIDENTIAL~~ Report of Informal Conference to Discuss "Development of Gliding Bombs".

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6. It was recognized by the conference that the Army has primary cognizance over the bombs and that the Navy has primary cognizance over the torpedoes.

7. It was agreed that the Army should continue its developments on the gliding bomb and that the Navy should test the equipment developed for use on torpedoes. It was further agreed that the Navy should continue its development of the gliding torpedo and adopt the Army glide equipment completely if proven superior or such parts of the control equipment as may be adaptable.

8. It was recommended that the following items be carried out:

(a) Tests reports be made to both services.

(b) Close liaison maintained between the two services on all projects.

9. The foregoing division of responsibility for development and test, coupled with miantaining close liaison between the two services, appears to carry out the intent of reference (a).

Copy to:
Col. Gardner, A.C.
Col. Coupland, A.C.
Maj. Chidlaw, A.C.
Maj. Fink, A.C. Wright Field
Cdr. Schoeffel, Bu.Ord.
Cdr. L. C. Stevens, Bu.Aer.
C. S. O.

NOTE: Kindly return this copy with appropriate comments to Comdr. D. S. Fahrney, Bureau of Aeronautics. After getting all comments the final draft will be made.

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June 5, 1941

Chief, Materiel Division, OCAC, Washington, D. C.

Request for Torpedo, Aircraft, Mark VIII, Mod. 1, With Exercise Head, from the Navy Department.

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1. Reference is made to a letter dated April 18, 1941 from the Navy Department, Bureau of Aeronautics, Washington, D. C., Subject: Report of Informal Conference to Discuss Development of Gliding Bombs; teletype EX-245 dated April 30, 1941; teletype EXP-T-890, dated May 1, 1941 and Inter-Office Memorandum to the Chief, Materiel Division, OCAC, Washington, D. C., from the Chief, Experimental Engineering Section, dated May 21, 1941, Subject: Nomenclature of Controllable Bombs, Glide Torpedoes, etc.

2. Paragraph 7 of the letter from the Navy Department, Bureau of Aeronautics, mentioned above, states as follows: "It was agreed that the Army should continue its developments on the gliding bomb and that the Navy should test the equipment developed for use on torpedoes. It was further agreed that the Navy should continue its development of the gliding torpedo and adopt the Army glide equipment completely if proven superior or such parts of the control equipment as may be adaptable."

3. This office has proceeded with the procurement of wing structures to which will be attached a 2000 pound standard bomb. Three different designs are being procured from three different manufacturers. These wing structures will be fitted with the necessary control surfaces, gyro stabilizing equipment and servo control mechanisms. It is planned, by a simple modification of the attaching mechanism, that a standard Naval torpedo may be substituted for the 2000 pound bomb.

4. This development has now reached the stage at which it is necessary that this office be supplied with a Naval type torpedo in order

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Signature and Grade

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June 5, 1941

Chief, Materiel Division, OCAC, Washington, D. C.

Request for Torpedo, Aircraft, Mark VIII, Mod. 1, With Exercise Head, from the Navy Department.

that suitable attaching mechanisms may be designed and necessary static and dynamic balance of the whole structure may be obtained. In compliance with the recommendations contained in the letter from the Navy Department, Bureau of Aeronautics and teletype EXP-T-890, mentioned above, this equipment will be submitted to the Navy Department for all tests at their torpedo testing station. This is believed advisable due to the large amount of equipment necessary for such tests, and it is understood the Navy Department now has this equipment available and in operation.

5. It is therefore requested the Navy Department be asked to furnish this office with one torpedo, aircraft, Mark VIII, Mod. 1, with exercise head at as early a date as practicable in order that this project may not be delayed.

JUN 10 1941

F. O. CARROLL,
Lt. Colonel, A. C.,
Chief, Experimental
Engineering Section.

Major, Air Corps,
Asst. Technical Executive

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Wright Field, Dayton, Ohio.
March 24, 1941.

Chief, Materiel Division, O.C.A.C., Washington, D. C.

Gliding Torpedoes and Bombs for use from Aircraft.

1. In compliance with the instructions contained in paragraph 2 of your Inter-Office Memorandum dated March 3, 1941 on the above subject (copy attached), there is given below a brief list of the projects now under way regarding gliding torpedoes and bombs for aircraft use.

a. With reference to paragraph 2 of the basic inter-office memorandum, the projects promising positive results in the near future are as follows:

(1) Aircraft and aircraft torpedoes, (CTI-147), utilizing Navy equipment, and a study towards adapting present Air Corps airplanes to torpedo bombing.

(2) Ten (10) aerial torpedoes, type A-1, have been purchased from the Research Laboratory Division of the General Motors Corporation. These torpedoes will carry approximately 500 lbs. of explosive, will be powered with a 175 H.P. engine, will have a speed of approximately 200 miles per hour, and will be launched from the ground. It is indicated that these aerial torpedoes will be capable of striking a target, consisting of a circle one-half mile in diameter, at ranges up to 50 miles. These torpedoes contain no radio control by which they may be changed in course or range after launching, and require that necessary data be set in prior to launching.

(3) After a careful study of the data supplied by, and several conferences with Wing Commander James D. Bruce of the Royal Air Force during his recent visit to this country, a tentative design has been arrived at for a glider structure to which could be shackled either a 2000 lb. aerial bomb or a standard Navy type water borne torpedo. This bomb carrying glider will have control surfaces by which its flight may be changed in pitch and yaw. Stabilizing equipment will be provided in the structure for the prevention of roll. Two aircraft companies, namely, the Vega Airplane Company and Fleetwings, Inc., have been approached regarding this design, with a view to procurement of twenty (20) of these bomb or torpedo carrying gliders from each of these companies.

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CENTRAL FILES MDAC-190-WF-11-8-40-200M

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Wright Field, Dayton, Ohio.
March 24, 1941.

Chief, Materiel Division, O.C.A.C., Washington, D. C.

Gliding Torpedoes and Bombs for use from Aircraft.

(4) The development of radio control equipment required for the above described bomb or torpedo carrying glider has already been accomplished in the development of the small type aerial target. This equipment was shown to Wing Commander Bruce and detailed information has been forwarded to the British Air Commission through prescribed channels.

(5) Several laboratory and flight tests have been conducted by this office on a small and compact television equipment, manufactured by the Hazeltine Service Corporation. It is intended that this equipment will be placed in the bomb carrying glider. This will permit the controlling bombardier to have presented to him the same picture that he would see if he were actually in the nose of the bomb. It is possible that this will allow the bombardier to know the changes in range and deflection required to cause the bomb to strike its target. This particular television equipment is being sponsored by Section D3 of the National Defense Research Committee, and funds have been allocated by this Committee to the Hazeltine Service Corporation to accelerate development of the equipment.

(6) Section D3 of the National Defense Research Committee has undertaken a series of experiments by which information may be obtained regarding the characteristics of a free falling bomb during its whole trajectory. This Committee is obtaining several bomb casings in which it is intended placing a suitably protected movie camera. This will record all that is "seen" from the nose of the bomb during its fall. It is expected that information regarding tumbling and roll may be obtained in this manner. This project is considered fairly well advanced.

(7) There has been proposed by the Radio Corporation of America, Camden, New Jersey, a dirigible bomb which is considered similar to the glide bomb now in use by the British, except that the R.C.A. bomb is to be equipped with remote radio controlling equipment and a television transmitter in its nose. At the present time the National Defense Research Committee is sponsoring the aerodynamic phase of this development. Tests of the television components are to be conducted by this office in

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Wright Field, Dayton, Ohio.
March 24, 1941.

Chief, Materiel Division, O.C.A.C., Washington, D. C.

Gliding Torpedoes and Bombs for use from Aircraft.

the immediate future. Predicated on the success of the above tests, funds have been allocated to the Aircraft Radio Laboratory for the purchase of a number of sets of the television equipment to be used in this bomb.

b. The projects promising positive results in the next few years are given below:

(1) A bombsight is now under development by the Bell Telephone Laboratories, in conjunction with the Western Electric Company, by which bombing might be accomplished through an overcast. It is believed that this item will be of great importance for the dropping of controlled bombs during inclement weather.

(2) A heat, or infra red detection and directive device is now under development at the Research Laboratories of the General Motors Corporation. A considerable amount of success has been obtained with the experimental articles, and it is indicated that this development may culminate in a useable article in the near future.

(3) A working model of a sound detection and directive equipment has been built by the Pioneer Instrument Division of the Bendix Aviation Corporation. A demonstration is to be witnessed, and tests made of this equipment, in the immediate future.

(4) A directive equipment, in which light differentiation is used, is under development by the Fairchild Aviation Corporation. This company has promised that a working model will be presented to this office during the next thirty days. This equipment, as well as those mentioned in the two preceding paragraphs, may be installed in the bomb or torpedo carrying glider, and be directly connected to the control surfaces. In this manner, the bomb or torpedo carrying glider may be made to actually seek the source of energy, which is being detected, after the glider has been dropped from the carrying aircraft.

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Wright Field, Dayton, Ohio.
March 24, 1941.

Chief, Materiel Division, O.C.A.C., Washington, D. C.

Gliding Torpedoes and Bombs for use from Aircraft.

c. Projects of a research nature, the results of which cannot be forecast.

(1) Studies and investigations are being carried on contiguously, pertaining to equipments which will cause a controllable bomb or torpedo to seek its target.

(2) Study of a controlled aerial torpedo, launched from the air, has been initiated. This torpedo will be powered with a suitable power plant, dropped from a carrying aircraft, and then controlled toward either an aerial or ground target. This torpedo may be of the purely radio controlled type, the television equipped type, or the target seeking type.

MAR 26 1941

P. G. CARROLL,
Lt. Colonel, A. C.,
Chief, Experimental
Engineering Section.

1 Incl.
Inter-Office Memo,
3-3-41 (copy).

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GEORGE C. KENNEY,
Brig. General, U. S. A.
Ass't Chief, Materiel Division

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

CLP:ms:54:5815

MEMORANDUM REPORT ON

Date September 27, 1941

SUBJECT: Radio Controlled Glide Bomb.

SECTION Experimental Engineering

SERIAL No. EXP-M-54-673-41

Contract No.
Expenditure Order No. 673-1-12
Purchase Order No. 41-11734

A. Purpose.

To report on a visit to Timm Aircraft Corporation to approve the first article of controllable bomb being constructed under purchase order 41-11734.

B. Factual Data.

1. The first article of the controllable bomb was completed and hung by a hoist to the ceiling of the building. The rudder and the elevator were connected to the control and the operation of this equipment was checked. In general this article looked satisfactory.

2. A wind tunnel model had been constructed and tested by Prof. Merrill at the Pasadena Jr. College. The aerodynamic analysis of the structure, the results of the wind tunnel test and a complete set of drawings were delivered to Wright Field by the writer. Tentative approval of the first article was given.

3. Since aerodynamic engineers from the Vega Airplane Company have checked the calculations it was not considered necessary to static test the first article.

4. It was tentatively agreed that the first article should be shipped to Wright Field.

5. It was tentatively agreed that the static test could be conducted on any one of the subsequent articles, the article to be used to be determined by Timm engineers who are to build the static test rig.

6. It was tentatively agreed that vertical load only, on wing and tail, would be required.

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Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-4B
September 27, 1941

7. The Timm Aircraft Corporation have provided a tripping mechanism which will permit the wing to be released from the bomb. To date no provision has been made for the paravane development. The mechanism for controlling the rudder and elevator is mounted in the stabilizer. This arrangement was tentatively approved but has a slight disadvantage. It may be necessary to replace the McGuire pilot equipment used on the first article with equipment which may be considerably heavier in weight. Addition of weight in the stabilizer will be difficult to overcome in obtaining proper aerodynamic balance.

8. The Timm engineers were asked to place a mark to indicate the proper point for aerodynamic balance of the entire assembly (24% back of the leading edge of the wing).

9. All of the controls are mounted on ball bearing hinges. This point was discussed to great length with the Timm engineers. They were told that the selection of the bearing was their responsibility and that satisfactory operation might be obtained with plain bearings. It is the opinion that ball bearings will not stand long periods of storage as well as plain bearings.

10. The first article is complete and should be shipped to Wright Field. A wind tunnel model which has been constructed at Timm's expense should be shipped to Wright Field to check the wind tunnel results obtained at Pasadena Jr. College.

11. The Timm Aircraft Corporation needs more McGuire pilot assemblies, electric servo units and venture tubes.

12. The present article of the McGuire pilot control is attached to the rudder but provision has been made for attaching this equipment to the ailerons - that is, all mounting bolt holes and linkage are provided.

13. The Timm engineers were asked to stencil the word "Timm" and a serial number on the side of the boom of each article. The lettering to be not more than 1/2" high. This identification will be necessary in reporting results of the tests.

14. The completed articles are to be packed in two boxes, one for the wings and empennage and the other for the boom.

15. Personnel present were:

<u>Timm Aircraft Corporation</u>	Air Corps <u>Materiel Division</u>
Mr. O. W. Timm	Mr. C. L. Paulus
Mr. R. J. Wigg	
Mr. Geo. Michky	<u>Inspector</u>

[redacted]r. Geo. Comstock.

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Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-4B
September 27, 1941

C. Conclusions.

1. That the development of a paravane to be used with the controllable bomb should be started immediately.

2. That instructions be forwarded to Timm Aircraft Corporation regarding the painting (color, etc.).

3. That shipping instructions should be forwarded to Timm Aircraft Corporation.

4. That all government furnished equipment now available should be forwarded to Timm Aircrafc Corporation.

5. That final approval of the first article be forwarded to Timm Aircraft Corporation as soon as results of the wind tunnel results obtained at the Pasadena Jr. College can be accomplished.

6. That if any delay is caused by the lack of government furnished equipment, the shipment of the bombs should be allowed minus the government furnished equipment.

D. Recommendations.

1. That the development of a paravane to be used with the controllable bomb be started immediately.

2. That instructions be forwarded to Timm Aircraft Corporation regarding the painting (color, etc.).

3. That shipping instructions be forwarded to Timm Aircraft Corporation. In this connection it is suggested that telegraphic instructions covering the shipment of the first article to Wright Field be forwarded to the Western District Supervisor.

4. That all government furnished equipment now available should be forwarded to Timm Aircraft Corporation.

5. That final approval of the first article be forwarded as soon as a recheck of the wind tunnel results obtained at the Pasadena Jr. College can be made.

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Experimental Engineering Section
Memorandum Report No. EXP-M-51-673-4B
September 27, 1941

6. That if any delay is caused by the lack of government furnished equipment, shipment of the bombs should be allowed minus the government furnished equipment.

Prepared by CHARLES L. [illegible]
(Name)

Approved by RANDOLPH P. WILLIAMS, Lt.Col.A.C.
Chief, Equipment Laboratory

Concurrence:

Approved by F. O. CARROLL, Lt. Colonel, A.C.
Chief, Exp. Engrg. Section.

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Equipment Lab.

Exp. Sec

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TECHNICAL EXECUTIVE PLEASE REMOVE FROM TELETYPE RECORDS

THE ADJUTANT GENERAL IN 1ST INDORSEMENT DATED MAY 17, 1941, APPROVED THE MILITARY CHARACTERISTICS FOR A GLIDING BOMB, RADIO-CONTROLLED, SUBMITTED BY EXPERIMENTAL ENGINEERING WITH INTEROFFICE MEMORANDUM DATED MARCH 3, 1941. THIS PROJECT IS ASSIGNED TO THE AIR CORPS AND THE SIGNAL CORPS AND ORDNANCE HAVE BEEN DIRECTED TO COLLABORATE WITH THE AIR CORPS. COPY FOLLOWS.

EXECUTIVE

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November 17, 1941.

Subject : Testing of Special Weapons at Muroc Dry Lake.

To : The Assistant Chief of the Materiel Division,
Wright Field, Dayton, Ohio.
Attention: Chief, Experimental Engineering Section.

1. The followingt ests have been made as of this date:

a. Three flights of the N.D.R.C. - R.C.A. controllable glide bomb, on November 7th, 10th, and 11th, 1941.

b. Three flights of Aeronca controllable glide bombs on November 12th and 13th, 1941.

c. One flight of the General Motors Corporation power driven controllable bomb on November 15th, 1941.

2. a. All flights of the N.D.R.C. - R.C.A. controllable glide bombs resulted in spins. The parachute device saved one of the two bombs for a second release. On this occasion the parachute did not save the equipment.

b. Photographic and other records were made of the flights. It is understood that personnel of the N.D.R.C. and the R.C.A. propose study of the records and aerodynamic redesign of the structure. No action is indicated by the Materiel Division at this time since the development is an N.D.R.C. project.

3. a. For the first flight of the Aeronca controllable glide bomb, gyro stabilization equipment for roll only was installed, and the elevators were locked. The flight was intended to secure aerodynamic data. The bomb was highly unstable, for either aerodynamic or meshanical reasons, and appeared to spin. Duration of the flight was twenty-six seconds. The altitude of release of all the Aeronca bombs was 7000 feet over the surface.

b. To more definitely ascertain the cause of improper flight, gyro stabilizing equipments were removed and the second bomb dropped as a pure glider with all surfaces locked. Modifications had been made in both the fixed and movable horizontal surface

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settings. The bomb weight was reduced to 1000 pounds in lieu of 2140 pounds. This bomb glided poorly in a steep spiral path. The flight duration was 29 seconds.

c. A third release with a bomb identical with the second except for additional modification of the elevator surface setting, resulted in somewhat improved flight. Duration of this flight was thirty-five seconds.

d. Releases will be continued with the remaining Aeronca bombs, with a view of achieving stabilized controllable flight.

4. The general Motors Corporation power driven bomb achieved a speed of ninety-seven miles per hour on the take off track and lifted off the carrying truck, but after a flight of about 200 feet settled to a crash. The cause is unknown at this time. Motion picture film of the flight has been sent to Lowry Field, Denver, Colorado for development. This film will be studied here upon its return. It is expected that the next General Motors Corporation bomb will be ready for test within two weeks.

Randolph P. Williams,
Lieut. Colonel, Air Corps.

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

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MEMORANDUM REPORT ON

Date December 13, 1941.

SUBJECT: Controllable Bomb Projects

SECTION Experimental Engineering

Contract No.
Expenditure Order No. 673-1-12
Purchase Order No.

SERIAL No. EXP-M-54-673-4P

A. PURPOSE:

1. To report on the status of the controllable bomb projects.

B. FACTUAL DATA:

1. During November and December 1941 tests were conducted at Muroc Bombing Range, Muroc, Calif. of several types of controllable bombs.

a. Power Driven Controllable Bomb -

(1) Type A-4 targets (converted BT-2BI airplanes) were taken off, flown and landed without any one aboard. This flying was accomplished despite the fact that the target aircraft involved were freighted to the test station, assembled and flown without previous air check.

(2) Weather service balloons inflated with helium were moored by twine at roughly 1,000 feet of altitude and destroyed by dive bombing tactics in which the assault airplane was controlled from another airplane in close formation. Close formation tactics, although unsuitable for actual combat dive bombing with control bombs, were necessary in this case since the controlling airplane was biplace in tandem. Proper control airplanes will provide unobstructive vision forward.

b. Research Laboratories Division of General Motors Corp. power driven bomb -

(1) Four bombs developed by the Research Laboratories Division of the General Motors Corp. were launched.

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Experimental Engineering Section
Memorandum Report EXP-M-54-673-4F
December 13, 1941.

This item is in effect a small airplane powered by a 200 horse power engine. The combination being throughout designed for rapid production. The airplane or bomb can be launched from a truck operated on a metal track as was the case at Muroc Bombing Range, or presumably from the top of a rapidly moving automobile. Originally this controllable bomb was designed to fly up to 50 miles utilizing the gyro magnetic stabilization in azimuth depending on inherent aerodynamic lateral stability and with an air log for range determination. An altitude control was also provided. The bomb carries 500 pounds of explosive and can be flown 400 miles in still air at 175 miles per hour. When so utilized bombing accuracy would require an accompanying control airplane controlling the bomb by radio. (During the recent testing both radio controll and the preset data equipment described above were installed for optional use.)

(2) The first test was unsuccessful due to readily remedied mechanical difficulties and to small aerodynamic maladjustments.

(3) A second bomb was successfully launched and radio controlled for a period of 1-1/2 minutes but failed when the bomb was turned over to the preset data control equipment.

(4) A third bomb was successfully launched, flown by radio for fifteen minutes in various test maneuvers and was then turned over to the preset data radio control which failed to operate and caused a crash before the bomb could be recovered by radio control.

(5) The fourth bomb was successfully launched and flown for a period of one hour and thirty six minutes. On several occasions during the flight unsuccessful attempts were made to control the bomb by the use of the preset control equipment. In each case it was necessary to recover stabilized flight by radio control equipment. At the end of the hour and thirty six minutes a landing was made on the Lake floor under radio control. This landing of necessity was of the nature of a crash since the equipment carried no landing gear.

(6) Six more bombs have been fabricated and will be available for subsequent tests as soon as the necessary design revisions are completed to provide satisfactory operation of the preset data control equipment.

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c. Controllable Bombs, Glide -

(1) A total of twelve controllable glide bombs were dropped during the test period. These bombs were equipped with wings produced by the Aeronca Aircraft Corp. and controlled by various combinations of one or two axes gyro stabilization and in some instances by radio as well.

After a few initial difficulties, seven successful flights were made culminating in the last test in which a 2000 lb. bomb over loaded to 2200 lbs. was successfully launched at 6300 feet above the ground surface, flew approximately six and one-half miles under radio control and demonstrated promising accuracy in range. The directional control was not perfected in this bomb due to the rate of movement of the control units. This discrepancy is immediately remediable. The bomb demonstrated its ability from the normal gliding path to flatten its glide under radio control or to be plunged almost vertically to the ground from any desired point.

d. Performance of Controllable Bombs -

(1) Power Driven Controllable Bombs may be of an infinite variety of aircraft types loaded to rated capacity with standard high explosive bombs and capable of a range peculiar to the aircraft and loading utilized. Thus, obsolete aircraft may be under radio control operated in a manner similar to the "suicidal" type bomber without the suicidal hazard. Also special new and experimental aircraft types may be designed for maximum aerodynamic and performance efficiency around one or more standard high explosive bomb.

(2) The Research Laboratories Division power driven controllable bomb carries up to 500 pounds of explosive and has an estimated accurate range of 50 miles when controlled entirely by the preset data equipment and up to 400 miles when radio controlled by an accompanying control airplane.

(3) Glide bombs have been flown loaded up to 2200 pounds exclusive of wing and control structure. This type of controllable bomb has been carried underneath the fuselage and between the motor nacelles of a type B-23 bombardment airplane. The range and

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speed of the carrying airplane is somewhat reduced. Under wing locations for controllable glide bombs have not been tested to date.

2. Facilities needed for tactical operations with controllable bombs:

a. The tactical operations of controllable bombs require the acquisition in production quantities of control equipment which is now in the experimental or service test stage. Among the items needed are gyros, servos, radio control, television transmitters and receivers. The Research Laboratories Division of the General Motors Corp. bomb when operated in competition with long range cannon requires no radio or television equipment but utilizes in lieu thereof preset azimuth range and altitude controls. When operated at longer ranges under radio control the General Motors Corp. bomb requires equipment similar to any other power driven controllable bomb. It requires further launching equipment in the form of a track or launching automobile. The normal ground launched power driven controllable bomb will take-off on a suitable airdrome utilizing its own undercarriage.

Glide bombs require modification of the carrying bombardment airplane consisting of the installation of special racks and buffers. to insure rigidity of the bomb in flight.

b. All controllable bomb operations exclusive of the General Motors Corp. preset data type require a control airplane and control pilot per controllable bomb during control flight. However, a successfully designed wing installation would permit two glide bombs to be carried to the assault position at the same time.

In all cases of controllable bomb operations Operating Squadrons will be required. These Squadrons must be equipped with carrying or control aircraft in each case except that of the short range operation of the General Motors Corp. bomb.

Mr. Charles F. Kettering of the Research Laboratories Division of the General Motors Corp. stated that a period of seven months would be required for mass production tooling for the building of the controllable bomb of his organization.

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C. CONCLUSIONS:

1. The testing of the controllable bombs to date has indicated the practicability of utilizing this equipment for precision bombardment attack.

2. Controllable Bombs, General Motors Research Laboratories type.

a. The tests of this equipment were successful while the bomb was radio controlled. Some design improvements should be made in the control mechanisms to provide greater ease of control. As now designed, however, the bomb can be used to transport approximately five hundred (500) pounds of offensive load several hundred miles. The adaption of television equipment to this bomb should make it an effective weapon up to the limit of its range and bomb capacity.

b. The tests of the bomb using preset data controls were unsuccessful. Design improvements are necessary before the bomb can be operable without radio as the short range (up to fifty miles) weapon for which it was designed. Modifications of the preset data equipment are now in process of development at the General Motors Research Laboratories. Tests of these modified designs can be anticipated in the near future.

c. Mass production of this bomb would require a period of seven (7) months for tooling of the engine production facilities.

d. The tactical use of the Research Laboratories Division bomb as a preset controllable bomb in lieu of long range artillery requires an organization trained in its maintenance and operation, launching equipment, truck or other delivery trains for transportation of the bombs themselves to the point of launching, weather personnel or other sources of accurate wind aloft data, and the usual ordnance, communications and other servicing details.

3. Power Driven Controllable Bomb.

a. The testing of the type A-4 radio controlled target as a power driven controllable bomb indicates the feasibility of using this equipment as an effective assault weapon. Although the testing is incomplete at this time in that television equipment was not installed, and the distances between the control airplane and the assault bomb were too small for safety in actual attack, previous experience with television equipment and with control airplanes

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that permitted adequate forward vision strengthens the belief that a properly designed power driven bomb and control equipment will greatly increase bombing accuracy.

b. Power driven controllable bombs can be produced utilizing the carrying capacity of already constructed aircraft, possibly obsolete, through the installation of equipment for gyro stabilization and radio control.

c. The potentialities of effective bombing utilizing efficiently designed power driven bombs of large explosive carrying capacity warrants the design of a special weapon for this purpose. For maximum effectiveness this new bomb design should be made in close cooperation with representatives of the using tactical organizations. The tactical use of power driven controllable bombs, ground launched from normal airdromes on their own landing gear will require operating squadrons containing highly trained bombardier personnel capable of accurately controlling by radio the assault bombs and trained maintenance personnel for the control mechanism.

4. Glide Bombs.

a. Controllable glide bombs have been developed and experimentally tested carrying 2200 pounds of bomb load. The wing structure of these bombs can be rapidly produced in quantity.

b. A tooling period will be necessary for the mass production of control mechanisms. Normally either the standard 1,000 or 2,000 pound high explosive bomb would be used in this equipment.

c. The type B-23 bombardment airplane has satisfactorily carried the controllable glide bomb at speeds around 200 miles per hour utilizing a specially designed carrying mechanism for suspending the bomb below the fuselage and between the motor nacelles. Larger bombardment aircraft should be capable of carrying two such bombs from wing suspension points but a single radio control transmitter cannot be expected to control in flight simultaneously more than one bomb.

d. Television Equipment in experimental quantities have been delivered for these bombs but not tested therein to date. Such tests should take place during January 1942.

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5. Due to the use of Muroc Bombing Range by other Activities, Eglin Field, Fla. should offer a more satisfactory proving ground for future development.

6. The recent testing at Muroc Bombing Range has provided sufficient information to permit proper design of wing structures and flight control mechanisms. However, since the B-23 airplane is not in quantity production and no experience has been secured relative to carrying these glide bombs under production type aircraft, further testing utilizing production aircraft is indicated prior to securing a large service test quantity of these controllable glide bombs. This testing is dependent on the availability of a B-17 or B-24 type airplane for such use.

7. An adequate number of qualified radio control pilots exist in the Air Corps to support a major use of this weapon. Probably not to exceed twenty so qualified pilots are currently available.

8. Radio control piloting personnel for control of glide bombs can be somewhat more rapidly trained than radio control pilots for power driven bombs, since the operation of take-off is absent in the glide bombs.

9. Before any controllable bomb production is initiated, a conference of interested personnel from appropriate staffs and using organizations should be held to determine design characteristics required and the organization of adequate training and supply facilities.

D. RECOMMENDATIONS:

1. That a conference of Officers be held at Wright Field at earliest convenience to discuss the following:

a. The performance requirements of controllable bombs best suited for tactical use.

b. The allocation of bombardment aircraft for use with controllable bomb activities.

c. The allocation of obsolete aircraft for conversion to controllable bombs.

d. The personnel training program requisite to the large scale employment of controllable bombs.

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Experimental Engineering Section
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December 13, 1941.

2. That the conferees comprise representatives of the War Department General Staff, the Air Staff, the Air Force Combat Command, the Training and Operation Division, OCAC, and the Materiel Division.

3. That the conference be held December 22, 1941.

Prepared by RANDOLPH P. WILLIAMS,
(Name) Lt.Colonel, A. C.

Approved by F. O. CARROLL, Lt. Colonel, A.C.
Chief, Exp. Engrg. Section

Concurrence:

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Approved by ....

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Glide Bombs

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1. The glide bomb test at Muroc has been completed. Results indicate that we might profitably put glide bombs and Kettering bombs to immediate limited use. The possibility of using obsolete airplanes as radio controlled crash bombs is also suggested. The attached notes prepared by Lieutenant Colonel Williams, Chief of the Equipment Laboratory, are attached for your information.

O. P. E.
Chief, Mat. Div.

Incl.
1-Notes, Controllable Bomb
Project Status, Summary.

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CONTROLLABLE BOMB PROJECT STATUS

SUMMARY

1. Controllable bombs have been developed to the point where they offer at least some tactical utility. Within thirty to forty-five days, about a dozen obsolete BT-2B aircraft could be made ready for carrying 500 pound bombs as far as 300 miles to sea for crash attacks. This measure is not recommended, unless it is believed to be an immediate urgent necessity, because the equipment is old and unreliable and to put it into commission would require a lot of engineering time that would have to be drawn from other promising developments.

2. Any combat airplane can be converted to a radio controlled assault bomb in six months. Control airplanes and trained operating personnel are non-existent and must be concurrently provided.

3. Some glide bombs can be produced within four months with radio and television control for daylight operation in fair weather. These bombs use standard 2000 pound cases. Television is not proven beyond question, but shows sufficient promise to warrant go-ahead.

4. The Kettering bombs should be modified by addition of gyro stabilization, so that they can be radio controlled, but this should not take long.

5. It is recommended that plans be drawn to:

   a. Produce 1000 glide bombs equipped with radio and television control.

   b. Organize as many glide bomb squadrons as can be equipped with B-23 airplanes for station at locations such as Los Angeles, San Francisco and Seattle for emergency use.

   c. Release all B-23 aircraft for conversion as controllable bomb carriers at earliest feasible time.

   d. Start school at Biggs Field for radio control pilots and controllable bomb mechanics. School to start as soon as equipment can be secured (Approximately February 1st).

   e. Initiate study of the possibility of modifying a limited number of B-17 type airplanes as carriers whenever such airplanes can be made available.

   f. Make available as soon as possible one B-17E airplane for trial installation of glide bombs.

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Controllable Bomb Project Status - Summary

5. Continued.

g. Detail ten graduates of Scott Field radio course to Wright Field for instruction in bomb radio and television equipment:

(1) These men to form a nucleus of trained personnel at Biggs Field.

h. Request the Signal Corps to extend development of micro wave equipment for use in operation of glide bombs at night and in bad weather.

i. Divert ten C-45 airplanes for immediate conversion to radio control airplanes to be used at Biggs Field, Wright Field and Eglin Field. Tentatively divert twenty additional C-45 airplanes for subsequent conversion on call in connection with target flights and with which to equip controllable bomb squadrons.

j. Tool up immediately for production of Kettering bombs.

R. P. WILLIAMS
Lt. Col., Air Corps
Chief, Armament Laboratory
Experimental Engineering Sec.
Wright Field

December 17, 1941

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NOTES ON CONTROLLABLE BOMB PROJECT STATUS

December 17, 1941

1. The controllable bomb program divides into three classifications:

   a. Power driven bombs.
   b. Glide Bombs.
   c. Gliders carrying bombs.

2. From the time element point of view, there are three phases of development:

   a. Emergency devices capable of use within thirty to forty-five days.
   b. Procurement for delivery in four to six months.
   c. Future developments.

3. For immediate emergency use, a few BT-2BI airplanes - obsolete and unreliable - exist. These could be made operable within thirty to forty-five days carrying 300 pound bombs with BT control airplanes for ranges up to 300 miles at sea. Pursuit protection is essential and operation unreliable at best. The development should not be conducted unless required in emergency national defense, as it will require personnel needed for more profitable developments.

4. Glide bombs offer the greatest promise of utility in the next six months, classed in Paragraph 2b above.

   a. Glide bombs - standard 2000 pound size - have been flown under radio and gyro control successfully. Extreme accuracy and the exact method of aircraft control best suited to tactical operation have not been proven since television has not been installed. Experience indicates that within four months the equipment for three 9-ship squadrons can be put into operation. If these aircraft are desired, B-23 airplanes must be made available at once and crews and organizations must be allotted for training, commencing February 1st.

5. For power driven bombs deliverable in four to six months, almost any service type bomber will suffice. If made available to Wright Field, controls will be installed.

6. Considering power driven bombs, three are for future development:

   a. The GMC bomb recently tested at Muroc Lake, designed originally for one-half mile accuracy at 50 mile range carrying 500 pound explosive. This device is not produceable in mass production for at least six to seven months and needs some engineering revision prior to final approval. If desired for the above purpose, tooling should be released. It is still in Class 2c above.

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Notes on Controllable Bomb Project Status 12/17/41

6. Continued:

b. The GMC bomb carrying 500 pounds of explosive can be radio controlled several hundred miles. This device - with some readily effected changes - can be used as a power driven bomb against Naval or fixed objectives provided:

(1) Pilot and mechanic personnel are trained.

(2) Control planes are made available. Aircraft capable of 1000 miles are desired, but C-46 aircraft can be used up to 300 mile range, if pursuit protected.

(3) Organizations are allotted to operate the equipment.

c. Future power driven controllable bomb procurement, for which studies are already initiated at Wright Field, include aircraft to carry one, two and four 2000 pound bombs. These airplanes are being designed for:

35,000 foot ceiling
225 M.P.H. top speed
1,600 mile range

They will have landing gear droppable by radio after take-off and be gyro stabilized and radio and television controlled. If these general characteristics are not satisfactory to the tactical using organizations, Wright Field should be so advised at earliest convenience.

7. Gliders carrying bombs all fall in the category of future development. A 10,000 pound glider is now in process of study at Wright Field.

R. P. WILLIAMS
Lt. Col., Air Corps
Chief, Armament Laboratory
Experimental Engr. Sec.
Wright Field

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

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MEMORANDUM REPORT ON

Date December 20, 1941

SUBJECT: Controllable Bomb Project.

SECTION Experimental Engineering

SERIAL No. EXP-M-54-673-10

Contract No.
Expenditure Order No. 673-1
Purchase Order No.

A. Purpose.

1. To make recommendations for continuation of the controllable bomb program.

B. Factual Data.

1. See Appendix 1.

C. Conclusions.

1. See Appendix 2.

D. Recommendations.

1. That the tactical utility of the short range use of the power driven bomb developed by the Research Laboratories Division of the General Motors Corporation be referred to the Air Staff, with a view to immediate tooling for mass production, if this weapon is desired.

2. That the tactical need for a radio controlled, 500 pound, 400 mile bomb of the type developed by the Research Laboratories Division of the General Motors Corporation be referred to the Air Staff, again with a view to releasing production tooling.

3. That as rapidly as feasible after February 15, 1942, various bombardment type airplanes be made available to the Experimental Engineering Section on call for conversion to pilot model power driven bombs.

4. That all Type B-23 airplanes be made available as soon as feasible for depot conversion to glide bomb carriers. Drawings will be furnished by the Experimental Engineering Section.

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Experimental Engineering Section
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5. That orders be placed for 1000 glide bombs, equipped with gyro stabilization and radio control mechanisms.

6. That a service test quantity of 1000 television transmitters and 100 receivers, RCA type, be negotiated by the Aircraft Radio Laboratory.

7. That three squadrons be selected for the operation of the type B-23 controllable bomb carriers.

8. That these squadrons be stationed at Los Angeles, San Francisco, and Seattle, to aid in guarding vital establishments against air raids.

9. That forty-five Fletcher PQ-11 radio controlled airplane targets be converted to power driven bombs at earliest possible date. These targets could be flown by the Type B-23 aircraft mentioned in Paragraph 7 above.

10. That ten Type C-45 airplanes be allotted to Wright Field at earliest opportunity for conversion to control aircraft for radio controlled airplane targets and bombs, and that twenty additional Type C-45 airplanes be tentatively allocated for subsequent conversion.

11. That five Type A-20C airplanes be allotted to Wright Field for pilot installations of radio controls and 1000 pound controllable bomb racks.

12. That, pending successful pilot installations mentioned in Paragraph 11 above, all available Type A-20C aircraft be diverted to special weapons projects.

13. That studies be conducted to develop power driven bombs capable of carrying one, two, and four 2000 pound bombs, with the following characteristics:

225 m.p.h. high speed
1,500 mile range

14. That gliders capable of carrying one, two, and four 2000 pound bombs be procured equipped with gyro stabilization, radio control, and television for use with bombardment types unsuitable for carrying glide bombs.

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December 20, 1941

15. That ten graduates of the radio course at Scott Field be sent to Wright Field at once for indoctrination in bomb, radio, and television equipment. This group is intended for subsequent use as an operating and instructing nucleus at Biggs Field, Texas.

16. That a school be organized at Biggs Field to train radio control pilots and controllable bomb, radio, and television mechanics, the school to start as soon as equipment can be secured. (Approximately February 1, 1942.)

17. That the Aircraft Laboratory, Experimental Engineering Section, initiate a study to ascertain what changes in construction, if any, will be required to permit two 2000 pound glide bombs to be carried under the wings of the Type B-17E, B-17F, and B-24 airplanes.

18. That as soon as feasible one Type B-17B airplane be made available to the Equipment Laboratory, Experimental Engineering Section, for pilot model installation of two 2000 pound glide bombs under the wings.

19. That the Office of the Chief Signal Officer be requested to expedite the development of suitable radar equipment for use as target seeking controls for controllable bombs in bad weather.

20. That in view of the $4,500,000.00 to be expended in the next six months for special weapons projects and the pressing necessity for additional personnel to speedily engineer same and to rapidly procure valuable weapons for the Service, the sum of $200,000.00 be transferred from the allotment authorized under Project 71-4 Supplemental 1942 Program to Project 72 Fiscal Year 1942.

Randolph P. Williams

Prepared by RANDOLPH P. WILLIAMS, Lt.Col., A.C.
Chief, Equipment Laboratory.

F. O. Carroll

Approved by F. O. CARROLL, Lt. Colonel, A. C.
Chief, Exp. Engr. Section.

Concurrence:

Approved by

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Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-10
December 20, 1941

APPENDIX 1
FACTUAL DATA

1. Controllable bombs may be power driven, glide (launched from a carrying bombardment airplane), or a glider (towed behind an airplane).

2. For emergency action, there exist about twelve Type BT-2BI airplanes, obsolete and unreliable. These could be made operable as power driven bombs within thirty to forty-five days, carrying 300 pound bombs for radii of action up to 200 miles. Pursuit protection is essential and operation unreliable due to the age of the equipment. The conversion should not be attempted unless required in emergency national defense, as this action would require personnel badly needed for more promising developments.

3. Glide bombs offer the greatest promise of utility in the next six months.

a. Glide bombs, standard 2000 pound bomb cases with wings, have been successfully flown under gyro stabilization and radio control. Extreme bombing accuracy and the exact method of aircraft control best suited to tactical operation have not been proven, since television equipment has not been tested in a glide bomb.

b. Television equipment suitable for use in controllable bombs has been tested in aircraft up to two and one half miles range, with successful results. Similar equipment has been tested in trucks up to four miles range. Final testing in controllable bombs will take place during January, 1942.

c. The recent glide bomb tests successfully utilized a Type B-23 airplane to carry the bomb. If a sufficient quantity of B-23's are made available, three squadrons of glide bombardment could be organized at key locations (Seattle, San Francisco, and Los Angeles) within four months. If this force is desired for action seaward up to the radius of action of the B-23's, the aircraft must be made available at once and crews and organizations must be allotted for training as soon as training equipment can be secured. (Approximately February 1, 1942. Efforts are being made to provide the equipment at an earlier date, possibly January 15, 1942.)

4. a. Power driven bombs can be produced in from four to six months, utilizing almost any service type airplane, preferably a bombardment type provided proper control mechanisms are developed for same. This is an important development for the attack of vital targets such as capital surface craft. The exact control for each type airplane is an individual study requiring four to six months. If aircraft are to be allotted for such conversion, the Experimental Engineering Section should be advised as to airplane type at earliest convenience.

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Experimental Engineering Section
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December 20, 1941
Appendix 1

b. Target aircraft on order for anti-aircraft gunnery practice are adaptable for use as power driven controllable bombs. The most promising type for this purpose is the PQ-11, capable of carrying a 300 pound bomb at approximately 200 miles per hour at 17,000 feet. Expected television deliveries should make possible the televising of forty-five of these targets for tactical assignment. As in the case of other bombs, trained personnel and control airplanes are necessary for successful operation.

c. The power driven bomb developed by the Research Laboratories Division of the General Motors Corporation recently tested at Muroc Lake was originally designed to carry 500 pounds of explosive up to fifty miles with one-half mile accuracy. This device will require six to seven months' preparation for mass production and needs some engineering revision prior to final production release. If desired in quantity, tooling should be commenced without delay.

d. The bomb developed by the Research Laboratories Division of the General Motors Corporation has been successfully flown under radio control. In this way it can be utilized as a bomb up to 400 miles range against naval or fixed objectives, provided:

(1) Pilot and mechanic personnel are trained.

(2) Control planes are made available. Type C-45 aircraft can be utilized for this purpose if pursuit protected. Type A-20C aircraft with bomb bay tanks would be suitable within their range limits.

(3) Organizations are allotted to operate the equipment.

e. Future power driven controllable bomb procurement for which studies are already initiated at Wright Field include aircraft to carry one, two, or four 2000 pound bombs. These assault bombs are being designed for:

35,000 foot ceiling
225 m.p.h. high speed
1,500 mile range

Landing gear will be dropable by radio after take-off. The aircraft will be gyro stabilized, radio controlled, and televised. If these general characteristics are not satisfactory to the tactical using organizations, the Experimental Engineering Section at Wright Field should be so advised at earliest convenience. Experimental orders are to be processed in the near future, if current studies warrant such action.

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Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-10
December 20, 1941
Appendix 1

5. Gliders can be employed as controllable bombs provided take-off can be affected nullo. Contacts with the industry are in progress leading to glider purchases. It is intended to procure gliders carrying one, two, and four 2000 pound bombs. If successfully developed, these bombs, controllable by radio and television, will be valuable for use with bombardment aircraft unsuited for carrying glide bombs.

6. Naval developments of large gliders and assault torpedoes are being conducted. These devices, especially the latter, will be very valuable for Air Force use.

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Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-10
December 20, 1941

APPENDIX 2
CONCLUSIONS

1. Controllable bombs have progressed to the point where their tactical utility is imminent.

2. Within thirty to forty-five days, a dozen obsolete aircraft could be prepared for use as controllable bombs and control aircraft of limited range and uncertain reliability. This conversion is inadvisable except in national emergency, since questionable performance will be acquired at the cost of personnel needed for more promising developments.

3. Any combat airplane can be converted to a radio controlled assault bomb in four to six months. Control airplanes and operating personnel are non-existent, and must be concurrently provided. The development should prove valuable for the destruction of such vital targets as capital ships.

4. The power driven bomb developed by the Research Laboratories Division of the General Motors Corporation, a device carefully designed for mass production, was unsuccessfully tested under the control of the preset data devices intended to be utilized when the bomb functioned as a long range artillery shell. Engineering revisions are in process at this time and the difficulty should be corrected in the near future. If a need exists for mass production of this bomb, tooling should commence at once, since six to seven months will be required for the preparation for production.

5. As a radio controlled 400 range bomb carrying 500 pounds of explosive, the bomb developed by the Research Laboratories Division of the General Motors Corporation is feasible. Minor revisions to the system of control are advisable but readily accomplished. If this bomb is desired in quantity, tooling should commence at once. For the operation of these bombs, control airplanes and trained crews are non-existent and must be provided if successful operations are to be conducted. Type C-45 and Type A-20C aircraft can be utilized within their range limits.

6. Immediate procurement should be effected for pilot models of power driven bombs capable of carrying one, two, and four 2000 pound bombs with the following characteristics:

35,000 foot ceiling
225 m.p.h. high speed
1,500 mile range

7. Suitable radio controlled airplane targets should be diverted from artillery assignment to conversion without delay into power driven bombs. Fifty such targets are expected for delivery by April 1, 1942.

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Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-10
December 20, 1941
Appendix 2

8. Glide bombs can be produced within four months, gyro stabilized, radio controlled, and televised, for daylight operation in fair weather. These bombs use standard 2000 pound or 1000 pound bomb cases. Television is not proven beyond question, but shows sufficient promise to warrant production. Type B-23 airplanes are satisfactory for use as carrying aircraft within their range limits. Other types should be tested for suitability.

9. Gliders carrying one, two, and four 2000 pound bombs should be procured for use with bombardment aircraft unsuitable for carrying glide bombs.

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June 5, 1942

Commanding General, AAF Materiel Command, Washington, D. C.

Flight Tests of Controllable Bombs.

1. The following is quoted from a directive dated April 20, 1942, from the Commanding General, Army Air Forces, to the Chief, Experimental Engineering Section, Materiel Command:

"There appears to be a misunderstanding as to the priorities on development and production of glide bombs. In order that all concerned may work to the same objective I am again listing the order of priorities on these projects:

"a. First priority - a simple glide bomb with stabilization only. This type of bomb will, of course, not have the accuracy of a more complicated type but when used in quantity will accomplish the result desired against vertical area targets. These bombs will be either attached to airplanes for release or be towed by airplanes and released. These will depend on quantity of projectiles released for effect.

"b. Second priority - a glide bomb with stabilization plus control, either radio-television, heat, light or what have you. This type of bomb will have the accuracy required for semi-precision work against a particular target."

2. The Chief, Army Air Forces, recently visited Eglin Field to ascertain the progress of controllable bomb projects of the Special Weapons Unit, Equipment Laboratory, Experimental Engineering Section, Wright Field, Dayton, Ohio.

3. As a result of this visit, Colonel Grandison Gardner, Air Corps, acting under General Arnold's direction, visited the Materiel Center to ascertain the probable logical trends for controllable bomb development and the current status of various projects in order that he might personally report these facts to the Chief, Army Air Forces.

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Date 4-1-45

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Commanding General, AAF Materiel Command, Washington, D. C.
Flight Tests of Controllable Bombs.
June 5, 1942.

In his report Colonel Gardner stated that the glide bomb, gyro stabilized, would probably be standardized for the purpose and use given first priority by the Commanding General, Army Air Forces, within a matter of sixty days and that production thereof could be initiated during August, 1942, provided flight tests indicate the suitability of type B-17E airplanes as carrying aircraft.

4. This Office concurs with the findings reported to General Arnold as noted above. The type B-17E is the most suitable carrying bombardment airplane. The controllable glide bombs will serve no useful purpose and should not be procured in production quantities until the practicability of the use of a production type carrying bomber has been demonstrated. Up to this time, all flight testing has been done utilizing a B-23 type airplane which obviously is not available in tactical quantities. It is estimated that approximately ninety days will be required to install and flight test the mechanisms necessary to make glide bombs usable with type B-17E airplanes.

5. This Office urgently requests that an additional type B-17E airplane be made available for the above described purpose not later than June 15, 1942, for a period of ninety days. If possible, the airplane should be equipped with bomb shackles on the wings for carrying 2000-pound bombs.

6. Following is a list of type B-17E airplanes now at Wright Field for use on projects with highest priority which indicates work in progress on each airplane:

A.C. No.	Work in Progress
41-2537	Flame damper installation and high altitude altimeter tests.
41-2539	Long range project and demand oxygen system.
41-2518	British B-17E special radio equipment installation.
41-2620	British airplane for SCR-517 (ASV-10) and SCR-595 radio equipment installation.
41-9163	For check installation of wide blade propellers for high altitude operation; now at Fairfield Air Depot and due to go to Hamilton Standard within the very near future.

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Commanding General, AAF Materiel Command, Washington, D. C.
Flight Tests of Controllable Bombs.
June 5, 1942

A.C. No.	Work in Progress
41-9061	Now at Vega Aircraft Corporation for mockup of flexible nose gun installation designed to eliminate distortion in plexiglas. Preliminary firing test completed at Eglin Field, Florida.

Experience has indicated that on major projects such as the glide bomb project it is practically impossible to accomplish any effective work in trying to combine tests with other major projects. During these tests this airplane will be at Eglin Field for long periods of time which also increases the difficulty of combining these tests with other projects. The importance of the glide bomb project is believed to be sufficient to warrant the assignment of a type B-17E airplane for this purpose alone. Every effort will be made to expedite the completion of the tests in order that the airplane may be released at the earliest possible date.

F. O. CARROLL,
Colonel, Air Corps,
Chief, Experimental
Engineering Section.

1 Incl.
Cy. IOM 4-21-42 fr. Chief,
Exp.Eng.Sec.,Mat.Com., to
Chief,Exp.Eng.Sec.,Mat.Com.,
w/1st Ind. 5-1-42.

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

WASHINGTON, D. C.
July 24, 1942.

TECHNICAL INSTRUCTIONS

Serial No.: CTI-811.
7544
Subject: Installation Assembly for Controllable Glide Bomb.

To: Technical Executive
Materiel Center, Wright Field
Dayton, Ohio

Classification cancelled
changed to
AUTH: CD-356
By
Signature and Grade
4-1-45

1. **Problem Presented:**

a. To make suitable arrangements on airplanes for carrying and releasing the controllable glide bomb.

2. **Factual Data:**

a. Directive from the Director of Military Requirements, dated July 17, 1942, subject as above, copy of which is attached.

3. **Action Desired:**

a. That controllable glide bomb installation now at Wright Field will be made on one (1) B-17F airplane which will be furnished by the Proving Ground command with necessary crew to conduct tests on this installation.

b. A report of the results will be furnished this office as soon as possible.

c. Immediately upon satisfactory installation, twenty (20) such controllable glide bomb installations will be procured for anticipated installation on B-17F airplanes.

d. This office will be informed of the progress of this project at the end of each week until all twenty (20) complete sets of installation parts have been fabricated.

Classification Cancelled
To "Restricted"
Auth: CD-362
Initials

By command of Major General ECHOLS:

B. [illegible]
Brig. Gen., U.S.A.
Chief of Staff.

Distr. by EES
Orig. - Equip. Lab.
Cy. - Col. Carroll.
Cy. - AAF Pr. Gr. Liaison
Incl. as above

AUG 13 1942

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WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

AUG 3 1942

SUBJECT: Controllable Glide Bombs.

TO : The Commanding General,
Materiel Command,
Washington, D. C.

1. General Arnold has directed that large scale tests employing controllable glide bombs be conducted at Eglin Field in the near future. It is planned that ten B-17 type airplanes will be employed and a total of sixty glide bombs will be released, twenty from each of three altitudes.

2. It is desired that you take necessary steps to complete preliminary work required in connection with the preparations for above tests by August 15, 1942. In viewof the limited time available, it may be necessary to forego, or reduce in scope, certain experimental work with the understanding that the accuracy of data obtained may be somewhat reduced.

3. The Commanding General, Proving Ground Command, is being directed to cooperate with you in the expediting of preliminary work, and will make available such airplanes, personnel, and facilities as are required to the extent of personnel and equipment on hand.

4. It is desired that you advise this office of the status of preparations being made and of any action which may be taken by this Headquarters to assist you in expediting thisproject.

By command of Lieutenant General ARNOLD:

MUIR S. FAIRCHILD,
Brigadier General, U.S.A.,
Director of Military Requirements.

/s/ H. W. Bowman
H. W. Bowman
Colonel, Army Air Forces

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

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WASHINGTON, D. C.
August 4, 1942

TECHNICAL INSTRUCTIONS

Serial No.: CTI-811, Addendum No. 1

7690

Subject: Installation Assembly for Controllable Glide Bomb

MX-108

To: Technical Executive
Materiel Center
Wright Field
Dayton, Ohio

1. Problem Presented:

a. To make suitable arrangements on airplanes for carrying and releasing the controllable glide bomb.

2. Factual Data:

a. Directive from the Director of Military Requirements dated August 3, 1942, subject "Controllable Glide Bombs", copy of which is attached.

b. Copy of teletype E-663 dated August 1, 1942, copy of which is attached.

3. Action Desired:

a. Accomplish installation of controllable glide bomb equipment on one (1) B-17E airplane which is being forwarded to your station in lieu of the B-17F airplane received on Friday, August 31st. The B-17E airplane should have arrived at your station on Sunday, ~~August~~ 2nd.

Classification cancelled or changed to
By CD-356
Date 4-4-45

b. Fabricate all necessary equipment for accomplishing the installations on ten (10) airplanes. These installations will be completed on or before August 16, 1942. The additional nine (9) airplanes will be provided immediately upon word from your office as to where the additional installations are to be accomplished.

c. Prepare sixty-nine (69) bombs for test purposes. Additional bombs to make up the difference between those you now have and the desired number of sixty-nine (69) are being shipped immediately to Eglin Field. These bombs must be ready for use on or about August 16, 1942.

AUG 19 1942

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CTI-811 Addendum No. 1
To: Technical Executive
Materiel Center

d. Anticipate large scale demonstrations of the controllable bomb at Eglin Field on or about August 18, 1942. In view of the limited time available, it may be necessary to forego or reduce in scope certain experimental work with the understanding that the accuracy of the data obtained may be somewhat reduced. The Commanding Officer of the Air Corps Proving Ground Command is being directed to cooperate with you in the expediting of preliminary work and will make available such airplanes, personnel and facilities as are required to the extent of personnel and equipment on hand.

e. It is requested that this office be advised of the status of the preparations every three or four days in order that the Director of Military Requirements may be kept posted.

By command of Major General ECHOLS:

B. E. [illegible]
Brig. Gen., U.S.A.
Chief of Staff

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Ltr. 8/3/42 fr DMR
to CG, Mat.Com.,
Teletype E-663, 8/1/42

Distr. by E.E.S. - 8-8-42
Orig. - Equip. Lab.
Cy. - Col. Carroll
Cy. - A.F.Pr.Gr.Liaison
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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

WASHINGTON, D. C.
August 25, 1942

TECHNICAL INSTRUCTIONS

Serial No.: OTI-811, ADDENDUM NO. 2
8050 CB

3527

Subject: Installation Assembly for Controllable Glide Bomb.

To: Technical Executive
Materiel Center, Wright Field
Dayton, Ohio

MX-108

1. Problem Presented:

a. To determine the effect on airplane flying and operating characteristics when glide bombs are carried.

2. Factual Data:

a. By direction of the Director of Military Requirements.

3. Action Desired:

a. To immediately conduct a study to determine the effect on the speed, ceiling, and range of B-17 and B-24 type airplanes when these airplanes are carrying one or two glide bombs suspended underneath the wings.

b. Study should also include the effect these glide bombs have on the airplane characteristics with respect to take-off, landing, and maneuverability.

c. This study will be expedited and a report submitted to this office at the earliest practicable date. If more than two weeks are required to accomplish this study, weekly reports indicating the status will be submitted.

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Auth. CD-326
Date 11-1-46

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By command of Major General ECHOLS:

Distr. by EES 8-29-42
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Cy. Col. Carroll
" A.F. Prvg. Gr. Liaison
" Arm. Lab.
" T.S.
" A.P. (C) and (B)
" Equip. Lab.
" Service Eng.
" Flight Research

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To "Restricted"
Auth: CA-206
Initials 3-1-45

John T. Murtha, Jr.
Colonel, Air Corps
Chief, Armament Section

for B. W. CHIDLAW
Colonel, Air Corps
Assistant Chief of Staff (E)

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CTI-811 - Addendum No. [illegible]

Installation Assembly for Controllable Glide Bomb.

Technical Executive
Materiel Center, Wright Field
Dayton, Ohio

CD-356

1. Problem Presented:

a. To initiate all necessary action in order that glide bombs may be used in combat at the earliest practicable date.

2. Authority:

a. Commanding General, Army Air Forces.

3. Action Desired:

a. Procure and have shipped a sufficient quantity of external wing racks, shackles, controls and sway braces for installation and release of glide bombs from B-17 airplanes, in order that four (4) heavy bombardment groups will be equipped with the aforementioned equipment in the U.K. not later than March 1943. Airplanes completely equipped for the carrying and releasing of 2,000 and 4,000-lb. bombs [illegible] at the [illegible] will not be sent to the U.K. until sometime after the first of the year, provided your previous information to this office as to when airplanes thus equipped will be delivered from the factory is still correct.

b. Initiate immediate procurement of wings and all controls (less gyros) for the 2,000-lb. glide bomb. It is desired that a rate of production of 1,000 per month be established at the earliest practicable date, preferably immediately, and that this rate be increased so that 2,000 per month will be reached by March 1943.

c. Facilities for the production of the wings and controls for this bomb will be based on a possible production of 4,000 per month. The establishment of a 4,000 rate per month, however, will be determined and based upon the success of the present planned and set program.

d. Hammond gyros which are now being tested will be procured in like quantities and at the same rate as the wing assemblies indicated in paragraph (b) above, dependent upon this instrument proving successful. Steps will be taken to expedite the test of this instrument to determine its suitability.

e. If the Hammond instrument does not prove successful, action will be initiated immediately for the further production and allocation of the Sperry directional gyroscope for use in these glide bombs. Allocation of the Sperry directional gyros, however, for this purpose, will not be

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October 19, 1942

Page 2.
CTI-811 - Addendum No. 3.
Subject: Installation Assembly for Controllable Glide Bomb.

anticipated before March 1943.

f. The development of the triple axis stabilization controls with Sperry type gyroscope for the remote control of the glide bomb will be expedited and, when successful, procurement at the rate of 1,000 per month will be anticipated.

g. Procurement of the television equipment for use in connection with the controlled glide bomb will be anticipated at the rate of 2,000 transmitters per month and 200 receivers per month at the earliest practicable date.

h. Materiel Center will aid and cooperate with the Individual Training Command to whatever extent is possible in the training of the first group of mechanics for this equipment. The Director of Individual Training has been directed to initiate immediately a training program for glide bomb mechanics. This directive states that 20 glide Bomb mechanics will be trained by December 15, 1942 and 150 by March 1, 1943

By command of Major General ECHOLS:

J. W. SESSUMS, JR.
Colonel, Air Corps
Assistant Chief of Staff (P)

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INTER-OFFICE MEMORANDUM

WAR DEPARTMENT, AIR CORPS
Office, Assistant Chief
Materiel Division

JMP:eas:54

Wright Field, Dayton, Ohio
Date June 30, 1942

TO: Chief, Production Engineering Section, Wright Field

SUBJECT: Request for type designation.

1. It is requested that the type designation "GB" be assigned to controllable glide bombs. The controllable glide bombs shall consist of lift-producing airfoils and control surfaces attached to standard demolition bombs. These controllable glide bombs shall be equipped with servo assemblies and radio-television, heat, light, sound or radio target seeking control equipment. Further, these controllable glide bombs may be equipped with pre-set data control equipment whereby the direction of the path to be followed can be set prior to release of the bombs from the carrying airplane.

2. It is further requested that the following type designations be assigned to controllable glide bombs now being developed.

a. Type GB-1, a controllable glide bomb essentially consisting of a high wing type of aerodynamic structure with two booms and tail surfaces, equipped with a servo control assembly and attached to a standard 2000 lb. demolition bomb.

b. Type GB-2, a controllable glide bomb essentially consisting of a mid-wing type of aerodynamic structure with two booms and tail surfaces, equipped with a servo control assembly and attached to a standard 2000 lb. bomb.

c. Type GB-3, a controllable glide bomb essentially consisting of a low wing type of aerodynamic structure with two booms and tail surfaces, equipped with a servo control assembly and attached to a standard 2000 lb. bomb.

F. O. CARROLL,
Colonel, Army Air Forces,
Chief, Experimental
Engineering Section.

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION MATERIEL COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

PFH:hle:54
Date June 26, 1943

SUBJECT: Pre-Set Data Glide Bombs.

SECTION Equipment Laboratory

SERIAL No. ENG-54-673-A XX

mx-108

Contract No.
Expenditure Order No. 673-12
Purchase Order No.

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OTHERS

A. PURPOSE:

To report on a trip to the United Kingdom for the purpose of training bombardment personnel of USAFETO in the use of Pre-Set data glide bombs.

B. FACTUAL DATA:

1. Materiel Command personnel arrived in the United Kingdom March 16, 1943, located and installed equipment, trained two bombardiers, two pilots, and two Ordnance Officers on the glide bomb, and returned to Wright Field May 22, 1943.

2. Demonstrations of the glide bomb were witnessed by the following personnel:

Army Air Forces

General Hansel
Colonel LeMay
Colonel R. Porter
Major H. Holt

Royal Air Force, M.A.P.

Air Commodore Vasse
Wing Commander Sewell
Squadron Leader F. J. Braithwaite
Flight/Lieutenant Carrier

Materiel Command

Lt. Colonel P. F. Helmick
Lieutenant C. H. Pierce

Ordnance

Colonel P. Schwartz, 8th Air Force
Lt. Colonel R. S. Sims, 8th Bomber Command

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3. Personnel trained were:

Pilots: 1st Lieutenant E. F. Wiley, O-443033
1st Lieutenant D. L. Shaffer, O-437646

Bombardiers: 1st Lieutenant W. B. Werther, O-660428
2nd Lieutenant J. . Bennett, O-726109

Ordnance Officers: 1st Lieutenant F. F. Mulkey, O-1548265
2nd Lieutenant J. W. Rose, O-1548538

4. Additional data contained in Appendix 1 attached.

C. CONCLUSIONS:

1. That training in any theater will probably be impractical and undesirable due to the many other activities required in tactical operations.

2. That complete operating units should be formed, the necessary equipment installed on the airplanes, the personnel trained, all in the United States, and these combat units be sent, with their equipment, to any desired theater for the purpose of dropping these bombs.

D. RECOMMENDATIONS:

1. That any future training of crews in the use of the pre-set data glide bomb be accomplished in the United States, preferably in the Southwest, or where weather and targets are such as to allow consistent and economical operations, and that airplanes be fully equipped for this weapon in the U. S.

2. That such training be conducted by the personnel mentioned above, inasmuch as they are the only crews so trained and available at this time.

P. S. HELMICK, Lt. Col., A.C.

G. V. HOLLOMAN, Col., A.C.
Equipment Laboratory
Engineering Division

F. O. CARROLL, Brig. General, USA
Chief, Engineering Division

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Engin. Div. Memo. Report No. ENG-[illegible]-675-4 XX
June 26, 1943

Appendix 1

1. Upon arrival in the theater of operations, no equipment had as yet been located. The first ten days were largely spent in searching through depots and warehouses for Glide Bomb Kits, Accessory Kits and External Bomb Racks for the type B-17F airplanes, and in conferences to arrange for training of personnel and possible tactical employment of the weapon.

2. One airplane and crew were allotted for the installation and training. Training of the crews was carried on as weather permitted. Later, another crew was obtained and training continued for both crews. During this period, [illegible] and RAF personnel were invited to witness the glide bomb in flight, and such personnel were taken on most missions.

3. The Commanding General, 8th Bomber Command, was not receptive to the employment of the weapon in the European theater principally for the following reasons:

a. Present strategy calls for precision bombing of point objectives.

b. Loss of speed of carrying aircraft was thought to be prohibitive.

c. Close formations at high altitude are necessary for protection against enemy fighters, and the loss in speed would cause an opening up of formations and consequently increased vulnerability.

d. Decreased bomb load.

e. Shortage of shipping space required to transport the necessary equipment to the United Kingdom.

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INTER-OFFICE MEMORANDUM
Army Air Forces
Headquarters of the Materiel Command
Washington

C
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March 2,1943

TO: Technical Executive,
Wright Field, Dayton, Ohio.

SUBJECT: Glide Bomb (CTI-811).

1. At a conference held Saturday, February 27, 1943, between the War Plans Division, of the Air Staff, and Director of Bombardment and this office, it was decided that present existent orders for the uncontrolled glide bomb were sufficient to meet all requirements for this type of equipment and, therefore, no additional orders or procurements of this bomb will be made.

2. It was further decided that any further pursual of glide bomb activities should be done in connection with controlled or precision types and, therefore, every effort should be made to bring an early conclusion to these developments. If and when they are considered to be satisfactory, definite and specific requirements will be established for their use.

3. In view of the results of this conference, it is recommended that the manufacturers of the present glide bomb parts be advised in order that they may plan their production accordingly. Every effort should be made to expedite the development of the controlled type missiles, particularly the unpowered type and, if possible, some arrangements be made with existent manufacturers to obtain their cooperation in order that the present facilities will not be lost.

(Signed)
J. G. PHILLIPS, Col., A.C.

for B. W. CHIDLAW
Brig. General, U.S.A.
Asst. Chief of Staff (E)

3-10-43 - Dist. by Eng. Div.
Orig. - Equipment Lab.

Cys. - Gen. Carroll
Airc. Lab. (2)
Arm. Lab. (2)

Classification Cancelled
To "Restricted"
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Initials [illegible]

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ADDRESS REPLY TO
CHIEF OF THE AIR CORPS
WAR DEPARTMENT
WASHINGTON, D.C.

CCF AV 168 F. #1
(3/8)

WAR DEPARTMENT
OFFICE OF THE CHIEF OF THE AIR CORPS
WASHINGTON

(4-F)

1 1942

SUBJECT: Military Characteristics of Glide Torpedo.

TO: The Chief of the Army Air Forces.

1. The following principal characteristics for a glide torpedo are submitted for approval.

GLIDE TORPEDO

RECEIVED

A. CLASS - Glide Torpedo.

B. MISSION - Aerial offense against naval targets.

C. REQUIREMENTS -

1. This torpedo shall be equipped with lift-producing air foils and control surfaces from which it will be detached before striking the water. After detachment, the torpedo will continue toward the target under water in the same manner as standard torpedoes released from airplanes.

2. This torpedo may also be equipped with stabilizing equipment, radio control (with or without television) and/or heat, light, sound or radio detecting and directing equipment. Further, this torpedo may be equipped with pre-set data devices whereby the path to be followed by it can be set in prior to its release.

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By ......CD-356...... Signature and Grade
Date ......11-1-45......

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For the Chief of the Air Corps:

L. S. SMITH
Lieut. Colonel, Air Corps,
The Executive Assistant.

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Co-210 XC-581

AAG 471.6 Aerial Torpedo (1)

CF AAA 494.
ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON, D. C.

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AFDMA-2B

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON, D. C.

20 August 1943

SUBJECT: Deceleration Devices for Aircraft Torpedoes.

CT1-1427

TO: Commanding General
Materiel Command, Wright Field
Dayton, Ohio
Attention: Technical Executive

1. The Assistant Chief of Air Staff, Operations, Commitments and Requirements has indicated that there is a definite and immediate requirement for the development of a device for decelerating the rate of fall of an aircraft torpedo. This requirement is established so that aircraft torpedoes may be released from high altitudes and a successful run anticipated.

2. The purpose of this development is to obtain, if at all possible, a method whereby a standard Navy aircraft torpedo may be released at higher altitudes, higher speeds than now permissable and from greater distances from the target than is possible when using only the run of the torpedo.

3. A suggested means of accomplishing the desired results appears to be by the use of air frames fabricated for the preset glide bomb project. Quantities of these are now available and in storage and it is suggested that some of these air frames be obtained and actual tests accomplished. A quantity of iron dummy torpedoes are available at Eglin Field and may be used for these tests. The facilities and personnel of the Torpedo Squadron at Eglin Field are available for any development and test work which it might be desired to have them cooperate in. General Gardner, Commanding General of the Army Air Force Proving Ground Command, has concurred in this work.

4. Further in this connection it might be stated that General Kenney has recently sent a Colonel Devine to this country to study and, if possible, to determine the feasibility of this technique. He is now at Eglin Field and may be contacted at that station.

5. [illegible] project should be expedited in every way possible

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

[redacted]
By Authority of
[illegible]
[illegible]

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CT1-1427

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Signature and Grade
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Date 10-1-45
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in order that its feasibility may be determined and if practicable actual results obtained.

By Command of General ARNOLD:

J. F. Phillips
J. F. PHILLIPS
Colonel, Air Corps
Chief, Dev. Eng. Branch, Mat. Div.
Office of Assistant Chief of Air Staff
Material, Maintenance and Distribution

[redacted]

Central Files MX 446

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

~~Washington, D. C.~~ JHO:jjb:HGP
Wright Field, Dayton, Ohio.
25 August 1943

TECHNICAL INSTRUCTIONS

Serial No.: CTI-1427

15162

Subject: Deceleration Devices for Aircraft Torpedoes.

To: Engineering Division

MX-446

1. Problem Presented:

a. To initiate a project for the development of a device for decelerating the rate of fall of an aircraft torpedo. This requirement is established so that aircraft torpedoes may be released from high altitudes and successful run anticipated.

2. Factual Data:

a. The purpose of this development is to obtain, if at all possible, a method whereby a standard Navy aircraft torpedo may be released at higher altitudes, higher speeds than now permissable and from greater distances from the target than is possible when using only the run of the torpedo.

b. A suggested means of accomplishing the desired results appears to be by the use of air frames fabricated for the present glide bomb project. Quantities of these are now available and in storage and it is suggested that some of these air frames be obtained and actual tests accomplished. A quantity of iron dummy torpedoes are available at Eglin Field and may be used for these tests. The facilities and personnel of the Torpedo Squadron at Eglin Field are available for any development and test work which it might be desired to have them cooperate in. General Gardner, Commanding General of the Army Air Force Proving Ground Command, has concurred in this work.

c. Further in this connection it might be stated that General Kenney has recently sent a Colonel Devine to this country to study and, if possible, to determine the feasibility of this technique. He is now at Eglin Field and may be contacted at that station.

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AAFMC-400-A, WF-8-12-42-25M

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

JHO:jjb:HQP
Page two
Wright Field, Dayton, Ohio.
25 August 1943

TECHNICAL INSTRUCTIONS

SECRET
AUTH: C. G., AAF
Materiel Center
DATE: 8/21/43
INITIALS: J.F.P.

Serial No.: CTI-1427 (Cont'd)

Subject: Deceleration Devices for Aircraft Torpedoes.

To: Engineering Division

3. __Authority:__

a. Commanding General, Army Air Forces. By letter dated 20 August 1943, subject: "Deceleration Devices for Aircraft Torpedoes", from Chief, Development Engineering Branch, Materiel Division, Office of Assistant Chief of Air Staff, Materiel, Maintenance & Distribution.

4. __Action Desired:__

a. Project indicated under paragraph 1, Problem Presented, should be expedited in every way possible in order that its feasibility may be determined and, if practicable, actual results obtained.

By Command of Major General BRANSHAW:

T. A. Sims

T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

cc: Production Division
Air Service Command

8-30-43 - Dist. by Eng. Div.
Orig. - Armament Lab. (2)
Cys. - Gen. Carroll
Tech. Staff
Airc. Proj. Sec.
A. A. F. Prov. Gr. Liaison
Equipment Lab.

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AUTH C.O., AAF Mat. Com.
Date 9-13-43
Initials J.A.P.

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Deputy Chief of Staff, Wright Field.

471.6

CTI-1427 - Deceleration Devices for Aircraft Torpedo.

1. Reference subject CTI dated 25 August 1943, it is the understanding of the Armament Laboratory that the project as outlined is already well underway at the AAF Proving Ground Command, Eglin Field, Florida, under the auspices of the Equipment Laboratory, Engineering Division. A number of drops have been made using the wings associated with the glide bomb project. Only dummy torpedoes have been used. Verbal reports from interested personnel at Eglin Field indicate success to date. However, the accuracy of such a system of torpedo bombing against moving surface vessels is questioned. It is the opinion of the Armament Laboratory that such glide torpedoe bombing will be unsatisfactory unless its use is confined to fixed installations of large size. Evidently, this is the application that General Kenny and Colonel Devine have in mind.

2. The Navy Department and the British have each tried to develop accurate glide torpedoes for use against moving targets but such development, it is understood, has been given up. In this connection, it is suggested that if the gliding torpedoes covered by this CTI are to be used against moving targets, immediate steps be taken to develop a suitable sight for aiming purpose.

3. Notification of further action to be taken by the Armament Laboratory on this CTI is requested inasmuch as Equipment Laboratory is already working on the project with Colonel Devine at Eglin Field.

H. Z. BOGERT,
Colonel, Air Corps,
Acting Chief,
Engineering Division.

COM. GEN.
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CENTRAL FILES

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HEADQUARTERS OF THE ARMY AIR FORCES
WAR DEPARTMENT
WASHINGTON, D. C.

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WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES AFDMA-3P
WASHINGTON, 25

23 October 1943

SUBJECT: Glider Borne Pattern Torpedo

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

MX-446

ATTN: Technical Executive

1. Reference to teletype AFDMA-4-176, dated 5 October 1943, subject, "Inventory of Glide Bomb Assemblies" and your letter, dated 18 October 1943, Department 70-5A, same subject, Requirements Division, AC/AS, OCR, has requested that 500 glider borne pattern torpedo kits be procured without delay.

2. The final report on the test of the glider borne pattern torpedo conducted in conjunction with Colonel Devine of the Fifth Air Force at the Proving Ground Command definitely establishes the fact that the proposed technique for the use of torpedo in this manner is feasible and effective.

3. In the inventory referred to above you reported in stock 3030 wings complete with controls. Please make available under this directive 500 such kits, together with such other spare parts, as are necessary from your stock of spare parts. These 500 kits should be checked by Aircraft Equipment Laboratory, Wright Field.

4. Advise this office when the kits are ready so that delivery instructions may be obtained.

By command of General ARNOLD:

R. C. Wilson

R. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Materiel Div.
Office, Asst. Chief of Air Staff
Materiel, Maintenance and Distribution.

Changed to
AUTH: CO 356
By
Date

[redacted]
By Authority of
The Commanding General
Army Air Forces
23 Oct 1943
Date Initials

FOR VICTORY BUY WAR BONDS

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AAFMC-452-A W-5-19-42-25M

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

WASHINGTON, D. C. [illegible]
Wright Field, Dayton, Ohio.
30 October 1943

TECHNICAL INSTRUCTIONS

Serial No.: [illegible]

SECRET
AUTH. C. G. AAF
Materiel Command
DATE: 23 October 1943
INITIALS: M. C. D.

Subject: Glider Borne Pattern Torpedo.

To: Production Division [illegible]

File [illegible] 11-6-43
Orig. [illegible] Unit
Cy. in [illegible] files
[illegible]

1. Problem Presented:

a. To effect procurement, at the request of Requirements Division, AC/AS, OC&R, of 500 Glider borne pattern torpedo kits without delay.

2. Factual Data:

CD-356
11-1, 45

a. The final report on the test of the glider borne pattern torpedo conducted in conjunction with Colonel [illegible] of the Fifth Air Force at the Proving Ground Command definitely established the fact that the proposed technique for the use of torpedo in this manner is feasible and effective.

b. Materiel Command letter, TD-[illegible], dated 16 October 1943, subject: "Inventory of Glide Bomb Assemblies" to AC/AS, MM&D, lists such partially complete and complete components as are currently being held in inventory by the Army Air Forces.

3. Authority:

a. Commanding General, Army Air Forces. By letter dated 23 October 1943, subject as above, from Chief, Development Engineering Branch, Office, AC/AS, M. M. & D.

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4. Action Desired:

a. To make available without delay 500 each of the subject kits together with such spare parts as are necessary.

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b. These kits shall be checked by the Equipment Laboratory, Engineering Division.

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To "Restricted"
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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

~~WASHINGTON, D. C.~~ Wright Field, Dayton, Ohio.
30 October 1943

MHBD:jjb:HQP
Page 2

TECHNICAL INSTRUCTIONS

Serial No.: CTI-1482 (Continued)

Subject: Glider Borne Pattern Torpedo.

To: Production Division

c. As soon as it has been determined when these kits will be ready, the Chief, Development Engineering Branch, Materiel Division, AC/AS, OC&R, shall be so notified through the Office of the Technical Executive so that delivery instructions may be furnished.

By Command of Major General BRANSHAW:

J a Sims
J. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

Distribution:
Engineering Division
Air Service Command (2)

6 Nov 43 - Dist. by Prod. Div.
Orig. & cy. to Aero. Equip. Branch - Nec. Action
CC: Resources Control Section
Production Division File

NOTE: This connects with CTI-811 and addenda thereto.

W. E. [illegible]
Asst. to Chief
Production Division

31

CD-356
11-1-45

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////////////// JEO:jb:NEP
Wright Field, Dayton, Ohio.
10 November 1943

CTI-1471, Addendum I
cb
MX-446

Test of Glide Bombs.

[redacted]
AUTH: C. G., AAF
Material ~~Center~~ Command
DATE: 28 Oct. 1943
INITIALS: W.O.D.

Production Division

1. **Problem Presented:**

a. To effect procurement, at the request of Requirements Division, AC/AS, OCAS, of 500 glider borne pattern torpedo kits without delay.

2. **Factual Data:**

a. The final report on the test of the glider borne pattern torpedo conducted in conjunction with Colonel Devine of the Fifth Air Force at the Proving Ground Command definitely establishes the fact that the proposed technique for the use of torpedo in this manner is feasible and effective.

b. Material Command letter, 70-54, dated 18 October 1943, subject: "Inventory of GliderBomb Assemblies" to AC/AS, MM&D, lists such partially complete and complete components as are currently being held in inventory by the Army Air Forces.

3. **Authority:**

a. ~~Commanding~~ General, Army Air Forces. By letter dated 21 October 1943, subject as above, from Chief, Development Engineering Branch, Office, Assistant Chief of Air Staff, Materiel, Maintenance & Distribution.

4. **Action Desired:**

a. To make available without delay 500 each of the subject kits together with such spare parts as are necessary.

b. These kits shall be checked by the Equipment Laboratory, Engineering Division.

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////////////////// Page 2
Wright Field, Dayton, Ohio.
10 November 19[illegible]

CTI-1471, Addendum I

Test of Glide Bombs.

Production Division

c. As soon as it has been determined when these kits will be ready, the Chief, Development Engineering Branch, Material Division, AC/AS, MM&D, shall be so notified through the Office of the Technical Executive so that delivery instructions may be furnished.

By Command of Major General BRANSHAW:

T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

Distribution:
Engineering Division
Air Service Command (2)

GEN.
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Wright Field, Dayton, Ohio
15 February 1944

COM. GEN.
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TECH. DATA
OTHERS

SECRET
AUTH: C. G., AAF ~~Materiel Center~~ Command.
DATE: 2-18-44
INITIALS: Z.L.W.

IMMEDIATE ACTION

GTI-1471, Addendum No. 2

Procurement of GT-1 Glider Bomb Pattern Torpedo Kits.

Production Division,
Wright Field.

~~MX-100~~
MX-446

1. Problem Presented:

a. The Office of Asst. Chief of Air Staff, M. M. & D. has stated that delivery of 200 complete GT-1 Glider Bomb Pattern Torpedo Kits are urgently required for air shipment to a tactical project by 20 March 1944, and that an additional requirement for 200 complete GT-1 Kits is necessary in addition to the 500 now on order.

2. Factual Data:

a. Basic GTI-1471 directed the Engineering Division to conduct operational tests using the controllable glide bomb as follows:

(1) Release the controllable glide bomb at such an altitude and distance from the target so that it will pass directly over the target but at an altitude of 1000 ft. or more.

(2) When the controllable bomb is directly above the target at a proper distance as determined from the tests, it be placed in a vertical dive or spin with the idea being to lead the missile into the target from a vertical dive.

b. GTI-1471, Addendum No. 1 directed the Production Division to procure without delay 500 Glider Bomb Pattern Torpedo Kits, which kits should be checked by Equipment Laboratory, Engineering Division, prior to final delivery, and upon availability to notify the Development Engineering Branch, Office Asst. Chief of Air Staff, M. M. & D. in order that delivery instructions may be furnished.

c. These Technical Instructions confirm telephone conversations between Lt. Colonel [illegible] of M. M. & D. and Captain [illegible] of Production Division, on 15 February 1944.

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Date 10-1-45

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Wright Field, Dayton, Ohio
18 February 1944

OTI-1871, Addendum No. 2

Procurement of GT-1 Glider Borne Pattern Torpedo Kits.

Production Division,
Wright Field.

3. **Authority:**

a. Commanding General, Army Air Forces. By teletype AF[illegible] dated 17 February 1944.

4. **Action Required:**

a. That the Production Division take immediate action to procure 200 GT-1 Glider Borne Pattern Torpedo Kits for complete delivery by air shipment by 20 March 1944. These kits are in addition to the 200 now on order with American Aircraft. In the event American Aircraft cannot meet shipment requirement of 200 by 20 March 1944, an additional order should be placed with previous vendor, The [illegible] Company or any other vendor who can meet this rush requirement.

b. That upon request of the Production Division, the Engineering Division furnish any technical information that may be necessary to enable the Production Division to carry out this project, and, that specifically the Engineering Division furnish information to the Production Division concerning the necessary ordnance [illegible] to these kits in order that they be secured and shipped with the 200 kits.

c. That the Engineering Division continue to expedite the test of the [illegible] as outlined in paragraph [illegible] above, and that upon completion the Development Engineering Branch, Office Asst. Chief of Air Staff, M. M. & D. be advised of the results, together with appropriate comments and recommendations in order that they in turn may advise AC/AS/[illegible].

d. That the Production Division expedite the delivery of the original 200 GT-1 Glider Borne Pattern Torpedo Kits in addition to the 200 specified in paragraph 4a above, and that upon availability of these kits that the Development Engineering Branch [illegible]

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Wright Field, Dayton, Ohio
18 February 19[illegible]

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CTI-1471, Addendum No. 2

Procurement of SY-1 Glider Bomb? Pattern Torpedo Kits.

Production Division,
Wright Field.

4. Office Asst. Chief of Air Staff, M.M.&D. be notified immediately through the Office of the Technical Executive in order that delivery instructions may be furnished.

5. These Technical Instructions cancel and supersede basic CTI-1471 and Addendum No. 1 and CTI-1482 and Addendum No. 1.

By Command of Major General BRANSHAW:

T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

Distribution:
Engineering Division,
Procurement Division,
Air Service Command (3)
Aircraft Radio Laboratory.

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GENERAL FILES

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION:

HEADQUARTERS, ARMY AIR FORCES (AFDMA-2F)
WASHINGTON

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

MX-446

20 March 1944.

SUBJECT: Increase in Procurement for Glider Borne Pattern Torpedo

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Technical Executive

[redacted]
By Authority of
The Commanding General
Army Air Forces
3/20/44 ..... RCP
Date Initials

1. In reference to the previous letters of 16 February 1944 and 23 October 1943, subject, "Glider Borne Pattern Torpedo", the quantities on order are to be changed to the following:

a. GB-1 Airframes and Controls: The Air Service Command will be requested by Materiel Command to increase the number of GB-1 units for this project to 950. The previous total was 700, of which 200 have been shipped.

b. Spare Control Units for GB-1: A total of 67 spare units (including gyro, battery, and servo set) is to be secured. This total includes the 14 spares already shipped. If this quantity cannot be secured from the Air Service Command, the Materiel Command will initiate the necessary procurement. (It is desired that these spare units will not be secured by stripping complete GB-1 pack-ups). If the gyro and servo units are considered obsolete, and can only be secured through additional procurement the Special Weapons Branch is to be checked concerning the advisability of procuring a substitute. These spare units are to be shipped out concurrently with the GB-1 units on a basis of 7% spares.

c. GT-1 Modification Kits: The total quantity to be procured is to be increased to 998 (950 plus 5% spares). This is an increase from the previous total of 700 (of which 210 have been shipped overseas and 80 shipped to Eglin Field). The 5% spare kits are to be shipped out concurrently on each release.

d. Ordnance Kit for GT-1: The total quantity to be procured is to be increased to 870 (950 less the 80 shipped to Eglin - for which no kits were required). Each of these kits is to contain two of the "Machine bolt" type explosive pins.

e. Spare "Machine Bolt" Type Explosive Pins: 86 extra pins are

AUTH: CD 356
By
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Subj: Increase in Procurement for Glider Borne Pattern Torpedo (Cont'd).

to be secured and are to be shipped out concurrently with the kits on a 5% spare basis.

f. The previous standard explosive pin is to have the total quantity limited to 1140. 840 of this total have been shipped overseas and the remaining 300 to Eglin Field.

By command of General ARNOLD:

for M. C. Demler, Col. A.C.
R. A. LEGG
Colonel, Air Corps
Actg. Chief, Devel. Engr. Br., Materiel Div.,
Office, Asst. Chief of Air Staff
Materiel, Maintenance and Distribution.

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AUTH: C. G., AAF

RBW;cjt:HQP Material

DATE: 3/29/44

INITIALS:

ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

[redacted]

TECHNICAL INSTRUCTIONS

Wright Field, Dayton, Ohio

28 March 1944

Serial No.: GTI-1471, ADDENDUM NO. 3

Subject: Procurement of GT-1 Glider Borne Pattern Torpedo Kits.

To: Production Division

Rec'd MPB 3/31/44 4PM

1. Problem Presented:

a. The Office of the Assistant Chief of Air Staff, Materiel, Maintenance and Distribution has directed that the glider borne pattern torpedo kits program be increased from a total of 700 to 950.

2. Factual Data:

a. It is understood that the total GB-1 frames and Kits are available in Air Service Command stock and can be utilized for this program.

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 20 March 1944, Subject 1. Increase in Procurement for Glider Borne Pattern Torpedo, from, Acting Chief, Development Engineering Branch, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution.

4. Action Desired:

a. That the Production Division secure from the Air Service Command 250 additional GB-1 frames in order to increase the glider borne pattern torpedo project from 700 to 950.

b. That the Production Division take necessary action to secure a total of 67 spare units (including gyro, battery, and servo set). ~~Fourteen (14) of this quantity has already been secured and shipped leaving a remainder of 53 to be procured.~~

total is still 67 new as 14 units were taken from GB-1 in stock

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Classification cancelled

AUTH: CD 356

By: 94

Signature and Grade

Date: 10-7-45

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WSD-454

ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND EHW:cjt:HQP

[redacted]

TECHNICAL INSTRUCTIONS

Wright Field, Dayton, Ohio

Serial No.: CTI-1471, ADDENDUM NO. 3

28 March 1944

Subject: Procurement of GT-1 Glider Borne Pattern Torpedo Kits.

To: Production Division

c. That the Production Division procure 298 additional GT-1 Modification kits. This will make a total procurement of 998 (950 plus 5% spares). 210 of the previous procurement of 700 have been shipped overseas and 80 have been shipped to Eglin Field. The 5% spares are to be shipped out concurrently on each release.

d. That the Production Division take necessary action to procure a total quantity of 870 Ordnance Kits for the GT-1. This quantity is arrived at by subtracting the 80 shipped to Eglin Field from the total of 950. Each of these kits is to contain 2 of the "Machine bolt" type explosive pins.

e. That the Production Division take necessary action to secure 86 extra spare "Machine bolt" type explosive pins which are to be shipped out concurrently with the kits on a 5% spare basis. The previous standard explosive pin is to have the total quantity limited to 1140. 840 of this total have been shipped oversees and the remaining 300 to Eglin Field.

By Command of Major General BRANSHAW:

[redacted]

T. A. Sims
T. A. SIMS
Colonel, Air Corps
Deputy Chief of Staff

cc: Engineering Division
Procurement Division
Air Service Command
Aircraft Radio Laboratory
Ordnance Section

15:32

30 Mar 44 - Dist by Prod Div
Orig & cy to Aero. Equip. Branch
CC: Resources Control Section
Prod. Division File

W. E. DONNELLY
Asst. to Chief,
Production Division

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Auth: CG, [illegible]
Date: 1 Aug 45
Initials: [illegible]

TORPEDO SECTION
594TH AIR MATERIEL SQUADRON
APO 903

1 August 1945

SUBJECT: Report of Initial Drops of GT-1 Torpedoes.

THRU : Commanding Officer, 389th Air Service Group, APO 903.

TO : Commanding Officer, Special Weapons Branch, Wright Field, Dayton, Ohio.

1. In compliance with verbal request, following is a report of initial drops of GT-1 torpedoes.

2. To date two missions of GT-1 Glide Pattern Torpedoes have been fired. The targets were Kago Shima, Makurasaki and Sasebo Harbors.

3. The first two places were just targets of opportunity. Nine fish were used; observation was poor due to flak and high altitude. About four were seen to explode in the water and one went over the target, hit the side of a mountain and exploded.

4. The second mission, thirteen planes, fired into Sasebo Harbor. One fish was hit by flak in midair and exploded and one had a hole from flak on its wing, before leaving the plane and slipped off to the right, hit land and also exploded. The other eleven were seen exploding in the harbor against or near carriers and one against a cargo vessel. Observation, either visual or through camera, was very poor due to flak and altitude. Altitude of release was between 7500 and 7800 feet and all flew perfect.

5. It was found advisable to load torpedoes with a spare vane and wire, so that in case of accidental loss of vane the plane would not have to return to the base.

6. Due to some tactical difficulties, all of the planes had to land with the fish at least once. No difficulties were encountered although the vane should be gotten rid of before landing to lessen injury to any personnel or equipment near run way. Vanes are released about twenty to thirty minutes before reaching the target.

7. If possible, information on depth of initial dive of glide torpedo is desired.

8. Request shipment of the following parts by air if possible, as they are urgently needed for completion of missions:

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BASIC: Ltr Torpedo Section, 594th Air Mat Sq, Subj: Report of Initial Drops of GT-1 Torpedoes, dated 1 August 1945. (Cont'd).

0922

a. 100 ea. Paravane Assembly - X4C9011.

b. 100 ea. 85ft. Music Wire .020" with 3/4" dia loop wrapped back 1" on one end and 1/4" loop wrapped back 3/4" on the other end, wire to be wound on spool. (Item - C)

c. 100 ea. Spool Assembly - X44S9127.

d. 12 ea. 12-Volt Time Switch Assembly, Hammond Instrument Drawing. ~~TA~~-60620.

Reference: Contract No. W-33-038-AC-1966.

Ernest P Koch
ERNEST P. KOCH,
1st Lt., Ordnance,
Torpedo Maint. O.

BJW/ddn

1st Ind.

HEADQUARTERS, 339TH AIR SERVICE GROUP, APO 903, 3 August 1945.

TO: Commanding General, VII Bomber Command, APO 903.

1. The Torpedo Section of 594th Air Materiel Squadron, this group, is composed of personnel formerly comprising detachment "A" 2070th Ordnance Training Company, Aviation, which organization was disbanded on 1 February 1945 and the entire detachment assigned to its present unit.

2. At the time the Torpedo Section was a separate organization, the Special Weapons Branch, Wright Field, Dayton, Ohio, requested Lt Koch, Commanding Officer of the detachment, to submit a report to them of initial drops of GT-1 torpedoes.

3. With reference to paragraph 3, basic letter, Lt Koch states that he is unable to obtain listed items in this area. As this is special torpedo equipment, urgently needed, it is requested that, if the equipment in question cannot be obtained from supply agencies in this area, this correspondence be forwarded to addressee. In the event the required equipment is available at a closer supply point, request this office be so notified, and the correspondence forwarded with a statement to that effect.

FOR THE COMMANDING OFFICER:

Burrows J. Wheless
BURROWS J. WHELESS,
Major, Air Corps,
Adjutant.

#-37189

[redacted]

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Mat. Div. A. C. 226a-Wright Field 10-15-39-50M

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION GVH:dh:54

MEMORANDUM REPORT ON

SUBJECT: Radio Controlled Television Dirigible Bomb. 471.62 Date February 7, 1941.

SECTION: Experimental Engineering

SERIAL No. EXP-M-54-655-198 B

Contract No. 655-1
Expenditure Order No.
Purchase Order No.

A. Purpose.

1. To report on a conference held January 31, 1941 between a representative of the Materiel Division and personnel of the Office, Chief of the Materiel Division, regarding a radio controlled television dirigible bomb.

B. Factual Data.

1. A complete resume of the radio controlled television dirigible bomb was given by the representative of the Materiel Division.

2. This equipment was first proposed by the Radio Corporation of America, Camden, New Jersey. Since the original proposal was made by the above corporation, a television equipment which indicates that it might be suitable for the subject purpose has been prepared by the Hazeltine Service Corporation, Little Neck, New York. Two series of flight tests have been conducted by the Aircraft Radio Laboratory on this equipment.

3. A conclusion was reached sometime past by both the Equipment Laboratory and the Aircraft Radio Laboratory that the key to the successful completion of the project, as a whole, depended upon the successful development of a television equipment which would be of a suitable size and weight to be included in the bomb. It has further been concluded by these two laboratories that no procurement should be initiated for the completed article until suitable television equipment has been developed, and is available.

4. During the discussion at the Office, Chief of the Materiel Division an indorsement to a letter was introduced. This indorsement had been written by the Office, Chief Signal Officer. The indorsement recommended that military characteristics be drawn up for a radio controlled television dirigible bomb, in order that necessary supplementary funds could be set up by the Office, Chief Signal Officer, for the 1942 budget, to cover the development of those items, connected with this project, for which the Aircraft Radio Laboratory would be responsible.

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Memorandum Report No. EXP-M-54-655-198B
February 7, 1941.

5. The Materiel Division representative stated that Section D3 of the National Defense Research Commission had indicated that that Committee was planning to assist the Hazletine Service Corporation in their development by allocating certain funds to this Corporation.

6. Present at the conference were:

Materiel Division	Office, Chief of the Materiel Division
Lt. Col. Franklin O. Carroll	Major Benjamin W. Chidlaw, A.C.
Major Howard Z. Bogert	Captain William Brown
Major George V. Holloman	

C. Conclusions.

1. That no procurement should be initiated for a complete radio controlled television dirigible bomb until suitable television equipment has been developed, and is available.

2. That military characteristics for the subject article should be prepared.

D. Recommendations.

1. That the military characteristics for a radio controlled television dirigible bomb be prepared and forwarded to The Adjutant General for approval.

G. V. HOLLOMAN, Major, A.C.
G.V. Holloman
RANDOLPH P. WILLIAMS, Maj. A.C.
Equipment Laboratory.
F.O.C.
F.O.CARROLL, Lt. Colonel, A.C.
Chief, Experimental Engrg. Section.

[redacted]

Ch., Mat. Div., Att. Executive, [redacted]
Central Files, Aircraft Radio Lab.

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GVH:dh:54
Wright Field, Dayton, Ohio.
March 3, 1941.

Chief, Materiel Division, OCAC, Washington, D. C.

Military Characteristics for a Dirigible Bomb, Radio Controlled.

1. Attached is a draft of letter to The Adjutant General, Subject: Military Characteristics for a Dirigible Bomb, Radio Controlled, prepared for signature in the Office, Chief of the Air Corps.

MAR 10 1941

F. O. CARROLL,
Lt. Colonel, A. C.
Chief, Experimental
Engineering Section.

1 Incl.
Ltr. to A.G.(undated)
(in quin.)

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Captain, Air Corps
Asst. Technical Executive

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CVF:dr:54
March 3, 1941.

Military Characteristics for a
Dirigible Bomb, Radio Controlled.

The Adjutant General.

1. The following military characteristics for a dirigible bomb, radio controlled, are submitted for approval by The Secretary of War.

A. Class - Dirigible bomb, radio controlled.

B. Mission - Use against objectives which will require an extremely high degree of accuracy.

C. Requirements -

(1) This dirigible bomb shall be equipped with control surfaces, actuated remotely by radio.

(2) The radio and associated controlling equipment shall permit the controlling bombardier to change or correct the trajectory of the bomb during its flight.

(3) This dirigible bomb shall incorporate equipment which shall indicate to the controlling bombardier the changes in trajectory necessary to correct for errors in range and deflection.

2. It is intended that the initial test article shall have a television equipment installed in the nose. The bomb will be dropped and, from a picture presented on a television screen to the controlling bombardier, the trajectory of the bomb will be changed or corrected. This should result in a missile with an extremely high degree of accuracy. Lift producing airfoils will permit the bomb to be glided. From present knowledge, this will allow the bomb trajectory

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The Adjutant General

to be brought within six degrees of the horizontal, if so desired. This will permit the bomb to be dropped from a point well outside the range of existing anti-aircraft artillery, and be glided from that point to the objective.

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MATERIEL DIVISION

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EXP-7-632   5-19-41

CHIEF, MATERIEL DIVISION

REQUEST APPROVAL BE OBTAINED FROM CHIEF SIGNAL OFFICER FOR THE INITIATION OF A PROJECT BY THE AIRCRAFT RADIO LABORATORY TO COVER THE PROCUREMENT AND DEVELOPMENT OF TELEVISION AND RADIO CONTROL EQUIPMENT FOR DIRIGIBLE BOMBS AND TORPEDOES. THE TRANSFER OF FUNDS AMOUNTING TO $60,000 TO THE AIRCRAFT RADIO LABORATORY HAS BEEN INITIATED TO PROVIDE FUNDS FOR THIS PROJECT

TECHNICAL EXECUTIVE

MAN

10:16 AM

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ARMY AIR FORCES
MATERIEL CENTER

MEMORANDUM REPORT ON TLM:ble:54:18476

Date September 29, 1942

SUBJECT: Controllable Glide Bombs

SECTION Experimental Engineering

SERIAL No. EXP-M-54-673-4 V

Contract No.
Expenditure Order No. 673-12
Purchase Order No.

A. Purpose:

To report on a trip to Warren Grove, New Jersey, September 16, 1942 to observe tests conducted by Section D-3, of NDRC, on radio controlled television glide bombs.

B. Factual Data:

1. Tests were conducted on two identical units equipped with the following:

> Block 1 television; converted turn indicator with dead spot electric pick-off for pitch stabilization; converted turn indicator with dead spot electric pick-off for roll and direction stabilization; differentially operated elevons for control in roll, direction and pitch.

The Units had a wing span of 8.4 feet and carried 420 pounds of ballast to simulate a bursting charge. The Units were dropped from a Navy XBF-2 airplane.

2. The first unit flew, had fair directional and pitch stability, and had a hunt in roll of between five and ten degrees. It was controllable by radio. The television was not good enough to show objects on the ground except those of large contrast and area. Roads parallel with the horizon showed clearly from about 3000 feet altitude down. Roads parallel with the line of flight showed as rapidly moving crooked lines. The target, a cluster of white meterological balloons, was not recognizable in the picture at any time.

3. The second unit flew, had fair directional and pitch stability, and had a hunt in roll of between five and ten degrees. It was controllable by radio. The television picture was about the same as in the first test. The target, a cluster of white meterological balloons, was not recognizable in the picture at any time.

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AFMC-266-WF-1-6-42-50M

Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-4 V
September 29, 1942

4. Present at the tests were:

Army Air Forces

Captain T. L. Mayrath
Lieutenant Shoemaker
Lieutenant Love
Lieutenant Scripps

United States Navy

Admiral Fuhrer
Captain Smith
Commander Fahrney
Lieut. Commander DeVars
Doctor Fiore

Section D-3 NDRC

Doctor Dryden
Doctor Eaton
Doctor Joliffe

Radio Corporation of America

Mr. Loren Jones
Doctor Zworykin
Mr. Ray

C. Conclusions:

1. That the television equipment as tested did not give a picture of sufficient clarity to enable the operator to locate the target.

2. That no results were obtained which would indicate what accuracy of control can be expected of this type of controllable glide bomb.

Concurrence:

Prepared by Thomas L. Mayrath
THOMAS L. MAYRATH, Capt., A.C.
(Name)

Approved by J. G. Hopkins Maj. A.C.
J. F. HOLLOMAN, Col., A.C.
Chief, Equipment Laboratory

Approved by M Hayward Lt Col. A.C.
F. O. CARROLL, Col., A.C.
Chief Exp. Engrg. Section

Distribution:
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DAC-200-A-WF-5-27-41-60M

WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION
ENGINEERING DIVISION
MEMORANDUM REPORT ON

AN:ms:54:245

Date January 29, 1943

SUBJECT: Television.

XXXXXXX Equipment Laboratory

SERIAL No. ENG-M-54-673-4 MR

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Contract No.
Expenditure Order No. 673-12
Purchase Order No.

A. Purpose.

1. To report on an Army-Navy conference on utilization of television research facilities.

B. Factual Data

1. A conference was held on January 12, 1943 at the Navy Building in Washington, D. C.

2. Present at the conference were:

Materiel Center

Lt. Col. D. B. Young
Lt. Col. F. Nyman
Mr. H. T. Rohl

Signal Corps

Lt. Col. M. M. Brandt
Maj. L. G. Swendson
Lt. Col. F. S. Dollenbaugh and a group of officers.

Materiel Command

Maj. Allis
Capt. Norwell

U. S. Navy

Rear Adm. Furer and a group of officers.

N.D.R.C. - (Group 5.3)

Dr. Buckley
Dr. Pierre Mertz

R.C.A. Mfg. Co.

Mr. Rhea

General Electric Company

Dr. Frankl.

3. Admiral Furer opened the conference by indicating the need for utilization of available research facilities and personnel conversant in television on projects of essential nature only.

4. The U. S. Navy had a list of seven projects of which two were decided to be unessential.

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Equipment Laboratory, Engineering Division,
Memorandum Report No. EXO-M-54-673-4 NN
January 29, 1943

5. The Army Air Forces schedule indicated a major project for the utilization of television on controlled projectiles of glide and high angle types.

6. The utilization of television on a telemetering system was indicated as both an Army and Navy project.

7. Dr. Buckley discussed the available research facilities of which R.C.A. was considered predominant. The Hazeltine Service Corporation, General Electric Company, Philco Company, Farnsworth Television & Radio Corporation and Remington-Rand Inc., were also mentioned.

8. Dr. Buckley considered the improvement of the present Block I and Block III equipment as developed jointly for Army and Navy as the most important work.

9. Dr. Buckley suggested that the Hazeltine facilities be used to establish a test program.

10. Mr. Rhea outlined the available facilities at R.C.A. and their assignment to different Army and Navy projects.

11. A Materiel Center representative indicated that a reduction in size or a rearrangement of parts of Block III equipment for a more compact unit should be vigorously considered as a part of R.C.A. research program without alteration in the established production schedule on this equipment.

12. The Materiel Center representative indicated also that standardization of test procedure as suggested by Dr. Buckley would be of advantage especially with regard to the following features:

a. Resolution of image and identification of small objects on the image.

b. Illumination range for successful operation.

c. Range of operation. (Distance for different assigned wave lengths.)

d. Interference and microphonics.

13. The Materiel Center representative suggested also that the development of telemetering devices by an R.C.A. associate (N.B.C. of New York) be coordinated in use with Block III television equipment and radio control equipment developed by the same Company.

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Equipment Laboratory, Engineering Division.
Memorandum Report No. ENG-M-51-673-4 NH
January 29, 1943.

14. A suggestion was offered by Lt. Comm. Conrad that any new development projects on television be coordinated through Dr. Buckley as the head of the corresponding group of N.D.R.C.

15. A representative of the Aircraft Radio Laboratory voiced a strong objection to this suggestion as being contradictory to the assigned function of N.D.R.C. for the development of devices for the military forces.

16. A compromise was reached by changing the suggested coordination to an optional unofficial consultation by interested personnel.

C. Conclusions.

1. That the utilization of research facilities has been thoroughly discussed.

2. That the requirements of television development for the Material Center have been clearly indicated.

3. That some advantage would accrue from consultation with N.D.R.C. group on any new development.

D. Recommendations.

1. That the development of a more compact television set for replacement of Block III be vigorously investigated. (Action taken by the Aircraft Radio Laboratory.

2. That standardization of tests and specifications be established in cooperation with the U. S. Navy and the N.D.R.C. group. (Action to be taken by the Aircraft Radio Laboratory.)

A. NYMAN, Lt. Colonel, Air Corps.

G. V. HOLLOMAN, Colonel, Air Corps.
Equipment Laboratory,
Engineering Division.

F. O. CARROLL, Brig. Gen. U.S.A.
Engineering Division.

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Chief of Staff Materiel Command AAF.
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THE DEVELOPMENT OF GUIDED MISSILES

APPENDIX B

AAF Missiles Documents

VOL. II

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Downgraded to Unclassified in accordance with letter from AMC dated 17 Nov 59, Sub: "Declassification of Histories (U)"

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Auth:N.D.R.C.

Development of Television Equipment for Glide Bombs.

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X-413.44

1st Ind.

Equipment Laboratory, Engineering Division, Wright Field. JAN 29 1943
To: Chief, Engineering Division, Wright Field.

1. This Office has carefully studied the attached Routing and Work Sheet and must take exception to a number of statements contained therein:

a. It is true that considerable pressure has been exerted by personnel of this Office on personnel of the Aircraft Radio Laboratory to investigate new and promising developments of television equipment observed by members of this Office. This Office not only considered them promising but they have shown sufficient advance in the art to cause contracts to be placed by that section of N.D.R.C. which is charged with the development of television equipment.

b. In reference to the second paragraph of this Routing and Work Sheet, prior to April 1942 the personnel of the Special Weapons Branch of this Office were informed by the Aircraft Radio Laboratory that the Radio Corporation of America, manufacturers of Block I equipment, would be able to decrease the size and weight of this equipment in a new design referred to as Block III "Jeepette" type television. However, at a conference held in the Aircraft Radio Laboratory on April 16, 1942, the Special Weapons Branch was informed by RCA and Aircraft Radio Laboratory representatives that the size of Block III equipment would be practically double the size of Block I equipment. This Block III equipment therefore became too large to be installed in the available glide bomb without possible injury to its flight characteristics. As no alternative television equipment was suggested at that time the Special Weapons Branch agreed to design a new glide bomb suitable for Block III equipment.

c. An experimental quantity of these bomb structures is now being manufactured and will be available for tests about February 28th. This new structure is necessarily more complicated and bulky than the original glide bomb and requires moreover a period of testing and correction to assure proper flight characteristics.

d. It is therefore evident that great advantage would be achieved if small television equipment can be obtained of a size and configuration suitable to the present available and less expensive glide bomb.

e. The CTI-611, Add. #3 dated October 19, 1942, placed on the Engineering Division, and in particular the Special Weapons Branch, the obligation to initiate procurement of a large number of television units for glide bombs. This procurement has been initiated on the basis of the only available television equipment suitable for the intended tactical use which is the aforementioned Block III equipment. This procurement will be handled through the Director of Communications, Army Air Forces and the Office of the Chief Signal Officer.

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1st Ind. to Chief, Engineering Division.
Development of Television Equipment for Glide Bombs.

JAN 2 9 1943

f. The basis of this procurement is outlined in the fourth paragraph of the 1st Indorsement to the Chief, Production Engineering Section, Wright Field, dated December 18, 1942. As the Block III equipment may not be suitable for the available type of glide bomb and the above CTI-811 Add. #3 places urgent requirements for delivery of glide bombs equipped with television, it becomes therefore the duty of the Special Weapons Branch to consider any new developments in television which could possibly aid in the furtherance and a successful accomplishment of these requirements.

g. All information that has reached this Branch on the subject of such new developments has been communicated to the Aircraft Radio Laboratory with urgent requests that the new sources for procurement of small television sets be investigated and encouraged to develop suitable television equipment of small size in so far as their research and manufacturing facilities were adequate.

h. In reference to paragraph 3. of the Routing and Work Sheet of the Aircraft Radio Laboratory, the personnel of the Special Weapons Branch were informed by Section D-3 of N.D.R.C. in connection with a high angle bomb project which the latter is carrying out at the request of the Special Weapons Branch, that the Remington Rand Company and the Farnsworth Television Company were developing a small size television unit for use on the high angle bombs. The equipment developed by the Remington Rand Company was inspected by representatives of the Special Weapons Branch on November 11, 1942 as reported in Memorandum Report EXP-M-54-673-4 CC. The recommendation of this report is as follows:

"1. That the Aircraft Radio Laboratory investigate the manufacturing facilities and the design features of the Remington Rand television devices with the procurement of those devices as eventual possibility."

As no action has been taken independently by the Aircraft Radio Laboratory in accordance with this suggestion, a visit was arranged for representatives of the Remington Rand Company at their request on January 11, 1943 to Wright Field. A conference between these representatives and the Aircraft Radio Laboratory was held on that date. It is understood that the Remington Rand Company will submit a development proposal to the Aircraft Radio Laboratory.

On November 26, 1942 representatives of the Special Weapons Branch and of the Aircraft Radio Laboratory visited the Farnsworth Television Company during which visit a demonstration of their television set was given and certain requirements of a television set suitable for glide bombs were discussed. This visit is reported in Memorandum Report EXP-M-54-673-4, FF and in Aircraft Radio Laboratory report dated November 27, 1942. The Aircraft Radio Laboratory report bears no recommendations and the Special Weapons Branch report bears the following:

"1. That a proposal be obtained from the Farnsworth Television Company to modify their present device to suit operation in a glide bomb. (Preliminary action has been taken.)

[redacted]

CCF MX108 F6
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[redacted]

1st Ind. to Chief, Engineering Division.
Development of Television Equipment for Glide Bombs.

JAN 29 1943

e. That consideration be given to incorporation of the improved iconoscope at least on the Block III equipment sub-contracted to the Farnsworth Television Company. (Action to be taken by the Aircraft Radio Laboratory.)"

A proposal from the Farnsworth Television Company in accordance with the first recommendation of this report was received, addressed to an individual of the Special Weapons Branch on January 5, 1943. It was immediately referred to the Aircraft Radio Laboratory. On January 9, 1943 a conference was held between the representatives of the Farnsworth Television Company and the Aircraft Radio Laboratory in order to consider this proposal and introduce such changes as may be necessary. It is understood that a modified proposal is expected from that Company by the Aircraft Radio Laboratory.

f. In reference to paragraph 4.a. of the Routing and Work Sheet investigation and negotiation of new types of television equipment are properly the function of the Aircraft Radio Laboratory. However, it has become the duty of the Special Weapons Branch, entrusted with the procurement of suitable television equipped glide bombs to bring to the attention of the Aircraft Radio Laboratory such devices as in their opinion may have possible utilization for this purpose.

g. In reference to paragraph 4.b. the Aircraft Radio Laboratory has been constantly kept aware of the specific requirements and limitations of the necessary television equipment. In particular, strong and insistent protests have been voiced against the large and unwieldy size of Block III equipment. RCA has expressed the opinion until very recently that the size of the Block III equipment could not be further reduced. Upon learning of the recent consideration that has been given to Remington Rand Inc., and the Farnsworth Television Company however, RCA now seemingly is willing to cooperate by decreasing the size and changing the configuration of the Block III equipment.

h. In reference to paragraph 4.c. it is the understanding of the Special Weapons Branch that the operating features of the equipment existing under N.D.R.C. contracts are entirely inadequate for glide bombs having a much lower resolution and much smaller range.

i. In reference to paragraph 4.d. it is the opinion of this Office that the new Companies referred to should be given an opportunity to demonstrate their skill in providing equipment suitable for glide bombs. In substantiation of this opinion attention is invited to report of Section D-3 of N.D.R.C. subject, Notes on Orthicon-Iconoscope Camera Tube Conference dated October 17, 1942, a copy of which is inclosed.

j. In reference to paragraph 4.e. the suggestion of this paragraph is entirely in order but such coordination should certainly be obtained by the Aircraft Radio Laboratory directly from N.D.R.C.

[redacted]

508

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1st Ind. to Chief, Engineering Division.
Development of Television Equipment for Glide Bombs.

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n. In reference to paragraph 4.f. it is not considered advisable at the present time to interfere in any way with the production schedule and procurement requirements of Block III equipment. Only if, and when, smaller but adequate equipment is available should such changes be considered.

2. In reference to Inter-Office Memorandum from the Aircraft Radio Laboratory dated January 4, 1943, a statement is made in paragraph 3 concerning a new type of glide bomb being developed for the Navy. This project is believed to have been initiated as a result of a selling campaign by R.C.A. The development was originally carried out independently by N.D.R.C. and was initiated at no request by either the Army or the Navy. Preliminary tests of the glide bomb were made by the Special Weapons Branch followed by tests of a scale model made by the Navy at which Special Weapons Branch representatives were present. Later all the tests of full size models were conducted with the assistance of the Special Weapons Branch. The results of these tests are reported in Memorandum Report EXO-4-51-673-4 MS. This glide bomb is not large enough to carry the Block III equipment and is certainly not as far advanced as the glide bomb developed by the Special Weapons Branch.

3. It is requested that information and proposals from Remington Rand Inc. and the Farnsworth Television Company concerning new developments of television sets be closely coordinated with the Engineering Division to determine their suitability to the available types of glide bomb. It is also requested that vigorous steps be taken to encourage R.C.A. to develop a smaller size television set for the available glide bomb, or to rearrange their present Block III to fit this bomb without detriment to its flight characteristics.

4. It is anticipated that within two weeks information will be on hand of the maximum possible space and the configuration of this space available for television equipment on the present type glide bomb.

RW

G. V. HOLLOMAN,
Colonel, Air Corps.
Chief, Equipment Laboratory,
Engineering Division.

2 Incls.
Incl. #1 - Withdrawn
Incl. #3 - Added:
Notes on Orthicon
Iconoscope Camera Tube
Conference.

[redacted]

[redacted]

CEF MX 108 #7
1/1

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490

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES (AFDMA-2F)
WASHINGTON

10 November 1943.

SUBJECT: Procurement of Glide Bombs Type G B-8

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio.

1. It has been requested by Air Communications Officer that necessary action be taken to provide 2000 glide bombs (less radio equipment) adapted to radio control within the range that a smoke flare installed in the base of the bomb can be seen.

2. Instructions should be issued to the manufacturer chosen to make delivery of these glide bombs on a schedule to be determined by the schedule of radio equipment deliveries.

3. Contacts should be made for details of the radio equipment and its delivery as well as for specifications and drawings of the glide bombs with Colonel George Holloman of the Aircraft Equipment Laboratory, Wright Field.

4. It is urgent that a decision be reached as soon as possible on the type of radio control since more time may be required in its procurement and production than for other parts of the bomb.

5. This office should be advised of probable delivery dates in order that shipping instructions can be coordinated with the Air Communications Officer and the Aircraft Equipment Laboratory at Wright Field.

Classification cancelled
~~or changed to~~
AUTH:
By
Signature and Grade
Date

By command of General ARNOLD:

[redacted]

R C Wilson

R. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Materiel Div.
Office, Asst. Chief of Air Staff
Materiel, Maintenance and Distribution.

Classification Changed
To "Restricted"
Auth:
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FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

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Date Initials

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AEB-2

ARMY AIR FORCES

10 Nov 43
RCW

HEADQUARTERS OF THE MATERIEL COMMAND

WASHINGTON, D. C.

TECHNICAL INSTRUCTIONS

Serial No.: [illegible]

Subject: [illegible]

To: [illegible]

1. [illegible]

a. [illegible]

[illegible]

a. [illegible] glide-bombs [illegible]

CD [illegible]
11-1-45

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND
WASHINGTON D. C.

TECHNICAL INSTRUCTIONS

Serial No.:

Subject:

To:

Engineering Division

10 Dec 4[illegible] - Dist by Prod Div
Orig copy to Glider & Misc. Branch
for necessary action.

[redacted]

CC: Chief, Airplane Projects
Aero. Equipment Branch (2)
Resources Cont. Section
Production Division File

NOTE: Release of this directive has been withheld until determination was made as to the branch to administer this project.

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[redacted]

ARMY AIR FORCES

HEADQUARTERS OF THE MATERIEL COMMAND

WASHINGTON D.C.

TECHNICAL INSTRUCTIONS

Serial No

Subject:

To:

[redacted]

3104

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

WASHINGTON, D. C.

[illegible] Field, [illegible], Ohio

TECHNICAL INSTRUCTIONS

[illegible] November, 1943

Serial No.: [illegible]

Subject: Procurement of [illegible]

To: Production Division

c. [illegible]

d. [illegible]

[illegible]

Deputy Chief of Staff

CD-356

11-1-48

Cc: Aircraft [illegible]
Air Service [illegible]
Engineering Division

10 Dec 43 - Dist by Prod Div
Orig & cy to Glider & Misc. Branch for necessary action.

CC: Chief, Airplane Projects
Aero. Equipment Branch (2)
Resources Cont. Section
Production Division File

NOTE: Release of this directive has been withheld until determination was made as to the branch to administer this project.

W. F. DONNELLY
Asst. to Chief,
Production Division

CCF MX 108 #8
1/2

[redacted]

492

TO-9

Lt. J. R. Dungan,
3-1249
JRD:abs

2 February 1944

Status Glide Bomb Procurement
GB-4 and GB-8

Commanding General
Army Air Forces
Washington 25, D. C.

Attention: AC/AS, MM&D, Chief Development Engineering Branch
Major V. A. Stace

1. Letters of Intent have been issued for the procurement of the subject Glide Bomb units as indicated below.

Contractor	Article to be Mfgd.	Letter of Intent
Klassen Company	GB-4 Airframe	25 January 1944
Aeronca Aircraft	GB-8 Airframe	29 January 1944
Hammond Instrument	Hammond Units RF & ASF	27 January 1944
Delco Remy Division, General Motors	Batteries	27 January 1944

2. The contractors concerned are at present securing allocation of materials and as soon as the materials situation is cleared, the production of Glide Bombs can begin. As was indicated previously, however, it appears that the radio control equipment will be the limiting factor. The Special Weapons Branch of Equipment Laboratory, in conjunction with Aircraft Radio Laboratory, has determined, as a result of test, that the RC-185 radio receiver contemplated for the GB-4 is unsatisfactory. In lieu thereof, it is recommended that the AN/CRW-3 receiver, which is already to be incorporated in the GB-8, be used in the GB-4. This change will necessitate an additional procurement of two thousand (2000) AN/CRW-3 receivers and the cancellation of the RC-185 receivers.

3. The following contracts have been placed by the Dayton Signal Corps Procurement District for the radio equipment.

Contract No.	Manufacturer	Item	Del. Schedule	Quantity
750DAY-44	Hammond Inst.	AN/CRW-3	None Available	2000
Navy Diversion		Block III	" "	2000

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AAFMC-100-WF-5-26-42-2 Mil.

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Commanding General, Army Air Forces
Subject: Status Glide Bomb Procurement
2 February 1944

In addition to this equipment, which is contracted for, the additional quantity of two thousand (2000) AN/CRW-3 receivers will be required as was indicated above.

4. It is desired to point out that, in view of the above, the Material Command, it is anticipated, will be in a position within ten (10) days to set up production schedules for the GB-4 and GB-5 airframe units and Army Air Forces procured control equipment. However, the availability of the associated radio equipment is still unknown. It is urged that every effort be made to expedite procurement and scheduling of the Signal Corps procured equipment.

For the Commanding General:

W. M. MORGAN
Colonel, Air Corps
Chief, Production
Engineering Section

cc:
Special Weapons Br., Equip. Lab., E. D.
Airc. Components Br., RCS - Lt. Col. Royce
Unit A, General Proc. Br., Proc. Div. - Lt. Geiser
Technical Executive - Capt. Davis
Chief, Airplane Projects, PES

COM. GEN.
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MX-108

AAFMC-190-WP-5-20-42-2 MIL

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Address reply & ENVELOPE to:

1/3

Commanding General
AAF Materiel Command
Engineering Division
Reference ESE:mo:54
Wright Field, Dayton, Ohio

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[redacted]
AUTH: F. O. CARROLL
BRIG. GEN., U.S.A.
DATE 23 MAY 1944
INITIALS: [illegible]

23 MAY 1944

COM. GEN.
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Use of GB-8 Glide Bombs.

794

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Special Projects Section,
Air Communications Officer.
Thru: Asst. C/AS, MMD, Materiel Division.

1. Tests conducted at Tonopah, Nevada during the past two months have proven the technical reliability of the GB-8 glide bomb and resulted in the development of a dropping technique which in the opinion of this Office will result in satisfactory accuracy.

2. During this period, thirty-eight (38) glide bombs were dropped; thirty-four (34) controlling perfectly; one spun in due to damage caused by an accidental opening of bomb bay doors; one spun in, cause unknown; one could not be controlled due to failure of the fuse in the radio transmittor; and one did not respond to right or left control, cause unknown. No failures of any kind have occured in the last twenty-four (24) bombs dropped.

3. The technique of dropping is as follows: The airplane heads directly for the target at an altitude between 9,000 and 14,000 feet, (9,000 feet being the minimum which provides sufficient altitude to accomplish the maneuver and 14,000 feet the maximum which visibility of the flares permits.) When the horizontal distance to the target is 3.75 times the altitude, the pilot turns 70° in either direction. As soon as the airplane resumes level flight, the bomb is dropped. The airplane then turns 30° away from the target, flies straight for 30 seconds, turns 30° toward the target, and then continues in a slight bank toward the target until the impact of the bomb. The bomb is flown in a curve to the target.

4. Controlling the bomb requires considerable judgement and mental calculations since the controller can only see the location of the bomb but not its altitude nor direction of flight. This he must estimate from a knowledge of control previously applied. It was found that it is possible for one man to perform the entire operation of dropping and controlling the bomb but only very carefully selected and highly trained men would be [illegible] of achieving

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Commanding General, Army Air Forces, Washington 25, D. C. Attention: Special Projects Section, Air Communications Officer. Thru: Asst. C/AS, MMD, Materiel Division.
"Use of GB-8 Glide Bombs"
23 MAY 1944

a satisfactory degree of accuracy. On the other hand, it was found that by having the radio operator or other crew member control the bomb in azimuth from the waist gunner's position, training would be greatly simplified and accuracy greatly increased. Therefore, the latter method is greatly preferred.

5. Due to numerous variations in the methods used and different control operators trying their hand, none of whom were particularly trained, a complete tabulation of results would not be indicative of results to be expected in tactical use. The following, however, using the method outlined, are believed to be representative:

Bomb No.	Date	Altitude Above Target	Horizontal Distance of Impact From Center of Target	Direction of Error
17	29 Mar. 44	10,000 ft.	175 ft.	7 o'clock
18	29 Mar. 44	10,400 ft.	250 ft.	2 o'clock
19	30 Mar. 44	10,[illegible]00 ft.	130 ft.	7 o'clock
20	30 Mar. 44	10,200 ft.	340 ft.	1 o'clock
40	5 May 44	9,500 ft.	50 ft.	3 o'clock
41	5 May 44	15,000 ft.	200 ft.	1 o'clock

In controlling bombs number 17, 18, 19, 20, and 40, the airplane remained approximately seven miles from the target during the flight of the bomb and eleven miles during drop number 40. Due to difficulty in seeing the flares at the end of the latter run, it is recommended that 14,000 feet be considered the upper limit using this method.

6. Due to the success outline above and to delays now apparent in obtaining control equipment for GB-4, it is further recommended that steps be taken to place GB-8's in use without waiting for the necessary equipment for GB-4's. Reasons for this plan are as follows:

a. GB-8 production article has been tested and has proven satisfactory. No tests have yet been made of GB-4 production article. These will be completed approximately 15 June 1944.

b. The GB-8 is simple and cheap compared to GB-4.

c. All components for GB-8 are available in large quantities, and quantity production is now under way, while the supply of television equipment for GB-4 is extremely limited.

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Commanding General, Army Air Forces, Washington 25, D. C. Attention: Special Projects Section, Air Communications Officer, Thru: Asst. C/AS, MMD, Material Division.
"Use of GB-8 Glide Bombs"

23 MAY 1944

d. Recent tests indicate accuracies at least as good as GB-4.

e. Training required to put GB-8 into tactical use will require only a fraction of the time and personnel necessary for GB-4; therefore, GB-8 can be put into use months before GB-4.

7. It is suggested that simple modification kits to adapt B-17's and B-25's be assembled at once and that a supplementary kit to adapt B-17's for use with GB-4's be made up when components become available. It is now believed impractical to use GB-4's on B-25 airplanes due to limitations on space in the airplane for control equipment and to the fact that it would be necessary to cut a hole in the bottom of the airplane to accommodate the bomb antenna.

For the Commanding General:

G. H. WINDSOR, CAPT., A.C.

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

25 MAY 1944

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...ing General,
...erial Command
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Wright Field, Dayton, Ohio

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

Colonel S. R. Stewart
mec: Ext. 2-0155

WRIGHT FIELD, DAYTON, OHIO
5 JUL 1944

Subject: New Methods of Employment of GB-8 Glide Bomb.

To: Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Development Engineering Branch, Materiel Division, AC/AS, MMD. Lt. Col. F. H. Richardson.

1. This Office has now flight tested a large number of GB-8 glide bombs. The results of these tests indicate that the glide bomb itself, with its radio flight control apparatus and flare assembly, functions with excellent reliability. However, the degree of skill required to hit a target with the desired accuracy is evidently more than was anticipated. Since the use of the bomb in the manner originally contemplated may not be practical, this Office has under consideration several other uses for this glide bomb. The employment of one or more of these alternative methods will prevent the waste of the units now in manufacture and may result in the development of new and valuable weapons. By variations in the present bomb equipment, the same glider and control box could be used in the following applications:

a. GB-9 Radio Altimeter Controlled Glide Bomb - It is now believed that the most practical approach to the development of this weapon is through use of the standard GB-8 glide bomb with the addition of the so-called PY nose which will carry the radio altimeter control apparatus. Negotiations are now under way with the Hammond Instrument Company for development of the modification kit which, when added to a GB-8, will make a GB-9. This additional apparatus will automatically pull the bomb out of a fast diving flight into a smooth pull out and cause the bomb to fly horizontally with diminishing speed at a fixed altitude above the ground or water. It is believed that steering the glider in plan view from above will be easy to accomplish and the bomb can be dived into a target with accuracy. Tests will be made shortly to determine the ease of control in azimuth.

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CENTRAL FILES
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Commanding General, Army Air Forces, Washington 25, D. C.
Attn: Devel. Engin. Br., Mat.Div., AC/AS, MMD. Lt. Col. F. H. Richardson.
"New Methods of Employment of GB-8 Glide Bomb."

6 JUL 1944

b. Flare Carrying Glide Bomb - This method of utilizing the GB-8 is intended for tactical use to accompany night bombing raids in which conventional vertical bombing is used. The standard glider and the GB-8 control box is used but, in place of the bomb, would be carried a large wooden box in partially streamlined shape containing up to 90 parachute flares with a mechanism for releasing the flares during flight at intervals of 1 second or less by radio control. The first airplanes in a large formation would drop the flares and steer these gliders over the target area. Steering during the early part of the flight would be accomplished by observing electric lights which could be seen only from above. When the low altitude over the area is reached, the operator would press what normally would be the "Up" button and long as the button is held down the flares would drop out approximately 200 feet apart. Ninety flares would result in a line approximately 3 miles long. Several such gliders launched simultaneously would illuminate the entire target area with a brilliance not obtainable by any other method.

c. Anti Personnel Glide Bomb - This method of utilizing the GB-8 glide bomb would employ a standard glider, control box, and flare panel assembly, but carrying in place of the bomb a wooden box similar to that of the flare carrier. In place of the flares, 18/100 pound bombs or a larger number of smaller anti personnel bombs could be carried and released individually or in train attack on a road. Thus, an area could be covered with small anti personnel bombs without the hazards now encountered by airplanes making these attacks in a conventional manner.

2. It is requested that the above suggested uses of the GB-8 glide bomb be transmitted to the Office of Assistant Chief of Air Staff, Operation, Commitments, and Requirements, for a determination of requirements for the weapons as outlined and that such information be transmitted to this Office as a guide in developmental work on these weapons.

For the Commanding General:

S. H. Windsor

S. H. WINDSOR, CAPT., A.C.
F. O. CARROLL,
Brig. General, U.S.A.
Chief, Engineering Division.

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C. A.

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1st Ind. (AFDMA-2F)

Aug 12, 1944

FROM: Hdqrs. AAF, AC/AS, M&S, Materiel Division, Washington 25, D.C.

25109 TO: Commanding General, Materiel Command, Wright Field, Dayton, Ohio, Attention, Engineering Division.

1. The suggestions have been forwarded to Air Communications Officer and AC/AS, OC&R.

2. A directive has been sent to the Materiel Command to cancel 1000 of the 2000 GB-8's now in procurement.

3. It is recommended that the equipment now on hand be used for further development of the GB-9 and other Aeronca airframe missiles.

By command of General ARNOLD:

Jack A. Gibbs, Lt. Col. A.C.
For H. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Branch, Materiel Division
Office, Asst Chief of Air Staff
Materiel & Services

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AUTH: C. G. AAF
DATE: 8/1/44

CH. STAFF
DEP. CH. STAFF
TECH. SEC.
ADJ. GEN.
EXEC. PROC.
AIR. INSP.
INTELL.
COMPTROLLER
C.O.
PROD. DIV. (?)
PERS. SEC.
ENG. DIV.
PROD. DIV.
ENG. DIV.
PROC. DIV.
OTHERS

GMB:cjt
Wright Field, Dayton, Ohio
31 July 1944

[redacted]

GTI-1502, ADDENDUM NO. 5

Cancellation of Procurement of 1000 GB-8 Glide Bombs

Production Division

1. Problem Presented:

a. The Assistant Chief of Air Staff, Materiel and Services has directed that 1000 of the present procurement for 2000 GB-8 glide bombs be cancelled immediately and that all future work on the GB-8 project be terminated.

2. Factual Data:

a. Procurement of 2000 GB-8 glide bombs was established in GTI-1502, Addendum No. 1, dated 29 November 1943.

b. These instructions have been given verbally to Lt. Colonel Royce, Components Branch, Resources Control Section, on 25 July 1944.

c. Serious consideration should be given during cancellation of components for GB-8 bombs to present procurement for 700 target seeker vehicles now being processed and a potential order for 2000 GB-4 glide bombs for 1945.

3. Authority:

a. Commanding General, Army Air Forces, by teletype AAF-71705 dated 28 July 1944, from, Chief, Development Engineering Branch, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Production Division take immediate action to cancel 1000 GB-8 glide bombs from present procurement of 2000 units and advise the Assistant Chief of Air Staff, Materiel and Services through the Technical Office on or before 7 August 1944 the results of this cancellation. Complete information should be given on articles or components which could not be cancelled due to their production status at this date.

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Signature and Grade
Date: 11-1-45

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To "Restricted"
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Wright Field,
31 July 1944

[illegible]-1802, [illegible] RESTRICTED

[illegible]ncellation of Procurement of 1000 [illegible]
Glide Bombs

Production Division

b. That the Engineering Division suspend all further experimentation and test work on the [illegible] project.

c. These Technical Instructions amend [illegible]-1802, Addendum No. 1.

By Command of Brigadier General [illegible]

T. [illegible]
Colonel, Air Corps
Deputy Chief of Staff

cc: Engineering Division (action copy)
Inspection Division
Procurement Division
Air Service Command
Readjustment Division

COM. GEN.
CH. STAFF
DEP. CH. STAFF
TECH. EXEC.
ADJ. GEN.
EXEC. PROC.
AIR INSP.
INTELL.
COMPTROLLER
C.O.
BUD. OFF.
PERS. SEC.
ENG. DIV
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS

[illegible]
By CD-352
Signature and Grade
Date 11-1-43

[redacted]

[redacted]

AAFMC-190-WF-5-12-44-976M

CENTRAL FILES

ATSC Form No. 10-5 CEF MX 108
(19 Mar. 45)

376

ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

Use this form for inter-office correspondence within headquarters.
Use entire width of sheet, both sides.

Use authorized office symbols to designate addressor and addressee.
Number all comments consecutively.

Place initials of dictator and typist, telephone number and location to right of signature.
Separate comments by horizontal lines across page

SUBJECT Request Cancellation of CTI-1502, Add. 5

TO TSTEX
THRU: TSBPR
TSBC02

FROM TSBPR8G

DATE 9 May 45

COMMENT NO. 1

1. CTI-1502, Add. 5, dated 31 July 1944, Subject: Cancellation of Procurement of 1000 GB-8 Glide Bombs, directed that 1000 of the procurement for 2000 GB-8 glide bombs be cancelled.

2. Action desired was completed 23 Oct. 1944 when termination action by Procurement Division was completed.

3. It is requested that CTI-1502, Add. 5, be closed out.

/s/ H. I. Lord, Maj. AC
ORVAL R. COOK
Brig. General, U.S.A.
Chief, Procurement Division

R.P.M.
RPM:wm
3-4334

CC: TSBPR4C3

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109

The Drury Prtg. Co.—3-45—2 Mil. (CONTINUE ON OTHER SIDE)

CEF MX 108
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[redacted]

WMB:ear:TSCMP-4
23 September 1944
Wright Field, Ohio

COM. GEN.
CH. STAFF
DEP. CH. STAFF
TECH. 110
ADJ. GEN.
EXEC. PROC.
AIR. INSP.
INTELL.
COMPTROLLER
C.O.
BUD. OFF.
PERS. SEC.
ENG. DIV.
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS

CTI-1502, ADDENDUM NO. 6

Cancellation of Procurement of
GB-4 Glide Bombs

MX-108

Procurement Division

1. Problem Presented:

a. The Office, Assistant Chief of Air Staff, Materiel and Services has directed that immediate action be taken to cancel all future production of the GB-4 Glide Bomb.

2. Factual Data:

a. Procurement of two thousand (2000) GB-4 Glide Bombs was established in CTI-1502, dated 29 November 1943.

b. Separate action will be taken by the Signal Corps to cancel the radio requirements and any Block Three Requirements that will not be needed for the Castor Project.

3. Authority:

a. Commanding General, Army Air Forces by teletype WAR 33217, dated 19 September 1944, from Chief, Production Division, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take immediate action to cancel production of GB-4 Glide Bombs and advise the Office, Assistant Chief of Air Staff, Materiel and Services, through this office as soon as possible concerning the number of GB-4 units that are finally produced so that cancellation action may be taken with the Signal Corps on the appropriate quantity of radio equipment.

b. These Technical Instructions cancel and supersede basic CTI-1502, Addenda 2, 3 and 4.

By Command of Lt. General KNUDSEN:

Classification cancelled
or changed to
AUTH: CD-356
By Signature and Grade
Date 11-1-45

Classification Cancelled
To "Restricted" ~~RESTRICTED~~
Auth:
Initials

T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Engineering Div.
Maintenance Div.
Supply Div.
Liaison Office

AAFMC-190-WF

CENTRAL FILES

[redacted] 110

367

[redacted]

HQ., AIR SERVICE COMMAND
Patterson Field, Ohio

OFFICIAL BUSINESS

OUTGOING CLASSIFIED MESSAGE

Office of Origin TSE[illegible] (Symbol)

Date 10 October 1944

Originator J. R. D[illegible], Jr., 1st Lt., Air Corps (Officer's Name)

Telephone 2-[illegible]23 (Originating Officer)

Classification CONFIDENTIAL (Restricted-Confidential-Secret)

Precedence R[illegible]TINE (Deferred-Routine-Priority-Operational Priority-Urgent)

To: COMMANDING GENERAL
ARMY AIR FORCES
WASHINGTON, D. C.

20497

PREVIOUSLY ANTICIP[illegible] CUTOFF POINT OF [illegible] GEORGE [illegible] GLIDERS FROM [illegible] COMPANY [illegible] WILLIAM [illegible] ASH [illegible] TWO FIVE NINE IS NOT FEASIBLE [illegible] ASSISTANT CHIEF OF AIR STAFF [illegible] TO THE [illegible] CUTOFF POINT [illegible] ACTION IS [illegible] ASH FOUR GLIDERS [illegible]

The making of an exact copy of this message is forbidden. Only such extracts as are absolutely necessary will be made and marked "confidential". This copy will be safeguarded with the greatest care and will be returned to Glider & Misc. Aircraft Branch, Production Section without delay.

CD-356

Content and classification authenticated by

[illegible] Price
Colonel, Air Corps
Chief, Production Section

Distribution TSE[illegible]-10-63

TS[illegible]1A, Attn: Mr. Donnelly
TSEPM[illegible], Attn: Lt. Hill
TSEP[illegible]F, Attn: Major Marshall
TSE[illegible]

[redacted]

111

W421 [redacted]

[illegible]

AC/AS, Materiel and Services

8 Nov 1944

1

AFRSQ/M Col Bunch/bs/71406

AC/AS, OC&R, Requirements Division

1. Since the meeting of 2 November 1944, between CACAS, ATSC, M&S, OCR and other interested parties, the Guided Missile Program has been under study. It now seems advisable to focus our attention and efforts upon those projects which have the promise of being valuable tactical weapons during the present war. It is felt that in arriving at a reduced number of projects through such an evaluation we will be able to release engineering and development effort which can more properly be applied on those missiles which must be developed in order to meet the presently approved characteristics for ground to air, air to air, ground to ground, and air to ground guided missiles. Such a list of projects is included herewith. Initial requirements are stated and priorities have been established based upon existing information concerning the probable tactical usefulness and suitability of the various weapons. The exclusion of other guided missiles from this list does not necessarily mean that development should stop on these other projects nor does it mean that we should not be ready to apply what we may learn as a result of these developments to those items which we feel should be put into production at this time.

a. VB, Vertical Bombs (all except ROC which is a medium angle bomb) to be carried internally.

TYPE	NAME	SIZE	PRIORITY	CLASS	REQUIREMENT
VB-3	Razon	1000#	1A	A	3000
VB-4	Razon	2000#	1B	A	2000
VB-5	Light Seeker	1000#	1A	A	2000
VB-6	Felix (Heat Seeker)	1000#	1A	A	3000
VB-11	ROC Heat Seeker	1000#	1A	A	2000
VB-12	ROC Visual	1000#	1B	A	2000

b. GB, Glide Bombs (all carry 2000# bomb).

TYPE	NAME	SIZE	PRIORITY	CLASS	REQUIREMENT
GB-5D	Flare Seeker		1A	A	2000
GB-6A	Felix (Heat Seeker)		1A	A	2000
GB-8	Visual		2C	A	1000

c. JB, Jet Propelled Flying Bombs.

TYPE	NAME	SIZE	PRIORITY	CLASS	REQUIREMENT
JB-2	Copy of German V-1	2000#	1A	A	3000

d. BQ, Powered Guided Missiles other than Jet Bombs.

112

TYPE	NAME	SIZE	PRIORITY	CLASS	REQUIREMENT
BQ-3	Fairchild	4000#	3A	D	None
BQ-7	B-17 Willie	20,000#	1A	A	1000 Control Kit
BQ-8	B-24 Willie	20,000# [redacted]	1A	A	Control Kit

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Gen.
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W422 [redacted]

Guided Missiles

AC/AS, Materiel and Services — 8 Nov 1944

AC/AS, OCR, Requirements Division — 1 cont'd

3. It is felt that the projects may be listed in order of usefulness as a tactical weapon as follows:

__1A__

VB-6	VB-11	GB-6A	BQ-7
VB-5		GB-5D	BQ-8
VB-3			JB-2

__1B__

VB-4
VB-12

__2C__

GB-8

__3A__

XBQ-3

MERVIN E. GROSS,
Brigadier General, U. S. A.

[redacted]

Gen
15-3/11 PP
Elec Sec, OCE

w 423

[redacted]

VB. VERTICAL BOMBS, ALL TO BE CARRIED INTERNALLY

VB-1: AZON 1000# Missile.

Development work is to continue on this missile in an effort to further increase the accuracy which, to date, has been poor. The Army Air Forces Board is at present dropping some of these bombs in an effort to arrive at figures which would be considered as representing normal dispersion. There will be no further procurement.

VB-2: AZON 2000# Missile.

Same remarks as VB-1. Bombs are at the Army Air Forces Board awaiting dispersion tests.

VB-3: RAZON 1000# Missile.

This project has been raised to a 1A priority in order to expedite the development since reports from preliminary tests indicate excellent capabilities and accuracy. It is felt that RAZON will completely take the place of AZON and is considered a powerful and effective weapon with a minimum of supply difficulties since it employs a standard bomb in combination with minimum added equipment. Production facilities presently set up. However, the manufacturer of the control equipment insists that he must have an order for at least 4000 control motors per month in order to maintain his production line. If the minimum requirement for this missile is such that we can immediately issue instructions for the procurement of 1000 units, the production facilities can then get into production almost immediately.

VB-4: RAZON 2000# Missile.

Same remarks as VB-3 with the exception that the priority has been raised to 1A on this unit. A requirement is desired for both VB-3 and VB-4.

VB-5: Light Seeker.

This project has been cancelled.

VB-6: FELIX - Heat Seeker

This is felt to be a most promising missile and tests, to date, have shown that its accuracy when used against a sufficiently strong heat source is extremely good. Production facilities are set up and if an immediate requirement can be established, these facilities can be in production up to 1000 units per month in ninety (90) days. The use of this missile in B-17's requires a shackle adapter which moves the bomb three (3) inches forward. Its use in B-24's requires the use of the same sort of adapter in a portion of the stations in the rear bomb bay, also a portion of the automatic pilot installation must be relocated. A requirement is desired.

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MEDIUM ANGLE BOMBS TO BE CARRIED EXTERNALLY

VB-9:	ROC Radar Seeker.	It is felt that this missile has the necessary desirable characteristics. Experimental work is still being continued.
VB-10:	ROC - Medium Angle - Television.	It is not felt that this missile has the necessary desirable characteristics partly due to the limitations imposed by the use of television equipment. Some work is going ahead on this device.
VB-11:	ROC - Medium Angle - Heat Seeker.	It is felt that this missile has excellent possibilities, the accuracy depending upon the discriminating ability of the heat seeker. From work which has been done [illegible] on other missiles, it is felt that the heat seeker [illegible] will shortly approach a state of development which will produce the desired results.
VB-12:	ROC - Medium Angle - Visual Control.	This development is continuing and it is felt that it may have desirable characteristics [illegible] the RAZON due to its higher rate of turn which will make it more desirable for employment against targets using violent evasive tactics.

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[illegible] ALL [illegible]

GB-1	[illegible] Glide Missile.	This project has been discontinued due to the inaccuracy, trouble, extra work and modification of aircraft involved due to the use of this missile. Theater reception of this [illegible] was not too good.
GT-1 -1	[illegible]	This project has been cancelled due to lack of interest on the part of the using services. A squadron of P-25's was prepared and sent to Hawaii. It was felt that there were no targets within their striking range and to date they have not been employed. Opinions differ as to the accurac which can be achieved.
[illegible]	[illegible] - Television Guided.	This project has been dropped to a 3A priority which means that some development work will be carried on. Results which have been obtained with this missile have not been encouraging due to the inherent limitations of television pictures.
GB-5A:	Light Contrast Seeker	This item has been dropped to a 3A priority in order that development work may continue on the contrast seeker head which, up to the present time, has been plagued with the inherent difficulties attendant to the use of any visual or television signal. The outlook does not appear to be too hopeful.
[illegible]	Flare Seeker.	Initial tests have indicated that flare seeker glide bombs can be used with extreme accuracy as they have repeatedly put these bombs into the flare on the ground. The usefulness of this missile and all others of the GB type is limited however due to the modification required on the aircraft and the special preparation necessary for the employment of these aircraft on a mission.
GB-6A:	Heat Seeker.	It is felt that this missile can be very effective, its effectiveness depending again upon the discriminating ability of the heat seeking unit which is constantly being improved. It is felt that the heat seeker device will shortly approach the point of having all the desired characteristics.
GB-7A:	RHB Reflected Radar Homing	Has been lowered from 1A priority to 3A since it is felt that development work has not progressed to a point where the accuracy is sufficient to make it an important tactical weapon.
GB-7B:	SRB Send Receive Radar	Has also been lowered to a 3A priority for the reason mentioned above.
GB-8:	Visual.	Has been dropped for the same reasons given in the case of GB-1.

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GB, GLIDE BOMBS, ALL CARRYING 2000# BOMBS

GB-9	2000# Ground Skimmer Glide Bomb.	Has been dropped.
GB-10:	Television.	No production is contemplated on this item which uses television similar to that used in the GB-4 although of a different size. Development work is continuing. In view of the superiority of the air frame used with the GB-4, it is felt that the GB-4 would be a superior weapon of this particular type. The inherent difficulties already mentioned in connection with television equipment imposes a considerable restriction on its employment.

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JB, JET [illegible]

JB-1: Northrop Tail-less Flying Bomb

The JB-1 is a Jet propelled aircraft having a gross weight of approximately 7,000 pounds, designed to carry two (2) 2,000 pound bombs on each side of the fuselage in a specially designed root fairing. It will have an estimated speed of between [illegible] and [illegible] miles per hour, an altitude of 15,000 feet and will have a range of about [illegible] miles. Only four (4) of the engines have been delivered and instead of producing 400 pounds of thrust each, they produce [illegible] pounds. This thrust is insufficient to fly the aircraft which has, therefore, not been flown except that one air frame has been dropped from an aircraft and flown as a glider with almost disastrous results due to longitudinal instability. This article has been lowered in priority to JB and the classification has been changed to C. It is felt that the expensive construction due to adherence to aircraft standards will not compensate for its possible longer range and that the JB-2 will accomplish essentially the same mission at much less expense.

JB-2: (Chinese) Copy of German Robot Bomb.

This project has been completed and is in production. The additional order of 1,000 being the only requirement at the present. As of 2 November 1944, four (4) launchings have been made, all unsuccessful. The fifth launching was to have been made [illegible] November 1944, but no information has been received on this. Development work is continuing on the automatic stabilizing controls which have a 1A priority. It is felt that this weapon will be our most successful ground to air pre-set missile. There is hope of converting this into a controlled [illegible] missile and tracking experiments will be continued at the earliest moment possible. 5,000 rockets to be used in launching are being procured (five (5) rockets per launching).

[redacted]

00418 [redacted]

XB[illegible], POWERED GUIDED MISSILE

XB[illegible]-3: Powered Guided Missiles. The XB[illegible]-3, built by Fairchild, carries a bomb load of [illegible],000 pounds, having a range of 1,[illegible] miles at a speed of 200 miles an hour. It is the only [illegible] since all of the others delivered have either crashed or the projects have been closed out. Development on this project is continuing on the basis of a [illegible] and the project is to be closed out upon the completion of the present development work.

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[illegible] AIRCRAFT USED AS GUIDED MISSILES.

[illegible] [illegible] B-17 modified as a control missile and has a 1A priority. At present, it has been directed that these missiles will be flown using the automatic pilot as the only control. Development work is to go ahead as fast as possible on a refinement of the control and the method of controlling from the air and from the ground in an effort to increase the accuracy with which the missile can be employed. In its present form, it will be an "area" weapon. However, it is felt by all concerned that there will be no difficulty in controlling the flight and point of impact of this missile up to 150 miles with the same degree of accuracy as is now possible in blind close support bombing.

[illegible] [illegible] B-24 modified as a control missile and has a 1A priority. Information in above paragraph applies to the B-17.

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TAB B

1. VB, Vertical Bombs all (except ROC which is a medium angle bomb) to be carried internally. All are NDRC developments.

TYPE	NAME	SIZE	PRIORITY	CLASS	ON ORDER	REQUIRE.
VB-1	Azon	1000#	2B	A	0	No
VB-2	Azon	2000#	2A	A	120	Test Only
* VB-3	Razon	1000#	1A	A	3000	No
* VB-4	Razon	2000#	2A	A	-	No
* VB-5	Light Seeker	1000#	Cancelled - - - - - - - - - - - - - -			
* VB-6	Felix (Heat Seeker)	1000#	1A	A	140-	No
VB-7	Television	1000#	Cancelled - - - - - - - - - - - - - -			
VB-8	Television	2000#	Cancelled - - - - - - - - - - - - - -			
VB-9	ROC Radar Seeking	1000#	NDRC	A	5	No
VB-10	ROC Television	1000#	NDRC	A	5	No
* VB-11	ROC Heat Seeking	1000#	NDRC	A	5	No
* VB-12	ROC Visual	1000#	NDRC	A	5	No

2. GB, Glide Bombs (All Carry 2000# Bomb).

TYPE	NAME	PRIORITY	CLASS	ON ORDER	REQUIRE.
GB-1	Preset	Cancelled - - - - - - - - - - - - - -			
GT-1	Preset	Cancelled - - - - - - - - - - - - - -			
GB-4	Television	3A	C	1000	No
GB-5A	Light Contrast Seeker	3A	C	25	No
-5C	Light Contrast Seeker	3A	C	30	No
* GB-5D	Flare Seeker	1A	A	20-	No
GB-6A	Felix Heat Seeker	1A	A	120-	No
GB-7A	Radar Seeker	3A	C	200	No
GB-7B	Radar Seeker	3A	C	500	No
GB-7C	Enemy Radar Seeker	Cancelled - - - - - - - - - - - - - -			
* GB-8	Visual	3C	D	1000	No
GB-9	Ground Skimmer	Cancelled - - - - - - - - - - - - - -			
GB-10	Television in Nose	3C	D	C	No

3. JB, Jet Propelled Flying Bombs.

TYPE	NAME	SIZE	PRIORITY	CLASS	ON ORDER	REQUIRE.
JB-1	Northrop Flying Wing	4000#	2B	C	13	No
* JB-2	Copy of German V-1	2000#	1A	A	1000	No

4. BQ, Powered Guided Missiles other than Jet Bombs.

TYPE	NAME	SIZE	PRIORITY	CLASS	ON ORDER	REQUIRE.
* XBQ-3	Fairchild	4000#	3A	D	-	No
* BQ-7	B-17 - Willie	20,000#	1A	C	275 (55 Control Kits)	No
* BQ-8	B-24 - Willie	20,000#	1A	C	275 (55 Control Kits)	No

* Those types marked with the (*) are deemed to have greatest possibilities and it is upon those that it is recommended that our efforts be concentrated.

[redacted]

[redacted]

			VEHICLES				
			DROPPED FROM AIRCRAFT			LAUNCHED FROM SURFACE	
			Corrected	Moderately Steered	Gliders	Reciprocating Engine	Pulse Jet
CONTROL	REMOTE	Visual	AZON VB-1, 2 RAZON VB-3,4	VB-12	GB-8	XBQ-[illegible]	
		Television Signal from Missile				BQ-7 (B-17) BQ-8 (B-24)	
	HOMING	On Infra Red	VB-6	VB-11	GB-6A		
		On Flare	VB-5		GB-5D		
	PRESET						(German V-1) JB-2

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P-1

Auth: DIR., ATSC
Initials ___
Date 23 November 1944

ARMY AIR FORCES
AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND
ENG

MEMORANDUM REPORT ON

Major J. M. Pomykata:hle
Ext. 2-7127
Date 23 November 1944

SUBJECT: Overseas Project No. 92809-S (Project "Batty," GB-4 and GB-8).

OFFICE TSEPL-31

Contract or Order No.

SERIAL No. TSEPL-3-673-4-J-2

Expenditure Order No. 673-12

A. PURPOSE:

1. To report on GB-4 and GB-8 mission in the European Theater of Operations.

B. FACTUAL DATA:

1. On 27 and 28 June 1944 Air Technical Service Command Personnel with B-17G airplanes, 42-97518 and 42-40043, and seven GB-4 and seven GB-8 glide bombs with necessary equipment were dispatched from Wright Field, Ohio, to the European Theater of Operations to carry out secret orders in connection with Overseas Project No. 92809-S.

2. Tests of GB-4 (television equipped) glide bomb were conducted under actual combat conditions during the period of 13 August 1944 to 13 September 1944. For the performance of these tests personnel and equipment from Wright Field were assigned to the 8th Air Force, Third Bomb Division, and stationed at AAF Station 140.

3. Six combat missions were attempted with the GB-4 bombs but only four missions were completed. For complete details see Appendix 1 attached.

4. Personnel sent to the European Theater of Operations on this project were:

Air Technical Service Command

Major Joseph M. Pomykata	T/Sgt. Elbert Rudder
Major James N. Hall	T/Sgt. Francis L. Wallis
1st Lt. Raymond J. Morris	T/Sgt. Paul R. Lorash
1st Lt. Leonhard Katz	S/Sgt. Horace A. Knox
F/O Roger B. Clendenen	Mr. Oscar Goldberg

5. The above personnel returned to Wright Field on 24 October 1944.

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Memorandum Report No. TSEPL-3-673-4-J-2
23 November 1944

C. CONCLUSIONS:

1. That the adverse weather conditions which are predominant in the European Theater of Operations preclude the use of the GB-4 and GB-8 type of glide bombs in this theater throughout the major part of a year.

2. That no expedition should be sent to a theater of operations in the future unless it is so organized and equipped that it can function and operate as a self-sufficient unit without depending on other organizations for airplanes, personnel or equipment.

3. That only new and fully equipped airplanes should be used in missions of this kind in the future.

4. That the GB-4 glide bomb can be used effectively with precision on targets which can be easily distinguished from surrounding objects or terrain providing the weather conditions are CAVU.

D. RECOMMENDATIONS:

None,

3,4,5,6,

Distribution: Mat. Div., AC/AS, M & S
TSEAL-6D

C/AS, M&S7, 8, 9
TSEPL-315

Prepared by JOSEPH M. POMYKATA, Major, A.C.

Approved by G. V. HOLLOMAN, Colonel, A.C.
Chief, Equipment Laboratory

Approved by F. O. CARROLL, Brig. General, USA
Chief, Engineering Division.

[redacted]

Concurrence:

MX-108

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Memorandum Report No. TSEPL-3-673-4-J-2
23 November 1944

APPENDIX 1.

1. The Air Technical Service Command personnel assigned to overseas project 92809-S departed from Wright Field for England on 27 and 28 June 1944 in specially equipped B-17G airplanes 42-97518 and 42-40043 respectively. Airplane 42-97518 arrived in England on 30 June 1944, but due to mechanical difficulties during the entire flight, airplane 42-40043 did not arrive in England until 10 July 1944. Both of these airplanes had about 500 hours flying time each prior to departure and were both in rather poor condition.

2. The airplanes and personnel proceeded to Burtonwood, England, and reported to the Chief Signal Officer, the second airplane (42-40043) reporting there on 12 July 1944. Maintenance work and modification on the airplanes was started immediately and the project officer reported to the Director of Operations, USSTAF on 15 July 1944. The project was assigned to the 8th Air Force by USSTAF and the 8th Air Force Headquarters then assigned it to the Third Bomb Division. The code name "Batty" was assigned to the project and AAF Station 140, Fersfield was selected as the operating base.

3. The "Batty" project personnel and one airplane, B-17G No. 42-97518, reported to the Commanding Officer of Station 140 on 17 July 1944. The other airplane, B-17G No. 42-40043 had been assigned to the "Aphrodite" project by the 8th Air Force. The GB-4 and GB-8 glide bombs were assembled and ready for use in one week but it was found that more maintenance work on the B-17G airplane 42-97518 was necessary before it could be used on combat missions. Moreover, Third Division Headquarters, having decided that the GB-4 (Radio-television control) glide bombs would be used first and that use of the GB-8 (Radio-Flare) glide bomb would be considered afterwards, had not yet selected targets for the GB-4.

4. B-17G airplane 42-97518 crashed and burned on 29 July 1944 leaving the "Batty" project without an airplane. B-17G airplane 42-40043 was returned to the "Batty" project on 6 August 1944. Everything was in readiness for a GB-4 mission on 7 August but due to unfavorable weather no missions could be flown until 13 August.

5. The following missions were flown:

a. The first GB-4 mission was flown on 13 August, the target being the E-boat pens at Le Harve, France. The mission consisted of the "Batty" project B17G airplane 42-40043 which took off at 1490 with two GB-4 bombs. The following airplanes also participated:

(1) One Mosquito (370) photographic ship. (This airplane flew too close behind the second bomb and was apparently struck by bomb fragments when the bomb hit the ground. It crashed a few seconds later.)

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MX-108 [redacted]

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Memorandum Report No. TSEPL-3-673-4-J-2
23 November 1944
Appendix 1.

(2) One P-38 (490) airplane which was used for observation.

(3) One B-17G equipped with television receiver and also used for observation. This airplane remained over the channel about twenty miles northwest of the target.

The bomb run was made from South to North. There were a few scattered clouds in the vicinity but the visibility was very good.

The first bomb was released at 1643 from 15,000 feet altitude and at 170 mph indicated airspeed. The bombsight angle at release on this mission and all following missions was 80° 40'. After dropping the bomb, the "mother" airplane (B-17G 42-40043) made a 180 degree turn and flew in the opposite direction away from the target while the bomb was in flight. (This was standard procedure on all missions). The second bomb was released at 1708 from 14,700 feet and 175 mph indicated airspeed. The television picture received from both bombs was of very poor quality and totally unusable in guiding the bomb to the target. The first bomb landed in the Seine river about one mile short of the target and the second bomb landed on the beach about one mile east of the target. Both bombs responded satisfactorily to radio control signals. It was later found that the television transmission from both bombs was also satisfactory since good pictures were received by the B-17 observation airplane, definitely indicating that the television receiving equipment in the "mother" airplane was faulty.

No enemy opposition was encountered throughout the mission.

b. After thoroughly checking the television receiving equipment in the "mother" airplane another mission was flown on 17 August 1944. The "mother" airplane (B-17G - 42-40043) took off at 1445 with two GB-4 bombs. Twelve P-51 fighters gave close support throughout the entire mission. One P-38 photographic airplane and one B-17 airplane with television receiving equipment for observation were also dispatched. The target was the submarine pen at La Pallice, France.

Due to the mechanical condition of the "mother" airplane it was impossible to climb over 17,000 feet with a load of two bombs. The weather at the target was CAVU. The bomb runs were made over the water from 270° and the bombs released from 17,000 feet, the first at 165 mph, time 1759; and the second at 175 mph, time 1808.

The shutter on the television camera of the first bomb failed to open and it was, therefore, impossible for a picture to be transmitted. As confirmed by visual observation, however, the bomb responded to radio control signals

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satisfactorily. The television reception during the flight of the second bomb was very poor and unusuable for directing the bomb as in the first mission. The observation airplane received a good television picture. The bomb responded to radio control signals. Duration of bomb flights was about 5-1/2 minutes each. It is not known where the first bomb landed but the second apparently landed in the city east of the pens. The only enemy opposition was a light anti-aircraft barrage in front of the target on the second bomb run which did not endanger the "mother" airplane since the bomb release point was outside of anti-aircraft range.

6. Following the above mission, an intensive program of testing and checking the television equipment in the "mother" airplane was initiated since it was definitely shown that the cause of the poor television reception was in the airplane equipment. (It must be remembered that no actual television tests or checks had been performed on this airplane prior to its departure for the ETO). After numerous test flights it was found that a new fixed television receiving antenna installation on top of the left rear horizontal stabilizer of the airplane gave much better results than had ever been obtained before. Therefore, as a safety factor, the original television receiver installation with the gyro-stabilized antenna was left intact in the airplane and an additional television receiver was installed and used with the new antenna installation. On future missions both receivers were used simultaneously. It was also decided at this time to only carry one bomb on future missions so that an altitude of 20,000 feet could be attained.

7. After 25 August 1944 the following missions were flown:

a. A mission was attempted on 26 August 1944. The target was a railroad bridge at Ravenstein, Holland. B-17G airplane 42-40043 carrying one GB-4 took off at 1515 accompanied by one B-17 as observation airplane, one P-38 photographic airplane and eight P-47 fighters. Upon approaching the point of release it was found that the target and vicinity were completely obscured by heavy clouds. The mission was cancelled and the bomb was brought back to the base.

No missions could be flown from 27 August to 10 September because of unfavorable weather.

b. A mission was flown on 10 September 1944. The target was a transformer switching station in a steel plant at Duren, Germany. B-17G airplane 42-40043 carrying one GB-4 took off at 1445 accompanied by one P-38 photographic airplane and a fighter escort of nine P-51 airplanes. The bomb run was made to the northeast and the bomb released from 20,000 feet at 1644. There was about a six to eight-tenths cloud cover [illegible]. The bomb dropped

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Memorandum Report No. TSEPL-3-673-4-J-2
23 November 1944
Appendix 1.

into the clouds and did not break out until 3,000 feet above the ground. It had passed over the target area by this time and, finding no suitable target in sight, the control operator directed the bomb into a tree in an open field about three miles northeast of the target.

The television picture from the receiver with the new fixed antenna installation was very good, while the picture from original receiver installation with the gyro-stabilized antenna was of practically no value, as on the previous missions. The radio control functioned satisfactorily.

c. A mission with one GB-4 bomb was attempted on 11 September 1944, but while climbing to altitude a short circuit developed in television equipment in the bomb and it was necessary to cancel the mission and return to the base about two hours later. The target assigned on this mission was the canal locks and railway bridge at Munster, Germany.

No mission could be flown on 12 September because a fighter escort could not be obtained.

d. A mission was then flown on 13 September 1944. The target was an oil refinery at Salzbergen, Germany. B-17G airplane 42-40043 with one GB-4 bomb took off at 1500 and was accompanied by one Mosquito photographic airplane and a fighter escort of eighteen P-47 airplanes. There were no clouds over the target area but there was a low ground haze which made target identification very difficult. After making two bomb runs the bombardier, having made an error in locating the target, released the bomb (20,200 feet altitude, time 1709) toward Emsburen instead of Salzbergen. The haze made the objects in the television screen difficult to identify. The control operator selected the largest building in the town as a target of opportunity and directed the bomb toward it. After the bomb passed through the haze the television picture became clearer and it appeared that the building might be a church. At this time the control operator tried to pull the bomb up to avoid hitting the building but the bomb was already so near that it was impossible to change the bomb's course enough to miss. The direct hit was confirmed by the photographic airplane. The attached photographs show a sequence of pictures of the television screen which begin after the control operator had selected the target and corrected the bomb's course toward it in azimuth and show the changes in attitude due to the control signals given during the remainder of the flight. The radio control and television receiver with the new fixed antenna functioned very satisfactorily but the reception on the original television receiver installation was again unsatisfactory.

8. The Air Technical Service Command personnel who flew on all of the

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Memorandum Report No. TSEPL-3-673-4-J-2
29 November 1944
Appendix 1.

above missions were as follows:

Major J. N. Hall - Acting command pilot
Major J. M. Pomykata - Glide bomb radio-television control operator.
1st Lt. Leonhard Kata - Television operator
1st Lt. R. J. Morris - Bombardier
T/Sgt. Francis L. Wallis - Radio operator

9. From 14 to 30 September no missions could be flown because fighter escort could not be obtained. Orders were then received to leave the remaining one GB-4 and seven GB-8 bombs for transfer to the British and Wright Field personnel were ordered to return to their home station. The departure from Army Air Forces Station 140 was made on 2 October 1944. Due to difficulty in obtaining transportation back the above personnel did not arrive at Wright Field until 24 October 1944.

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ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

Use this form for inter-office correspondence within headquarters. Use authorized office symbols to designate addressor and addressee. Place initials of dictator and typist, telephone number and location to right of signature.

Use full width of sheet, both sides. Number all comments consecutively. Separate comments by horizontal lines across page.

SUBJECT: CTI-1502 Addendum No. 6

COMMENT NO. 1

TO: TSTEX
THRU: TSBCO1 M.W.

FROM: TSBPR4Q/R.P.Miller/fl
Ext. 2-5114

DATE: 2-15-45

1. CTI-1502, Addendum No. 6, dated 23 September 1944 directed that Procurement Division take action to cancel production of GB-4 Glide Bombs.

2. Necessary action was completed prior to 3 November 1944 cancelling procurement of this equipment. Twelve hundred (1200) RT Controls, component of GB-4 and twelve hundred (1200) GB-4's were produced. Office, Assistant Chief of Air Staff, M. & S., was advised of facts pertaining to this cancellation by TWX Reference TSBPR3H1-10-7 dated 2 October 1944 as directed by this CTI.

3. It is requested that CTI-1502 Addendum No. 6 be closed out.

for Morrison Wand, Maj. A.C.
ORVAL R. COOK
Brig. General U.S.A.
Chief, Procurement Division

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cc: TSBCO1
TSBPR3H1

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Secret by authority of
CG AAF
26 FEB 1945

Col Travis/bl3/72438 initials
Wrtn 24 Feb 45
Room 4E 120

2 MAR 1945

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MEMORANDUM FOR ASSISTANT CHIEF OF AIR STAFF, MATERIEL AND SERVICES:

Subject: Controlled Missile Program.

1. Under the provisions of the directive to this office from the Deputy Chief of Air Staff dated 23 December 1944, subject: "Controlled Missiles," a preliminary survey of the controlled missiles field has been made. The first conclusions that became apparent were that the development effort has been handicapped and that it has not been as productive as possible because of the lack of statement of military characteristics and requirements. This office has a study in progress here, and in addition has established a project with the Army Air Forces Board to recommend the required military characteristics for all missiles pertinent to this program. These characteristics will be forwarded as soon as possible.

2. In the meantime there are certain fundamental concepts which we hold towards which development should be pointed, if the results are to be tactically useful. These are summarized briefly as follows:

a. Guided missiles must be suitable for all-weather use, and must be particularly suitable for use in bad weather when normal bombing cannot be accomplished.

b. Controlled missiles if they are to be carried must be designed so that they can be carried internally in the aircraft.

c. Controls should be of target seeking nature when possible, or when control is exerted from the aircraft, it should be such that the airplane can take normal evasive action, preferably staying at least 25 miles from the target.

d. The missile should be suitable for multiple release and control.

3. With these concepts in mind the individual projects have been analyzed with the following tentative conclusions:

a. Glide Bombs. As long as glide bombs must be carried externally on aircraft, even the most perfected weapons would have only limited application. Every effort should be made to develop missiles having glide bomb characteristics that can be carried internally and when launched have speed sufficient to make them a very much harder target to hit from the ground than they are at the present time. The development of target seekers against land or water borne targets must continue, but because of the factors above, the following comments on each project are made:

452.1 Radio Control Planes

OFFICE SYMBOL	1 AFRDB	2 AFACO	3 AFSCA	4 AOO-	5	6
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INTERNAL OFFICE COORDINATION				Power		

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(2) GB-1 (Present GB-1 with Torpedo) - No tactical requirement beyond the project already established.

(3) GB-4 (Television) - No tactical requirement.

(4) GB-5A (Light Contrast Seeker) - No tactical requirement.

(5) GB-5B (Light Contrast Seeker) - No tactical requirement.

(6) GB-5D (GB-13) (Flame Seeker) - No tactical requirement. The use visualized by [illegible] does not appear sufficient to this office to warrant the special effort required to put this item in tactical operations.

(7) GB-6 - Of definite interest tactically if it can be developed with folding wings and the control system perfected.

(8) GB-7A (Radar Seeker) - No tactical requirement.

(9) GB-7B (Radar Seeker) - Possible tactical requirement if completely developed.

(10) GB-7C (Enemy Radar Seeker) - No tactical requirement.

(11) GB-8 (Visually Guided) - No tactical requirement.

(12) GB-9 (Ground Skimmer) - No tactical requirement.

(13) GB-10 (Television in Nose) - No tactical requirement.

V. Vertical Bombs.

(1) VB-1 (Azon, Azimuth Control, 1000 lb) - This should be continued in development to complete the [illegible] phase.

(2) VB-2 (2000 lb Azon) - Tactical use expected.

(3) VB-3 (Razon, Azimuth and Range Control, 1000 lb) - Tactical use expected.

(4) VB-4 (Razon 2000 lb) - Tactical use expected but definitely on a lower priority than VB-3.

(5) VB-5 (Light Seeker, 1000 lb) - No tactical requirement.

(6) VB-6 (Felix, Heat Seeker) - This should be completed in development as rapidly as possible.

(7) VB-7 (Television, 1000 lb) - Possible tactical usage when [illegible]

[redacted]

[illegible] 1-(3 pp)

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(9) VB-9, 10, 11, and 12 (ROC, Med. Angle) - The merit of the ROC principle appears to offer tactical applications; however, it is believed that the effort should be concentrated on one item. It is believed that VB-10 offers best tactical possibilities and should receive the emphasis in the development. Major emphasis should be placed on incorporating the ROC principle into a design that can be carried internally.

c. Power guided missiles other than jet bombs - There are no tactical requirements for the XBQ-1, XBQ-2, XBQ-3, XBQ-4 or XBQ-5. Any need for this type weapon can be filled by using war weary airplanes.

d. Glider bombers - There are no tactical requirements for the usage of stripping worn out airplanes and using them as towed gliders.

e. Jet Bombs

(1) The JB-2 and the JB-1A should be continued in development with emphasis placed on the following phases:

(a) Improving the launching methods.

(b) Accuracy and control to the limit of range.

(c) Increase distance of flight.

(d) Carry, launch, and control from airplanes.

(2) JB-3 - Development should continue as an air-to-air missile.

(3) JB-4 - No tactical requirement.

(4) JB-5 - Development should continue.

(5) JB-6 - Development should continue.

(6) JB-7 - Development should continue.

(7) JB-8 - Development should continue.

(8) JB-9 - No tactical requirement.

4. It is realized that the research and development problems on the guided missile program are a matter of principal interest to your office and the above statements are submitted without the intention of [illegible] in research matters, but to provide a guide for research so that the primary effort can be concentrated on items that can be made ready in this war.

[illegible]
[illegible] General, U.S.A.
[redacted] Chief of Air Staff,
Operations, Commitments and Requirements

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Use of Abusive Missiles in Direct Support of Ground Operations

AC/AS, MMS, Material Division, Engineering Branch

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Maj Thorne/ak/72497

AC/AS, OCR, Requirements Division

1. The proposed use of guided missiles in cooperation with the ground operations warrants further consideration. Study and effort is being directed toward a possible solution for the destruction of cave-type entrenchments now being employed by the Japanese. It appears that the ground control of guided missiles might be a step toward the solution of this immediate problem. Further needs for this type of weapon may develop in the future.

2. The success of such a weapon will necessarily lie in its flexibility and maneuverability. Any system of control that will require extensive preparation and involve complicated control equipments will not meet the need of cooperation. The proposed system, as described in the attached correspondence, appears to be quite simple and maneuverable.

3. It is requested that the ATSC be directed to monitor a project for developing and thoroughly testing the proposed system against the cave-type entrenchments now being faced by our troops on Okinawa. The destruction of the cave-type target is sufficiently important to warrant conducting this test on a first priority. (1A)

4. Due to the immediate need as indicated above, it is felt that the tactical suitability of such a weapon should be determined concurrently with its development. The Army Air Forces Center will be directed to work as collaborating agency with the ATSC on this project. The abusive facilities now under the control of the Army Air Forces Center will be made available for this test and development program.

5. As pointed out in paragraph 2 above, the system of control must be kept simple. The use of radar for this control as indicated in the attached correspondence will probably complicate the equipment to such a point as to make it undesirable. Therefore, it is recommended that the radar proposals not be considered in this particular test.

6. The various guided missiles that might be used for close cooperation should be tested in the following order:

a. War Weary
b. Azon and Razon
c. Glide Bomb

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LESLIE GW PETERSON
Colonel, Air Corps
Acting Chief

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ARMY AIR FORCES
AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

TSEPL-3N6/WAS/ble
Date 25 August 1945

SUBJECT: Glide Bombs, Type GB-8
Expenditure Order No. 673-81,
Project MX-645.

OFFICE TSEPL-3N6 Contract or Order No.

SERIAL No. TSEPL-3-673-76 Expenditure Order No. 673-81

GB-8

A. PURPOSE:

1. To close out Expenditure Order No. 673-81.

B. FACTUAL DATA:

2. Expenditure Order No. 673-81 was initiated to conduct a further study of the Type GB-8 Glide Bomb with a view to the improvement of the accuracy of the missile.

3. Expenditure Order No. 448-27, was initiated by the Pilotless Aircraft Branch, Aircraft Projects Section, Engineering Division, to cover the development of visual ground control of glide bombs, type GB-4 and GB-8. Development and tests are now being conducted at Wendover Field, Utah, under this Expenditure Order on a 1-B priority.

C. CONCLUSIONS:

4. That a further study and development of type GB-8 glide bomb as outlined in Expenditure Order No. 673-81 is now being conducted under Expenditure Order No. 448-27.

D. RECOMMENDATIONS:

None - data merely submitted

NOTE: This Memorandum Report closes out Expenditure Order No. 673-81, Project 45-1056.

Concurrence:

Prepared by W. A. SANDER, Jr., Captain, A.C.

Approved by C. D. FRENCH, Jr., Lt. Col., A.C.
Chief, Control Equipment Branch

Approved by T. B. HOLLIDAY, Colonel, A.C.
Chief, Equipment Laboratory

Distribution:
AC/AS,M&S,(5) [redacted]
TSEAL-6D, Tech. Data Lab.; TSESK-2G, Aircraft Projects Section
TSEPL-3N6, Equipment Laboratory.

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ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

TSEPL-3N/GHP/md
Date 19 September 1945

SUBJECT: Ground Control of the GB-8, Radio Controlled Glide Bomb.

OFFICE TSEPL-3N   Contract or Order No.

SERIAL No. TSEPL-3-448-9   Expenditure Order No. 448-27

A. PURPOSE:

1. To report on tests of ground controlled GB-8 glide bombs conducted at Wendover Field, Wendover, Utah, from 26 June to 31 August 1945.

B. FACTUAL DATA:

2. Personnel present at the tests were as follows:

Air Technical Service Command

Equipment Laboratory

Capt. C. A. Kerner
Capt. R. L. Feik
Lt. R. S. Risley
Lt. B. P. Rosenbaum
Lt. A. B. Hollenstain
Lt. J. Lamprecht, Jr.
Lt. F. R. Stevenson
Lt. G. H. Pitner

Aircraft Radio Laboratory

Capt. M. E. White
Mr. D. C. Bright
Mr. H. W. Strege
Mr. H. W. Allen

Armament Laboratory

Mr. N. S. Lestz

3. The primary purpose of this first series of tests was to determine whether reliable operation of the GB-8 radio controls could be obtained with a ground control transmitter arranged to allow azimuth control of the bomb from one station and elevation or range control from another. Such a system introduces possible operating difficulties due to the fact that it is necessary to tune the control transmitter to the preset frequency of the bomb receiver, rather than tuning the transmitter directly to each receiver just prior to release, as is done with the standard air-controlled GB-8. Additional difficulties could also occur due to the two station control

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system with one station remote from the transmitter.

4. Secondary purposes of the first tests were to determine the characteristics of sighting devices suitable for ground control operation and to determine the accuracy of impact to be expected from this ground controlled glide bomb. After satisfactory control operation was attained, a second series of drops would be made to test specific sights and obtain an accuracy evaluation of the missile.

5. Fifteen bombs were dropped during the period of this report, consisting of eleven standard GB-8's with Hammond radio control, two GB-8's modified with ARL radio control (AN/CRW-7 receiver) and two GB-6 airframes with GB-8 Hammond radio control. The control transmitters used were: the SCR-299 (output approximately 300 watts) with the Hammond control system and the BC-186 (output approximately 20 watts) with the ARL control system. Two control stations operated the single transmitter; one station being remote from the transmitter and connected to it by a wire circuit. A radio link for the remote station was developed by ARL personnel but was not completed in time for use in the above tests. Control station locations and flight data for the fifteen bombs are shown in Appendices 1 and 2 respectively.

6. The two GB-8's with ARL radio control were dropped in a proposed series of ten to test the operation of this radio system. No further drops were made in this series due to excessive radio noise difficulties encountered with this system.

7. The two GB-6 airframes were used to observe the comparative response of the GB-8 (rudder only, azimuth control) and the GB-6 (rudder and aileron azimuth control) type glide bombs to radio control signals.

C. CONCLUSIONS.

8. That the Hammond radio control system is satisfactory and reliable for ground control operation over control distances up to at least twenty-five (25) miles, using a control transmitter comparable to the SCR-299. Satisfactory operation was obtained with this transmitter operating at approximately one quarter its normal output or about 75 watts. A reasonable amount of care is required in setting the control transmitter and the bomb receiver on the same frequency. However, when an accurate frequency meter is used for this purpose, no operating difficulties are encountered.

9. The Aircraft Radio Laboratory control system is not satisfactory as used with the low power (20 watt) BC-186 transmitter for operation with the GB-8 control box. The radio noise level of this box is high due to operation of the various servo and gyroscope motors and each bomb presents a separate problem in noise reduction before satisfactory operation of the AN/CRW-7 radio can be approached. No direct comparison

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between the ARL and the Hammond system is made since comparable control transmitters were not used. It is possible that the ARL radio would prove satisfactory if a transmitter with a higher power output were used.

10. That the accuracy of the ground controlled GB-8 is primarily dependent upon the ability of the control operators to judge the amount of turn necessary to bring the bomb on course and to give the proper amount of control to make this turn. The comparatively slow and variable response of the standard GB-8 to azimuth control signals makes accurate control extremely difficult even for an operator with considerable experience. It is essential for the azimuth operator to get the bomb on course in azimuth early in the flight or the flight path as observed from the range station is distorted and accurate range control is impossible.

11. That the GB-6 type airframe (rudder and ailerons) provdes a much better vehicle than the GB-8 (rudder only) for a ground controlled missile. The faster and smoother turns and generally more stable flight obtained with the GB-6 type airframe should increase appreciably the accuracy of azimuth control. This airframe also flys approximately on the aimed course when released from the airplane while the GB-8 usually drifts to one side or the other before reaching a stable flight condition. The difficulty of judging turns still exists with the GB-6 airframe but it is reduced by the facts that the bomb can be dropped more nearly on course, making only small azimuth changes necessary, and faster course corrections can be made.

12. That sighting devices used for control purposes should have a minimum field of view of 25°, should be of a right angle viewing type with the optical axis on the axis of rotation, and should have a single reference line reticule. A low powered (2-4X) telescope with the above features, tripod mounted to traverse in the desired plane is sufficiently accurate for ground radio control sighting of the existing missile. Extreme accuracy of sights is not essential, since the missile accuracy is more a function of the operator's ability to give the right amount of control than of sight accuracy.

13. That the distance of the azimuth station from the target is not critical as long as the target and bomb release point are both within the visibility range of the sight used. Judging the amount of control necessary to affect a course change is equally difficult from points 1000 yards or 5000 yards from the target. An evaluation of the range station locations

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used would not be conclusive since the missiles flown were seldom on course in azimuth for sufficient length of time to give the range operator a chance for accurate ranging. The range stations used were arbitrarily located on a line through the target at 45° to the bomb run. It is probable that range stations located on such a line 90° to the bomb run would be more desirable since there would be less apparent elevation error when the bomb was not on course in azimuth.

D. RECOMMENDATIONS:

14. It is recommended that the following action be taken by the organization designated below:

a. Air Technical Service Command, Engineering Division, Equipment Laboratory.

(1) That further tests be performed using the Hammond radio control system and the GB-6 type airframe as the most suitable combination of existing components to provide an accurate ground controlled glide bomb.

a. That such tests include operation from range control stations located on a line through the target at 90° to the bomb run.

b. That such tests include the use of a control transmitter of comparatively low power output (20 to 50 watts) to determine if a small portable transmitter is adequate for short range ground control.

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Control Equip Br, TSEPL-3N2 (1)
Cy # 8 TSESA-7(Mr. Thielkeld)
HIS (5) 9 thru 13

Gordon H. Pitner
Prepared by GORDON H. PITNER
(Name) 1st Lt., Signal Corps

R. K. Swanson Maj. A.C.
Approved by C. O. FRENCH, JR., Lt.Col.,AC
for
Chief, Control Equipment Branch

R. K. Swanson, Maj. A.C.
Approved by T. B. HOLLIDAY, Colonel, AC
for
Chief, Equipment Laboratory
Propulsion and Accessories Subdivisi
Engineering Division

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SPECIAL WEAPONS FIELD TEST UNIT — JL/11
CONTROL EQUIPMENT BRANCH
Air Technical Service Command
Wendover Field, Utah — TSEPL-3M11

25 September 1945

SUBJECT: Weekly Progress Summary - Glide Bomb Tests, 22 September to 28 September, inclusive.

TO: Commanding General, ATSC, Wright Field, Dayton, Ohio.

Attention: Chief, Performance Test Unit, TSEPL-3M6.

GLIDE BOMB WORK ENDED THIS DATE UNTIL FURTHER NOTICE

RLW 11/8/45

1. GB-4.

a. An attempt was made to drop one GB-4, #1, 24 September 1945, but the bomb failed to release on the live run; bomb dropped from B25-470 on downwind leg of the next run. It is believed that a dirty shackle was to blame for the trouble.

b. A GB-4, #2, was dropped 25 September. Control from ground stations was fair, but not good enough to bring the target into the television camera field so that the ground television operator could take over. Bomb landed about 600 ft. left and 75 ft. high.

c. Another GB-4, #3, was dropped 26 September and was controlled well enough from ground stations so that the television operator took over control after 35 seconds. However, the target was lost by him after about 20 seconds, and control was switched back to ground stations at about 75 seconds, but it was impossible to restore the bomb to an on course heading at so late a time in the flight.

d. No more GB-4 bombs were dropped, since (1) it is felt that the accuracy attainable with television control is not as great as with ground sighting station control; (2) the GB-4 airframe cannot be controlled as well as the Aeronca airframe (with ailerons) even when ground stations are used for both bombs.

2. GB-8.

a. A series of five GB-8A bombs using 6° stabilizer settings and 6°/second elevator was dropped from 24 September through 26 September.

b. #26 was controlled with the gun sight in range and the 1x scope in azimuth. Control was good, and the bomb hit with zero error in azimuth and 150 ft. high.

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c. #27 dived in 3 1/2 miles short after a flare apparently blew up. The first 15 seconds of flight was normal.

d. #28 was controlled with the gun sight in range and the Van Dyke aided tracking sight in azimuth. The bomb was lost from the azimuth sight after the first half of the flight. Bomb was then controlled with no sighting aid whatever. Bomb landed 125 ft. left and 50 ft. high.

e. #29 was controlled with the gun sight in range and the 1x scope in azimuth. Control was good. Bomb landed 5 ft. right and 200 ft. low.

f. #30 was controlled by the gun sight in range and the 1x scope in azimuth. Good control. Bomb landed 30 ft. right and 150 ft. high.

g. (1) The results of these 5 drops indicate that the elevation control is more difficult than the azimuth, possibly because of the elevation changes effected through azimuth control.

(2) One-man control at each station and wide angle sights are a necessity for glide bomb control.

3. General.

a. The above described drops complete the MX-711 tests for the present period at Wendover.

J. LAMPRECHT, JR.,
1st Lt., A. C.

W-52492

0372

Wright Field Air B.
AAFMC-[illegible]
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ARMY AIR FORCES
MATERIEL COMMAND

MEMORANDUM REPORT ON

SUBJECT: Use of Glide Bombs as Close Support Weapons; Project MX-711 - "HERMIT".

Date 26 October 1945

120

OFFICE TSEST-2G

Contract or Order No.

SERIAL No TSEST-2G-1224

448-27

A. PURPOSE:

1. To determine the feasibility of using already designed Glide Bombs as a close support weapon for ground troops by controlling the Glide Bomb's flight to a target from two sighting stations located on the ground.

B. FACTUAL DATA:

2. Personnel either (a) participating in drop tests or, (b) involved in the development and assembly of equipment for the "HERMIT" Project or, (c) both or, (d) present as observers. Include the following:

AC/AS-4

Lt. Col. V. A. Stace (d)

Hdq. Army Ground Forces

Lt. Col. D. F. Runroe (d)

Pilotless Aircraft Branch

1st Lt. R. T. Morris (a)

Equipment Laboratory

Capt. C. A. Kerner (c)
1st Lt. C. H. Pitner (c)
1st Lt. R. S. Risley (b)
1st Lt. E. P. Rosenbaum (a)
1st Lt. J. Lamprecht (c)
2nd Lt. F. R. Stevenson (a)

Electronic Subdivision

1st Lt. C. E. McLaughlin (b)
1st Lt. W. Y. Fish (c)
1st Lt. D. G. Clute (b)
2nd Lt. P. F. Murray (b)
Sgt. H. E. Brown (c)
Mr. D. C. Bright (b)
Mr. T. P. Clark (b)
Mr. H. W. Allen (b)
Miss B. Frenzer (b)

Armament Laboratory

Mr. N. S. Lestz (c)

L. N. Schwein Engineering Co.

Mr. H. A. VanDyke (c)

Mailed copies out about
5 Dec 45

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[illegible] W-69813-4

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3. This project was authorized by Headquarters, Air Technical Service Command Technical Instructions, Serial No. TI-2003, Addendum No. 42, dated 12 July 1945; subject, "Use of Guided Missiles in Close Cooperation with Ground Operations". The classification assigned was "Secret" and the priority, 1-B. Of the three types of guided missiles specified for investigation and test, Glide Bombs were given last priority after War Weary Airplanes and Razon-Azon Vertical Bombs.

4. Formal requests were made to the Armament Laboratory, TSEPL-2 on 23 July 1945 for development and test of sighting devices; to the Equipment Laboratory, TSEPL-3, for development and test of ground-guiding techniques; to the Aircraft Radio and Radar Subdivision (now Electronic Subdivision), TSERH, on 25 July 1945 for complete supervision of the development and test of ground radio installations for control of the missiles, for communications, and for any use of television during the tests; and to the Aviation Ordnance Engineering Office, TSORE, on 26 July 1945 for inert and live bombs, flares, and fuses for GB-4 and GB-8 type Glide Bombs when and if desired.

5. A series of thirty-four (34) drop tests was made at Wendover Field, Utah, from 20 July 1945 to 26 September 1945: thirty (30) of the GB-8 type with flares and radio control, and four (4) GB-4 Glide Bombs with flares added for visual sighting. Appendix "A" lists the factual data on each drop. Appendix "B" consists of nine (9) photographs of some of the impacts and some of the sighting devices, and the two ground installations. Appendix "C" lists the types of sights used and their relative ground positions. Appendix "D" covers the radio systems and a description of their functioning. Appendix "E" describes the various modifications of the standard GB-8 used during the tests.

6. Ten (10) drops of standard GB-8 Glide Bombs were made mainly to test ground radio controls, but during the drops it became apparent to the Equipment Laboratory Project Officer that the aerodynamic response of the standard GB-8 was not such as to afford the accuracy desired. The next fifteen (15) drops of GB-8 type Glide Bomb incorporated different modifications made in the attempt to assemble a satisfactory airframe from components of other airframes already on hand. Two of these drops included the CRN-7 receivers supplied by the Electronic Subdivision, but they failed to receive the radio signals due, it was found on later test, to the fact that the high noise level of the other electrical circuits in the Hammond Control Unit cut out the low powered signals from the associated BC-1158 ground transmitter. The last five (5) drops used the airframes found to have the best response during these tests. The maximum azimuth error of the four (4) that flew was 135 feet and the maximum range error was 200 feet. (See Appendix "A").

[redacted]

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W 64813-4

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7. The four (4) GB-4 Glide Bombs expended included one (1) that burned up before take-off due to a faulty flare connection and one (1) that hung-up at drop-away due to a faulty shackle which later opened when the plane was headed away from the target, launching the bomb out of sight and control. The two (2) finally tested did not respond well enough aerodynamically for the ground operators to hold them on course long enough for the television operator to have much success in locating the target. These Glide Bombs cost more than two and one-half ($2\frac{1}{2}$) times as much as the GB-8 type and are not recorded as being more accurate with full television control than a probable 200 foot circular error at the target.

8. Of the various sighting devices used, the simplest aiming sights were more accurate at the ranges of their positions than any of the Glide Bombs. The high power telescopes all have fields of view too narrow to encompass the normal azimuth sweeps of a Glide Bomb being controlled. The simplest aiming sights were less cumbersome, had wider field of view and could be easily obtained with little modification. (See Appendix "C")

C. CONCLUSIONS:

9. That the GB-8A(66) Glide Bomb (see Appendix "E") can be controlled from two ground stations to hit a point target with an error of less than one hundred (100) feet in azimuth and one hundred fifty (150) feet in range.

10. That only the simplest sighting devices are required to obtain this, or even better, accuracy. (See Appendix "C")

11. That the GB-4 television Glide Bomb cannot inherently be expected to afford greater accuracy than the GB-8A(66) and therefore may be omitted from consideration.

12. That the ground station radio network must make use of the AN/ARA-2 modulator and a high power radio transmitter (100 watts or better) to make control signals effective in the Glide Bomb receiver and selector.

13. That the range station should be located as nearly at right angles to the azimuth line as possible, with angular apex at the target.

14. That the ground station "jeeps" developed by TSERR are satisfactory, but could be simplified if they were to be used only with Glide Bombs.

[redacted]

W-80513-4

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D. RECOMMENDATIONS

15. That it be determined what additional tests are required to decide whether a better configuration than the GB-8A(68) type airframe can be developed for greater overall accuracy. (Action being taken)

16. That it also be determined how long before an airframe and a standardized control technique can be submitted for Army Air Forces Board or Proving Ground Command evaluation. (Action being taken)

17. That consideration of newly developed sighting devices be included in any further tests on MX-711. (Action will be taken)

R. T. Morris

Prepared by R. T. MORRIS, 1st Lt., AC

Approved by GEORGE E. PRICE, Col., AC
for Aircraft Projects

Approved by

Distribution:
AC/AS-4, Lt. Col Stace (3)
TSEPL-3W, Lt. Col French
TSERR
TSEPL-2
[redacted]

[redacted]

[illegible]

TSEAA (TSEIA-7) [illegible]mber 1945

Status of Project "Hermit"

Commanding General
Army Air Forces
Washington 25, D. C.

Attention: AC/AS-4

1. Project MX-[illegible] - Glide Bomb.

a. Extensive experimental tests were conducted at Wendover, Utah, during July, August, and September 1945. An estimated accuracy of plus or minus [illegible] feet in azimuth and plus or minus [illegible] feet in range from a point target visible both to the launching aircraft and to the two sighting stations was achieved using equipment already on hand in quantity but modified to give the most satisfactory aerodynamic control without excessive man-hours for modification. (See E/R [illegible] 1221 dated 26 October 1945.) Assigned W-64813 to this M/R on 12-5-45 This copy would be #8. [illegible]

b. Final consideration of the points recommended in the E/R mentioned above are listed in detail in Appendix I.

c. Since increased accuracy will require considerable production of modification kits without positive assurance of the achievement of spot hits, and since results of the "Hermit" [illegible] MX-[illegible] Project have already been considered satisfactory, it is not recommended that further development of a "Hermit" Glide Bomb be carried on.

d. Development of a technique for using Glide Bombs against targets on the reverse side of hills will not be undertaken unless the pin-point accuracy required in the original directive is relaxed to an approximate 500 feet diameter circle, as much poorer results must necessarily be anticipated when the last part of the controlled flight is out of sight to the control operators.

[redacted]

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e. Since the current military characteristics for air-to-ground missiles require a performance impossible to accomplish with any non-powered vehicle, a letter to AC/AS is being prepared requesting approval for abandonment of further expenditures of time and resources on the "Hermit" Glide Bomb Project MX-711.

2. Project MX-710 - Vertical Bombs.

a. Concerning the VB phase of the Hermit Project, considerable effort has been directed in attacking the most difficult part of the development, namely the sight. A sight was designed and fabricated by [illegible] Leland, Development Engineering Company, Dayton, Ohio, which consists of a plate glass screen on which a family of trajectories is inscribed. One each of these sights is mounted at both the range and azimuth stations and after release by the range station, the bomb is steered down the appropriate trajectory. Only one operator is required at each station. Good visibility is mandatory.

b. Range and azimuth sights of the type described above were tested at [illegible] between 5 November and [illegible] November 1945. Eight VB-3 [illegible] were dropped [illegible] flares not [illegible] functioned properly and therefore [illegible] could not be [illegible]. The flare failures were [illegible] inexperienced personnel. In spite of the [illegible] failures, sufficient information for sight modification was obtained. Furthermore the possibility of ground release from the range station was proved as being satisfactory. All eight bombs plus four 100 pound practice bombs fell and controlled within a [illegible] foot circle indicating that bombs can be satisfactorily aimed and released from the ground.

c. Immediate plans call for modification of the Leland sights as deemed necessary from these tests and further tests are contemplated with VB-3 bombs.

3. Project MX-7[illegible] - [illegible]sive.

a. As a supplement to the tests previously reported for the [illegible]sive phase of the "Hermit" Project additional tests were conducted with the Leland sight. Three flights tentatively indicate that the Leland sight is not satisfactory for the ground control of [illegible]sive aircraft. Further information will be forthcoming as soon as available.

[redacted]

[illegible]-65910

[redacted]

4. General -

a. [illegible] directive has been [illegible] developments and test work [illegible] the "Hermit" technique [illegible] such a position that they are [illegible] conference was called in [illegible] for [illegible] type targets would be [illegible] Vertical Bombs. It was further [illegible] that it is [illegible] to turn around Vertical and Glide Bombs [illegible] territory and home them toward a hidden target. The [illegible] for the [illegible] type of sight was tentatively set at [illegible] miles. [illegible] consideration is being given to [illegible] plotting board to vector the [illegible] ground station. This plan [illegible] improvement in the utility of the [illegible]. The plotting board would not have to be located [illegible] connected to it by [illegible] the radar technique [illegible] can be flight tested in [illegible] to the use of [illegible]

[illegible]

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AAFMC-266-WF-4-7-44-50M

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ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

TSESA-7/RTM/kt

SUBJECT: Use of Glide Bombs as Close Support Weapons, Project MX-711, "HERMIT".

Date 31 January 1946

OFFICE Aircraft Projects Section

Contract or Order No. None

SERIAL No. TSESA-7-1245

Expenditure Order No. 448-27

A. PURPOSE:

1. To close out Expenditure Order No. 448-27.

B. FACTUAL DATA:

1. Expenditure Order No. 448-27 was initiated to cover developments and tests on Project MX-711 which was set up on the authority of T.I.-2003, Addendum No. 42, dated 12 July 1945. This technical instruction included the use of glide bombs as a close support weapon along with war-weary aircraft and vertical bombs. Separate Expenditure Order Nos. 448-25 and 448-26 and Projects MX-709 and MX-710 were set up for these other missiles.

2. Thirty-four glide bomb drop tests were made at Wendover Field, Utah, during July, August, and September 1945. Full details were recorded in the following memorandum reports:

a. MR No. TSEPL-3-448-9, dated 19 September 1945.

b. MR No. TSEPL-3-448-9-B, dated 16 October 1945.

c. MR No. TSESE-20-1224, dated 26 October 1945.

3. The greatest accuracy obtained during these tests was an approximate circular error of 250 feet using a non-standard, but easily modified from standard, airframe. It was a conclusion of all personnel concerned that greater accuracy would not be obtained without additional modifications that would require development, manufacture, and a new testing program.

4. Based on the above information and on the more exacting military characteristics set up for future air-to-ground pilotless aircraft in July 1945, a letter dated 10 December 1945 was sent to Hqs. AAF, attention of AC/AS-4, recommending that tests on Project MX-711 be considered complete and that no further consideration be given to the use of glide bombs on the general "HERMIT" program. (Copy attached.)

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M. R. No. TSESA-7-1245
31 January 1946

5. The 1st Indorsement, dated 18 January 1946, to the letter mentioned in Paragraph 4 above concurred in the recommendation to discontinue further tests of glide bombs as applied to the "HERMIT" project. (Copy attached).

C. CONCLUSIONS:

1. That the use of glide bombs on the "HERMIT" project has proven unsatisfactory.

2. That further consideration of glide bombs on this project would be impractical and of little value.

3. That the glide bomb project MX-711 using the "HERMIT" technique should be terminated, and that Expenditure Order No. 448-27 should be closed out.

D. RECOMMENDATIONS:

1. None - date merely submitted.

NOTE: This Memorandum Report closes out Expenditure Order No. 448-27, and terminated Project MX-711.

Copies to:
AC/AS-4 (5)
TSEPE-11
TSEPE-5C
TSELT
TSEPS

Prepared by RICHARD T. MORRIS,
1st Lieut., Air Corps.

Approved by GEORGE E. PRICE, Col., AC
Aircraft Projects Section.

Concurrence:
John R. Kelly
JOHN R. KELLY, Colonel, Air Corps,
Chief, Pilotless Aircraft Branch.

Approved by

Distribution:

[redacted]

V-6159

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SAVE

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

IN REPLY REFER TO:

(AFTSA-2?)
24 April 1945

BUY WAR BONDS AND STAMPS

SUBJECT: Evaluation of the GB-4 Television Glide Bomb

[redacted]

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

4-27-45 BRP

Attention: Office, Chief of Administration

1. In accordance with the apparent lack of operational interest for the GB-4 expressed in guided missiles reviews of 2 November 1944 and 22 February 1945, it is understood that development and testing work on the GB-4 has been largely discontinued.

2. The following conditions, however, indicate that [illegible] evaluation of the GB-4 program is now necessary:

a. There has been [illegible] evaluation report from [illegible] giving the reasons [illegible] missile was not considered satisfactory and why development was dropped.

b. There has been no [illegible] to meet the recommendations of the AAF Board of [illegible], "Tactical Test of GB-4 Glide Bomb." These recommendations follow:

(1) That further tactical and technical development be undertaken so that this [illegible] may be employed against maneuvering targets.

(2) That the possibilities of increasing the television range be investigated so that these bombs may be dropped from higher altitudes.

(3) That the crosshairs on the television receiving screen be designed so that they will change their position in relation to the controls applied to the bomb.

(4) That the GB-4 glide bomb not be employed for combat operations at the present time but that technical development be continued as expeditiously as possible.

cancelled

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ADDRESS REPLY TO: COMMANDING GENERAL, ARMY AIR FORCES, WASHINGTON 25, D. C.

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c. New procedures in radar guidance to the target indicate the possibility that a radar navigation approach could be made to the target (even through a comparatively low overcast) and the television only used for the final approach to the target.

d. Personnel of the ATSC believe that the GB-4 could still be a decidedly precise device against special targets, provided the operator is given enough "leads" from the terrain or the radar navigator to identify the target soon enough. Satisfactory television pictures have evidently been secured with ceilings as low as 500 to 1000 feet.

3. It is directed, therefore, that a complete evaluation report be prepared by the ATSC and forwarded not later than 20 May 1945. This report is to include information on the following:

a. The development goals for accuracy and operation of the GB-4.

b. Degree to which these goals had been reached before expedited development was discontinued.

c. Reasons why the desired goals were not reached.

d. Reports on tests including ATSC tests, the AAF Board Preliminary Test, and the limited use in combat.

e. Comments on the airplanes the GB-4 could be used with, the operational effects on these airplanes, development that could be done to reduce the adverse effect, and recommendations on airplanes that the GB-4 could be used with, with a minimum of adverse operational effect.

f. Reasons why the expedited development was discontinued.

g. Comments on the probable goals that could be secured with the previous GB-4 with further development.

h. Estimates on the length of time the further required high priority development would take in order to secure these accuracy goals in combat.

i. Comments on the probable goals that could be secured with the addition of methods of radar navigation.

j. Estimates on the length of time the further required high priority development would take and on the length of time necessary to secure the required equipment.

X 11862

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. Statement of [illegible] future [illegible] re-
[illegible] 03-4 program.

. Any [illegible] recommendations on the future [illegible] development [illegible] included [illegible] previous paragraphs.

. [illegible] on availability, including:

(1) The quantity of air [illegible] in stock and where they are stocked.

(2) The quantity of television equipment for use in [illegible] available for prompt use and where stocked.

(3) The quantity of television equipment delivered and still on order for the war-weary program or for development programs with a statement on the amount and time requirement for necessary modifications.

(4) The quantity of television control equipment delivered and still on order for either the [illegible] or the war-weary programs and where available.

By Command of General ARNOLD:

Bruce B Price Lt Col AC

[illegible] PHILLIPS
Brig. General, USA
Chief, Materiel Division
Office, Asst Chief of Air Staff
Materiel and Services

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ATSC Form No. 10-508 (3 Jan 45)
(Old ATSC Form No. 43)

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

TSE-20/JAD/kt

12 May 1945

Evaluation of the GB-4 Television Glide Bomb

[redacted]
AUTH: DIR., ATSC
INITIALS EK
DATE 12 May 45

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Asst. C/AS, M&S.

Reference: AC/AS, M&S ltr dated 24 April 1945, subject
"Evaluation of the GB-4 Television Glide Bomb".

1. In reply to the reference letter, the following information is submitted:

a. The GB-4 in its present development is an accurate weapon when used by experienced personnel against a well defined target on a clear day.

b. The goal on this project is precision bombing under conditions of good television visability against both maneuvering and stationary targets. The Air Technical Service Command definition of precision bombing is a maximum error of 25 feet. However, the majority of hits should be much closer. By adaptation of radar tracking, it should be possible to accomplish accurate bombing through an overcast of sufficient height to permit visual recognition of the target in time to apply control to the bomb.

c. To achieve these goals, it is believed that one month would be required to assemble the necessary equipment under a high priority and three months work by qualified personnel under the same high priority. In an expedited development on this project, the main drawback would be lack of qualified television personnel. The GB-4 project has been carried on a 3A priority with the result that television personnel have been transferred to other work with higher priority.

d. In June 1944, the GB-4 was sent to the European Theater of Operations while still in the development stage. Considerable experimental work was done there that should have been completed before the weapon was sent to combat. Inclosed is a report of the Glide Bomb expedition.

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Commanding General, Army Air Forces, Washington 25, D. C. Attention: Asst. C/AS, M&S. "Evaluation of the GB-4 Television Glide Bomb"

e. In view of the unsatisfactory results obtained with the GB-4 Glide Bomb in combat, considerable adverse criticism was given to glide bombs as a whole. Unfortunately, the GB-4 was taken out for theater operation before development tests were completed and, in addition, considerable difficulty was experienced with the aircraft assigned to this project as well as other difficulties experienced in the theater (see ATSC Memo. Rpt. No. TSEPL-3-673-4-J-2). In addition, a meeting was held at Wright Field on 22 February 1945, that brought glide bomb development to a virtual standstill. Inclosed is a copy of the report of this meeting. On the basis of the underlined items in the Appendix of Incl. 1, all glide bombs were greatly reduced in priority and many technical personnel were transferred to other projects having higher priority.

f. If there is a military requirement for the existing glide bombs and if a high priority is assigned to the work, development will be immediately expedited to utilize radar tracking of the missile and a scanning camera to promote greater accuracy and precision work through an overcast with the weapon. Until such a statement is received, the Air Technical Service Command will continue work under a 3A priority as prescribed by OCSR in the conference of 22 February 1945. A clarifying directive is requested concerning the nature of the desired continued development on existing experimental glide bombs.

g. At present, the GB-4 can be carried on the B-17 and B-25 airplanes. There is a reduction in speed of approximately 10 mph on the B-17 with two GB-4's. Wind tunnel studies of system of mounting could probably reduce the drag of the installation and result in higher speed of the carrying aircraft. Any other type aircraft possessing the load carrying capacity and sufficient clearance could be used for carrying the GB-4.

h. At the present, there are 1192 GB-4 kits stored at Gadsden, Alabama, and 108 kits and 117 control boxes stored at Wendover Army Air Field, Wendover, Utah. One thousand nine hundred fifty AN/AXT-2 television transmitters are stored at the Dayton Signal Depot, Dayton, Ohio, with 50 more to be delivered upon installation of dynamotors at the manufacturer's plant.

i. Five hundred fifty Navy ATK transmitters are available for use with "war weary" projects.

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Commanding General, Army Air Forces, Washington 25, D. C. Attention: Asst. C/AS, M&S. "Evaluation of the GB-4 Television Glide Bomb".

j. Thirty R-64/AXR-1 television receivers are in the modification center in Dayton, Ohio, with 80 more stored at the Dayton Signal Depot. One hundred thirty receivers are available at Fort Wayne, Indiana, and will be shipped to Dayton upon settlement of a disagreement over shipping instruction manuals with the equipment.

k. One hundred forty-five monitor indicators, Type ID-66/AXR-1 have been shipped to the Dayton Signal Depot and 1[illegible] more are to be delivered in August 1945.

[illegible]

E. Fletcher Maj AC
for [illegible]
Colonel, Air Corps
Chief, Aircraft Projects Section
Service Engineering Subdivision
Engineering Division

[illegible]
1. [illegible] Memo. Rpt. No. [illegible]-7-[illegible]-37-I, [illegible]/23/45.
2. Rpt. GB-4 Glide Bomb Overseas Expedition, [illegible]/28/44-10/14/44.

CONTRACT FILES
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[redacted]

SUBJECT: Evaluation of the GB-4 Television Glide Bomb.

1st Ind AFDRA-3G

Hqs, Army Air Forces, Washington 25, D. C. 16 June 1945.

TO: Director, AAF - Air Technical Service Command, Wright Field, Dayton, Ohio. ATTN: Administrative Office, TSREX.

1. It is directed that development be actively continued on the procedure of navigation to a target of a remotely controlled missile by means of radar with the use of television for a precise final approach to the target. If this procedure can best be developed with the GB-4, it is directed that GB-4 development be continued. It is recommended however, that since the resultant missile would be different from the GB-4, that a new number be assigned.

2. Contacts are being made with the combat theaters outlining the present status and anticipated development of the GB-4, and requesting their statements of requirements. Until these statements are received, priority will continue at the 3A priority previously established.

By Command of General ARNOLD:

Bruce B Price A Col AC

J. F. PHILLIPS
Brigadier General, U. S. A.
Chief, [illegible] Division
AC AS, [illegible].

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Major Jon H. Ober
ees/TSTEX (5-6147)

SECRET
Auth: Dir, ATSC
Date: 6-25-45
Init:

TECHNICAL INSTRUCTION

Wright Field, Dayton, Ohio
25 June 1945

SERIAL NO: TI-2003, Addendum No. 36. → SUPERCEDED AND CANCELLED BY TI-2217, add. #7, dated 29 NOV 45

SUBJECT: Continued Development of GB-4.

TO: Engineering Division.

"ACTION" COPY TO AIRCRAFT RADIO LAB. ON 3 DEC 1945 (See 29 NOV 45 in this file)

1. Problem Presented:

a. To continue development on the procedure of navigation to a target of a remotely controlled missile by means of radar with the use of television for a precise final approach to the target.

2. Factual Data:

a. If the Problem Presented can best be accomplished by continuing development of the GB-4, that is to be done. However, it is recommended that since the resultant missile would be different from the GB-4, a new number be assigned.

3. Authority:

a. CG, AAF. By 1st Ind. dated 16 June 45, subj: "Evaluation of the GB-4 Television Glide Bomb", received from AFDMA-2G Materiel Division, AC/AS, M&S.

4. Action Desired:

a. That the Engineering Division accomplish that which is stated under paragraph 1, Problem Presented.

b. Contacts are being made with the combat theaters outlining the present status and anticipated development of the GB-4 and requesting their statements of requirements. Until these statements are received, the above project will containue on a 3-A priority.

By command of Major General MILLER:

T. A. SIMS
Colonel, Air Corps
Chief of Administration

Orig; Pilotless Airc (2)
Cys; Gen Ca roll
Airc P Sec
EHR (13)
Eq Lab (2)
File

SEE S-2217, #3. 8 AUG 1945 "RADAR CONTROL FOR GUIDED MISSILES" closed out with reference to TI-2003 #36

9-30-45

cc: Procurement Division
Supply Division
Maintenance Division
Tech Liaison Office
Aircraft Test Control

ACTION

[redacted]

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ATSC Form No. 10-3 (19 Mar 45) Velo Mlinatrie. G. MX717 614 8-N-741

ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

Use this form for inter-office correspondence within headquarters. Use authorized office symbols to designate addressor and addressee. Place initials of dictator and typist, telephone number and location to right of signature.
Use entire width of sheet, both sides. Number all comments consecutively. Separate comments by horizontal lines across page.

SUBJECT TI-2003, Add #36 - Development of Radar-Television Glide Bomb Type GB-

TO TSEPL-3N FROM TSESE-2G [redacted] DATE 8/1?/45 COMMENT NO. 1

1. TI-2003, Add #36 dated 25 June 1945, calls for "development on the procedure of navigation to a target of a remotely controlled missile by means of radar with the use of television for a precise final approach to the target" and recommends assignment of a type number other than GB-4. The new type number is GB-15 and the item has been entered into "experimental" status. Classification is "Confidential", priority is 3A, Project number is MX-717 and the E.O. number is 448-32.

2. It is requested that the Control Equipment Branch of the Equipment Laboratory furnish airframes, radio control units and parts to the Aircraft Radio Laboratories (TSERR-2) as required, cooperate in design and development problems connected with installing radar equipment on glide bombs, and run such engineering and service flight tests as are necessary to determine the correct procedure of navigation as directed in the Technical Instructions.

3. R&R dated 5 July 1945 from TSEPL-31 to TSESE-2G, subject, "Tests on Radar Beam", indicated that action along these lines was planned at that time. Any work already performed should be applied on this project MX-717.

4. The estimated completion dates call for study, design and fabrication by 1 November 1945, engineering tests by 1 December 1945, service tests by 1 February 1946 and tactical tests by 1 April 1946.

5. R&R to TSERR-2 dated today requests their study and design of the radar system to be used, and its installation in a type GB-4 airframe. Coordination of the project will be handled by Lt. R. T. Morris TSESE-2G, ext. 36351.

Jack List

MARCUS F. COOPER
Colonel, Air Corps
Chief, Aircraft Projects
Service Engineering Subdiv.
Engineering Division

RTM/jt
36351
Bldg.126

TO TSESE-2G FROM TSEPL-3N6 DATE 21 AUG 1945 COMMENT NO. 2

1. To confirm telephone conversation on 20 August 1945, the Control Equipment Branch of the Equipment Laboratory will assist and cooperate in the design and development problems connected with installing radar equipment in glide bombs with Aircraft Radio Laboratories (TSERR-2) and will conduct such engineering and service flight tests as are necessary to determine the correct procedure of navigation as directed in the Technical Instructions.

[redacted]

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TO FROM DATE 21 AUG 1945 COMMENT NO.

2. All testing and developmental problems particularly applicable to this office under the conditions stated in paragraph 1, above, will be coordinated by the project test officer, 1st Lt. Joseph Lamprecht Jr., of the Control Equipment Branch (TSEPL-3N6) Ext. 2-7127.

3. Your attention is invited to the fact that this Office cannot furnish airframes, radio control units and parts from its supply now in storage at Wendover, Utah because these units have been allocated for other test purposes for projects already scheduled. These prior committments preclude the shipment of any articles from the Wendover supply for use on Project MX-717. It is accordingly suggested that your office initiate action to review the requirements of the initial stages of the program with the proper authorities in Aircraft Radio Laboratory and request shipment of such units as may be required from the 829th Specialized Depot, Gadsden, Alabama.

C. A. K.
CAK/mpw
27127 193

Maj. AC.
for T. B. HOLLIDAY
Colonel, Air Corps
Chief, Equipment Laboratory
Propulsion and Accessories Subdivision
Engineering Division

AUG 22

10/17/45 - Capt. Kerner said today in tel. conv. with Lt. Morris, that they would now be glad to get rid of glide bomb frames & equipment.

R. Morris
1st Lt - AC

(DO NOT WRITE BELOW THIS LINE)

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2/3 [redacted] 617

BASIC: Ltr fr Hq AAF, 27 June 45, Sub: Radar Tracking of GB-4 Television Glide Bomb

1st Ind

HEADQUARTERS UNITED STATES ARMY STRATEGIC AIR FORCES, APO 234, AUG 15 1945

TO: Commanding General, Army Air Forces, Washington 25, D. C.

1. The current and projected uses of the GB-4 Television Glide Bomb with radar beacon have been considered carefully over the intervening time elapsing since the receipt of the basic letter. As a result of the study conducted, no immediate operation requirements can be forseen for it in its anticipated perfected development.

2. The factors governing this decision are:

a. The present shortage of combat crews in this Theater does not permit allotting the additional time re quired for training in the use of this bomb.

b. The bomb load which could be carried in terms of GB-4 Glide Bombs and the probably damage expectation of such 2000 pound bombs is not commensurate with the total bombing capacity of the B-29 aircraft.

FOR THE COMMANDING GENERAL:

1 Incl:
w/d

/s/
CURTIS E. LeMAY,
Major General, U. S. A.,
Chief of Staff

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WAR DEPA[redacted]
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

AFRDB 27 JUN 1945

SUBJECT: Radar Tracking of GB-4 Television Glide Bomb

TO: Commanding General
U.S.Army Air Forces, Pacific Ocean Area
A.P.O. 953, c/o Postmaster
San Francisco, California

1. The GB-4 Glide Bomb houses a television camera and transmitter and relays back to the controlling aircraft an aerial picture of the terrain at which it is pointing. Each unit contains a 2000-lb G.P. bomb and has a gross weight of 2500 lbs. The unit has a 12-ft wing spread and approximately 12-ft overall length. It is remotely controlled by radio in range and azimuth.

2. In August and September of 1944 a total of six GB-4's were employed against targets in France and Germany from B-17 aircraft. In four of the six drops the television pictures were poor and only occasional glimpses of the targets were available. On one drop the weather was bad and the targets were overshot; and on the last drop the bombardier released the bomb against the wrong target. Results of the combat tests were rather disappointing, although valuable information was gaine[illegible] further development of the GB-4.

3. Army Air Forces Board Report No. (T1) 30m, subject "Tactical Test of GB-4 Glide Bomb," dated 5 August 1944 is inclosed for your information. Further tactical and technical development of the GB-4 has been undertaken but progress has been relatively slow because of the comparatively low priority given the project. A low priority was assigned because of the doubtful operational value of the subject weapon.

4. With further development of the GB-4 it is believed we can obtain accurate bombing through an overcast by employing radar tracking for navigation to the immediate target area and television for the final approach. It is also hoped to obtain the degree of accuracy against maneuvering targets that has been obtained against stationary targets.

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By installing a radar beacon in the GB-4 the bomb can be guided through an overcast to the immediate target area by tracking it on the PPI scope. When the bomb breaks through the overcast, the television transmitter will transmit to the controlling aircraft an aerial picture of the terrain at which the bomb is heading, and the bomb can then be guided into the target.

5. To achieve these goals, it is believed that four months would be required under a high priority. This would be a hurry up program and should be done only if there is an immediate operational requirement for this type weapon, because in so doing, other developments would suffer, particularly those in which television is an integral part. To carry this project on a lower priority basis, the goals will probably be achieved in seven to eight months time.

6. In view of the above discussion, can you foresee an immediate operational requirement for the GB-4 television glide bomb in its anticipated perfected development?

FOR THE COMMANDING GENERAL:

1 Incl
Bd Rpt (TI) 30a

/s/

JACK ROBERTS
Colonel, Air Corps
Executive, Asst Chief of Air Staff
Operations, Commitments & Requirements

COPY

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AAFMC-228-WF-1-17-44-20M

File No. ... 1/1

[redacted]

MODEL OR TYPE DESIGNATION
CHANGE OF STATUS OF EQUIPMENT

Sheet No. 1
Item 1
Date 10 July 1945

1. Name of Article or Requirement Affected: Glide Bomb, Radar-Television. ~~GB-(To be assigned)~~ 15

Drawing No.: None — Specification No.: None

2. Entry, ~~Removal~~ ~~Change of Classification~~ ~~of Requirement~~: Experimental

3. New Type or Model: Yes — Supplements ~~of~~ ~~Replaces~~ Type or ~~Model~~: GB-4

New Status of Supplemented or ~~Replaced~~ Type or ~~Model~~: Subst. Std. — Lab. Charged with Development: Aircraft Projects Sect.

4. Estimated unit cost: Unknown

5. Indicate concurrence in the proposed action by Technical Services, Technical Committees, and/or Service Board reports: Directed by TI 2003, Add #36 dated 25 June 1945

6. Does item possess required military characteristics: Yes
   (a) In what respect is it lacking: None

7. Status of related equipment: GB-4, Standard

8. REMARKS: (Include a brief resume' of the characteristics of the article or requirement or resume' of reason for entry, removal or change of classification).

The radar-television glide bomb will consist of a standard 2000 lb. GP bomb to which is attached a GB-4 type airframe which will carry a radio control unit, a television conversion unit and transmitter, and a radar beacon or reflector. The radar equipment will furnish a visible pip on a radar search set in the parent airplane so that the position of the glide bomb in respect to the target in azimuth will be apparent to an operator even though a television picture is not available due to overcast or weather. It will be necessary, however, to have a television picture for position information during the latter part of the flight. Radio control in azimuth and range will be possible during the entire flight.

Approved:

Initiated By R. E. Morris, 1st Lt. AC

Br. ~~Lab.~~ Chief Jack Last, Major, AC
Pilotless Aircraft Br.

MARSHAL E. COMBS, Col. AC.
Chief
Aircraft Projects Sect.

Type designation GB-15 has been assigned ~~XXXXXXXXXXXXXXXXXXXXXXXX~~
~~XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX~~

F. J. RAWSON, Major, Air Corps
Chief, Spec. & Std.s Br.
TSESE 32
Specification Branch
Production Engineering Section

ARM

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N-21498-1129

ATSC Form No. 103
(19 Mar 45)

ROUTING AND RECORD SHEET AIR TECHNICAL [redacted]

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Use authorized office symbols to designate addressor and addressee.
Number all comments consecutively.
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Separate comments by horizontal lines across page.

SUBJECT: TI-2003, Addendum #36, Continued Development of GB-4

TO: TSTEX
Thru: TSECO-4

FROM: TSESE-2G

DATE: 10/19/45

COMMENT NO. 1

1. The continued development on the procedure of navigation to a target of a remotely controlled missile by means of radar, as presented in TI-2003, Add. #36, cannot be pursued until the control radar is perfected. The APW-5 and APW-6 are being developed for this purpose under E.O. 108-59, TSERR-2C.

2. It is requested that the subject Technical Instruction be closed out at this time because the radar control system will not be available until approximately March 1946. It will be determined at that time whether or not this system can be, or should be, applied to a Glide Bomb such as the GB-4.

3. It is further requested that this office be notified of action taken.

Jack Lief, Maj. A.C.

for B. S. KELSEY
Colonel, Air Corps
Chief, Aircraft Projects
Service Engineering Subdiv.
Engineering Division

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HEADQUARTERS, ARMY AIR FORCES
WASHINGTON
25

IN REPLY REFER TO:
(AFDMA-2G)

NOV 20 1945

SUBJECT: Cancellation of T.I. 2003, Addendum 36.

TO: Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: TSTEX

1. Reference is made to your message AT 24918, dated 30 October 1945, requesting authority to cancel Technical Instruction 2003, Addendum 36.

2. Since the development of the control equipment, rather than the overall development of the GB-4 glide bomb is the primary objective, cancellation of TI 2003, Addendum 36, is concurred in, providing provisions are made for continuing work on the control equipment.

3. There is still a definite requirement for the development of equipment to navigate a remotely controlled missile to a target by means of radar with use of television for the precise final approach to the target. A 2B priority is assigned this project.

4. The portions of our letter of 26 October 1945, subject, "Cancellation of Technical Instructions", which applied to TI 2003-36, is hereby superceded.

By Command of General ARNOLD:

G. Bunker
ALDEN R. CRAWFORD Col AC
Brigadier General, U.S.A.
Chief, Production Division,
Office, AC/AS-4

[redacted]L

ADDRESS REPLY TO: COMMANDING GENERAL, ARMY AIR FORCES, WASHINGTON 25, D. C.

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M. R. No. TSESA-7-1944
31 January 1946

4. It is here noted that the specifications [illegible] "BANSHEE" project included the tests of [illegible] control and [illegible] vision required by T.I.-2217, Addendum No. [illegible] as well as [illegible] Addendum No. 53.

C. CONCLUSIONS:

1. That Expenditure Order No. [illegible] and [illegible] Project [illegible] be closed out, as they cover tests and development that [illegible] higher priority of Expenditure Order No. [illegible], Project [illegible]

2. That B-17G airplane [illegible] may be [illegible] from Project MX-717 and assigned to Project "BANSHEE".

3. That development of a glide bomb [illegible] (GB-15) may be discontinued in favor of a [illegible] ciples of control.

D. RECOMMENDATIONS:

1. That this Memorandum Report [illegible] termination of Project MX-717, and [illegible] 448-32: (Action [illegible] with this report.)

2. That responsibility for B-17G airplane [illegible] from Project MX-717 to Project "BANSHEE". (Action [illegible])

3. That the type GB-15 glide bomb [illegible] all further reports and projects unless [illegible] taken.)

NOTE: This Memorandum Report [illegible] and terminates Project MX-717.

Copies to:
AC/AS-4 (5)
[illegible]
[illegible]
[illegible]

[illegible]
Aircraft Projects Section

[illegible] Colonel, Air Corps.
Chief, Pilotless Aircraft Branch.

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[redacted]

ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

SUBJECT: [illegible] Addendum No. 36, Development of Radar Television Glide Bomb, Type GB-[illegible]

[illegible] Feb. 1946

1. Reference is made to Comment No. [illegible] this Record and Routing Sheet dated [illegible] October [illegible] to [illegible], subject as above.

2. [illegible] was cancelled and superseded by [illegible] dated 2[illegible] November 194[illegible] [illegible] Subdivision.

3. Because [illegible] "remotely controlled missiles", and because the current [illegible] include development and tests of the radar television equipment [illegible] used in the GB-[illegible] glide bomb, [illegible] Aircraft Branch [illegible] Project MX-717 covering the GB-[illegible] glide bomb as well as [illegible] MX-717.

4. Unless reconsidered at a later date, no further development of a GB-[illegible] Radar Television Glide Bomb will be made by [illegible] aircraft [illegible], and the nomenclature will be dropped. If the [illegible] radar remote control equipment [illegible] glide bomb, arrangements should be [illegible] ated by Electronics Subdivision.

[illegible]

[illegible]
Colonel, Air Corps
Chief, Aircraft Projects Section
Service Engineering Subdivision
Engineering Division

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Div. A. C. 266a-Wright Field 8-9-40-30M

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

AH:ms:54

MEMORANDUM REPORT ON

Date June 7, 1941

SUBJECT: Light Responsive Devices.

SECTION Experimental Engineering.

SERIAL No. EXP-M-54-672-13

MX 109

Contract No.
Expenditure Order No. 672-1-13
Purchase Order No.

A. Purpose.

1. To report on the construction and tests of a preliminary model of a light responsive device for controllable bombs, target seeking, light directed.

B. Factual Data.

1. A preliminary model of a light responsive device was assembled in accordance with the description in Appendix I.

2. This device was tried first with sky targets. The tests were made on May 22, 23, and 24th., with various conditions of sky. The presence of clouds induced a large variation of sky intensities which would require reduction of sensitivity to about 1/6. With a clear sky full sensitivity could be used, except within 45° Azimuth from the sun. Within that sector the horizontal variations required sensitivity of about 1 to 3, and the vertical sensitivity of about 1 to 6. The presence of a passing airplane could be indicated at distances up to 1,000 ft.

3. The device was tried for land targets on May 29th. Observations were made from a B-18 bomber on a partly cloudy day. In open country the difference between a green field and a plowed field was sufficient to operate the device, thus masking the effect of small objects such as farm houses or barns. However, a bright roof or a dark shadow, in green surroundings, would give definite response, also ponds and other outstanding objects in an evenly colored background.

4. In flight over the city the general illumination appeared more uniform and the device would respond only to outstanding light or dark objects. For example: a tin roof of a factory, a railroad yard, or a light colored building. The action of the device was quite positive, directing the mechanism to the right or to the left depending on the direction of the object observed.

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5. Observation of ground targets through colored filters shows the greatest discrimination with red color and this may prove satisfactory for city targets. However, for open country the red filter seems to accentuate the difference between plowed fields and green fields. Thus the green filter may prove to give better results in open country, as with this latter filter, buildings and roofs stand out more conspicioously.

6. The possibility of illuminating targets has been considered. A high power incandescent lamp with a small light emitting source is available and has been tried with a 24" projector. This lamp gives a beam of 4,300,000 candle power spreading about 3/4°. This angle can be further reduced with longer focal distance projectors to about 1/3°. With such a projector a 50 ft. area would be illuminated from 10,000 ft. elevation.

7. A study is being made of possible adaptation of such telescopic devices as drift indicator for controlling such a radiation projector toward a visible target.

8. Modulated invisible light energy may be used in this projector. According to Professor E. H. Edgerton of the Massachusetts Institute of Technology, the source of such energy is technically possible.

9. There is also a possibility of making a night vision screen with invisible illumination as described in Appendix II.

C. Conclusions:

1. That these preliminary observations show that the general assembly of elements is sufficiently effective to initiate procurement of working models, using these elements, from some reliable manufacturer, preferably the Weston Electrical Instrument Corporation. (The photo-cells and the relays used are those manufactured by this corporation.)

2. That tests with different colored filters show the possibility of using such filters in connection with photocells to accentuate the discrimination of land targets.

3. That there is a possibility of illuminating targets for night operation.

D. Recommendations:

1. That procurement be initiated for a light responsive device using the elements and electrical connections of the preliminary device.

MX-109

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Experimental Engineering Section,
Memorandum Report No. EXP-M -54-672-13
June 7, 1941

2. That experimental work be continued with preliminary equipment to determine whether certain types of filters will permit discrimination of suitable targets:

a. On land.
b. On water.
c. In the air.

3. That procurement be initiated for modulated light sources with visible and with invisible radiations.

4. That the possibility of controlled bombs directed to illuminated land or water targets be considered, to determine the most suitable strategic combination of elements involved. These elements are as follows:

a. Location of light beam projector.
b. Type of light (visible or invisible).
c. Type of bomb; falling, gliding, or power driven.

5. That the development of a night vision camera be initiated.

A. NYMAN, Major, Air Corps

RANDOLPH P. WILLIAMS, Major, A.C.
Equipment Laboratory

F. O. CARROLL, Lt. Colonel, A. C.
Chief, Exp. Engrg. Section.

[redacted]
MX-109

Chief, Mat.Div; Att: Adm. Exec.
Central Files.

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The light responsive device consists of the following parts: (Refer to Air Corps Dwg. #S41A10307.

1. An 8" parabolic reflector with 5" focal distance mounted in an 8-1/2" tube, such as is used in lamp assembly type B-2 for air traffic control.

2. A four sector Weston photronic cell. Each sector is 7/16" X 9/16". The exposed surface of the four sectors in square formation is 13/16" square. This surface is located in the focal plane of the reflector.

3. Opposite cells are connected in series. Unbalanced current is passed to a Weston Model 705, sensitrol relay, 0-20 micro-amperes, double contact, adjusted to float in neutral position for 0 current and swinging to the right or the left for currents of +5 and -5 microamperes respectively.

4. A plug is placed between the cells and the sensitrol to permit reversing the sense of connections. Thus, either a light object on the right of the axis of reflector gives a right contact control, or a dark object to the right gives similar control.

5. The sensitrol relay operates two power relays, to be connected to servo controls.

6. Two sets of controls are provided: one set, consisting of one sensitrol and two power relays for right-left control and another similar set for up-down control.

7. The two power relays of each set have one pair of contacts, one on each relay, connected in parallel to the heating element of a Weston Model 613, Time Delay Relay.

8. The operating contacts of this time relay serve to operate the reset solenoid of the sensitrol of the corresponding set.

9. The time delay relay has double group of circuits. The second group of circuits is used on the second set of sensitrol and power relays.

APPENDIX I.

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MX-109

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Experimental Engineering Section,
Memo, Report No. EXP-M-54-672-13
June 7, 1941

Possibilities of Night Vision Camera.

The following elements can be coordinated to produce a visible screen with an image of an area illuminated only by ultra-violet radiations:

1. A very powerful light source giving short duration flashes of 50,000 watt radiant energy at 1/10 of a second intervals. The ultra-violet energy is about one fourth of the total energy.

2. A Schmitt camera with F.6 and a ten inch objective.

3. Fluorescent screen of zinc sulphide, the response of which is about fifty microlamberts for an ultra-violet radiation of one microwatt, per square centimeter. (Note: Fifty microlamberts is equivalent to the brightness of a perfectly white area illuminated with about .047 footcandles.).

4. With these devices coordinated an area at a distance of 3,000 ft. illuminated, with a projector covering 30° angle would give illumination of five microwatts per square centimeter assuming one hundred percent dispersion of ultra-violet energy. The image in the camera would then have about 1.8 microwatts per square centimeter. This would give a fluorescent screen brilliancy equivalent to illumination of .085 footcandles. (Note: Clear moonlight is about .01 footcandles illumination.)

5. The above figures are, of course, only theoritical and would have to be verified by actual experiments, but they indicate a sufficient margin of possibilities of this method.

6. The actual contrast on the screen of objects against background would correspond to approximately eight times the greatest visibility obtainable with moonlight, while actual visible illumination of the area would be nil.

APPENDIX II.

[redacted]

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FAIRCHILD AVIATION

C O P Y

4/3/42

I N T R O D U C T I O N

During the past nine months the Fairchild Aviation Corporation has been engaged in the development of a series of five control units for the automatic guiding of bombs toward naval targets. These units have an optical system which views the sea-scape surrounding the target. By virtue of the contrast of the target against the background a signal is produced through a photoelectric system which indicates in which direction a correction of course should be applied to cause the bomb to travel directly toward the target.

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This development work is being done under contract No. W535ac19430 and is the culmination of three years of research and development. Four of the five units have been constructed and tested and the fifth unit is now being assembled. These units represent a series of progressive improvements. When the first was built only highly contrasting targets on a relatively uniform background could be followed. The improvements incorporated in each successive unit, however, have resulted in a unit which will operate with targets of very low contrast, with back-grounds of much less uniformity, and under very poor light conditions.

At the beginning of our work on this contract it was anticipated that the high angle dirigible bomb would be the easiest application. The Air Corps has directed its main effort to the solution of the glide bomb problem and has delegated the work on high angle dirigible bombs to the N.D.R.C. The first two units that we constructed were designed to be used that we constructed were designed to be used in the high angle application only. The succeeding ones have been designed to operate at either high or

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low angles.

There are several advantageous features of the self-directing, high-angle bomb. The explosive charge for any caliber will be comparable to the corresponding caliber standard bomb. There is no use of radio transmission or reception with its high complexity, high cost, and danger of enemy interference. The N.D.R.C. has found that the space occupied by a dirigible bomb is the same as for a standard bomb of like caliber. Thus there need be no alteration in present bomb racks and bomb loads. The inherent simplicity of the control unit makes it easily and quickly adaptable to low-cost mass production methods. Hence the self-directing bomb can be used as freely as are the present standard bombs.

In use against naval targets, the effect of the control unit is to substitute an area target for an isolated object. This effect greatly reduces the skill required for accurate bombing. It would seem that the less rigorous requirements in skill would reduce personnel training time appreciably.

One of the most immediately realizable applications of our self-directing bombs is the destruction of enemy anti-aircraft searchlights. For this purpose a small caliber should suffice. The size and weight of the control mechanism would still be but a small fraction of the size and weight of the entire bomb.

In the work the N.D.R.C. is now doing on high angle dirigible bombs it has confined itself to a system using television to transmit a picture of the target area back to an operator who then controls the bomb's flight by means of a second radio link back to the bomb. The bomb is thus in the last analysis controlled by human intelligence.

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In carrying out this research project the N.D.R.C. has conducted wind-tunnel and dropping tests to determine the aeroballistic performance of the bombs in flight. These tests have shown to us and to them that the idea of deflecting a dropped bomb toward its target is entirely practical. With the smaller calibers the problems decrease rapidly.

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FAIRCHILD AVIATION

PRODUCTION IN 1942

There is, in our opinion, no technical barrier which could prevent the start of a large scale production program of an automatically self-directing freely falling bomb before the end of 1942. The control unit which we have developed has been refined to the point where its performance can no be predicted. We know that it will provide the guiding intelligence necessary to direct a bomb toward a naval target. The major uncertainties of the aerodynamic problem have also been solved and there remains only a problem of adaptation rather ahan research. We believe that the only program which should be considered at this time is a far-sighted plan designed to bring every phase of the project to a production goal at the greatest possible speed.

The idea of a target-seeking bomb is no longer just an eventual possibility - it is entirely practical and realizable in the next six months.

It is our belief and that of the N.D.R.C. that work should be started immediately on the adaptation of the results of the N.D.R.C investigations to our self-directing control system. We have at present a control unit capable of supplying the guiding intelligence to a dirigible bomb if such were available now.

The N.D.R.C. agrees that the major problems of such a system have been solved by them and that the remaining problems are of adaptation and refinement. The N.D.R.C. is unable to do this work in addition to their present project. We therefore offer this proposal for the performance of this work at maximum speed.

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We propose to carry forward a project to adapt the results of the work done by the N.D.R.C. on dirigible bombs to the self-directing system and to bring this problem to a practical solution in the shortest possible time. This program envisages an all out procedure starting with the data and methods developed by the N.D.R.C. and proceeding to the construction and dropping of full scale test bombs. Simultaneously with this work we will proceed with the adaptation of the entire unit to meet service conditions and specifications, and the planning and setting up of production facilities to manufacture the units to these specifications.

We will go from preliminary wind tunnel test directly to full scale dropping tests. In this latterphase we will use a motion picture recording system within the bomb itself to record the operation and effect of the automatic control equipment. We will use a method developed by the N.D.R.C. of salvaging this record from the bomb.

During the course of the work we will build 20 actual full scale bombs which will be dropped. A complete motion picture record of their performance will be produced and recovered from the bomb by parachute before impact or afterward by using a protective film casing.

Throughout the entire project we will cooperate closely with the N.D.R.C. to avoid duplication of work they have already done and to utilize to the maximum the results they have obtained. We will have the prototype done about the time of completion of our present contract. We will then begin construction on the 20 complete test bombs. Such a procedure will enable us to arrive at a final proven design in production before the end of this year.

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PROPOSAL

The above program may be summarized as follows: we propose

1. To investigate the aerodynamic features peculiar to this system which the N.D.R.C. believes to be necessary but which it will be unable to do.
2. We will construct a complete prototype bomb for laboratory and wind-tunnel tests containing control unit, recoverable motion picture recording equipment, rudder operating mechanism and power supply.
3. We will manufacture 20 complete bombs similar to the prototype with successive modifications as indicated by drop tests.
4. In collaboration with the Air Corps and the N.D.R.C. we will drop these 20 bombs in a sequential program on a bombing range with artificially simulated naval targets or actual targets.
5. We will maintain a production planning staff in close coordination with the whole project, and have complete production plans ready to operate as soon as the production order is granted.
6. We will complete this program within nine months from date of acceptance of this contract.

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MX-109

"Fairchild Aviation Corporation's Daylight Bomb Control System and Night Bomb Control Project"

RPW:ek:54

1st Ind.

Experimental Engineering Section, Wright Field. May 11, 1942.
To: Commanding General, AAF Materiel Command, Washington, D. C.

1. Reference basic communication, it has, throughout the negotiations with the Fairchild Aviation Corporation, been the understanding of this Office that the daylight target seeking device being built by them on contract was for use in glide bombs of flat trajectory, and not exclusively high angle bombs.

2. The three units referred to as completed did not perform satisfactorily when tested in the New York test station of the Special Weapons Unit, Equipment Laboratory, Experimental Engineering Section, where the target seeking qualities were investigated against boat targets in New York Harbor at, roughly, one-half mile range. The best of the three units operated correctly in right and left orientation only. Subsequent tests witnessed by representatives of the Materiel Center on April 13, 1942 showed appreciable improvement in the operation of the equipment. As a result of this latter development, arrangements are presently being made to install the equipment in a Type AT-8 airplane for tests against surface targets.

3. This Office has under development flat trajectory controllable bombs, glider and power driven, and has refrained from duplicating the National Defense Research Committee efforts directed to high angle controllable bombs. From the letter of the Fairchild Aviation Corporation it appeared that their device, as then designed, would not function on any controllable bomb now being developed. The tests of the equipment in an airplane, mentioned in paragraph 2 above, will determine the usability of the equipment in a flat trajectory controllable bomb, a use for which the Fairchild Aviation Corporation now claims their device is adaptable.

4. On written request from the Fairchild Aviation Corporation, this Office will initiate action to secure improved priority ratings for equipment which they are finding difficulty in obtaining.

5. The status of development of the Fairchild Aviation Corporation device does not warrant a production order at this time.

6. Regarding the Delco-Remy night target seeking device, this apparatus was discussed with the Delco-Remy Division prior to any suggestion from the Fairchild Aviation Corporation concerning such a device, and the contract therefor placed on October 13, 1941. The representatives of the Fairchild Aviation Corporation are apparently not aware of the scope of the engineering involved in the apparatus utilizing the Delco-Remy device. This device, with smaller power source equipment, should afford instantaneous light output of greatly

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CENTRAL FILES MX-109 MDAC-190-WF-6-28-41-1 M8.

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1st Ind. to Commanding General, AAF Materiel Command, Washington, D.C.
"Fairchild Aviation Corporation's Daylight Bomb Control System and Night Bomb Control Project"
May 11, 1942.

increased intensity, as compared with the Fairchild Aviation Corporation equipment.

7. If the Fairchild Aviation Corporation daylight device cannot be made operable with flat projectile bombs, a change order will be considered in their contract to provide for their complete fabrication of the bomb projectiles, with control equipment installed, (bomb case to be Government furnished), delivered to Eglin Field, Florida for test by the Materiel Center.

F. O. CARROLL,
Colonel, Air Corps,
Chief, Experimental
Engineering Section.

2 Incl. withdrawn.

MAY 10 1942

Signature ____________________

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MX-109

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REPORT

of

THE ARMY AIR FORCES BOARD

SUBJECT

CONTROLLED MISSILES

PROJECT No (G) 5

COPY No. 32

DATE

29 October 1943

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THE ARMY AIR FORCES BOARD
Army Air Forces School of Applied Tactics
Orlando, Florida

CONTENTS

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(4) Controllable Glide Bombs: The controllable glide bomb is the least impressive in its performance but is apparently one of the simplest long range bombs to put into operation. It consists of a normal glide bomb which, instead of being preset, is controllable by radio from the mother airplane. The purpose of this arrangement is to increase the accuracy and, therefore, the effectiveness of this weapon. However, in order to control it, it is necessary that the bombardier be able to see the bomb and judge its position with respect to the target throughout its entire trajectory. This is accomplished by means of a smoke candle or flare which is placed in the bomb and permits observation of its flight. Since the purpose of the glide bomb is to permit the launching airplane to remain outside of the heavily defended anti-aircraft zone around specific area targets, it is felt that this bomb has little practical application for what is gained in accuracy is lost by virtue of the fact that in order to obtain this accuracy, the launching airplane must continue close enough to the target to witness the fall of the bomb throughout its course. With the possible exception of ideal climatic conditions, its proper guidance does not appear feasible for distances in excess of 10 miles. This weapon might, however, be utilized successfully against coastal installations which do not permit of anti-aircraft protection on the attacking side of the target.

(5) Power Driven Bombs: The power driven bomb has very definite operational possibilities but its construction and production is just as complex as that of an airplane and takes almost as long. It requires technical personnel for its successful maintenance and operation and due to its expense and complex nature, is very definitely a weapon which should be limited to specific targets which are of the highest importance to destroy. The power driven bomb, although apparently operational, will not be available for combat use for some time since its production is slow and complex. It apparently operates best when utilizing television guidance, thus permitting the operator to control the bomb as if he were flying it personally.

(6) Target Seeking Bombs: Target seeking bombs will consist of various adaptations of the above type bombs which, rather than being controlled from a mother aircraft, will contain light seeking, heat seeking, radar seeking or other homing devices tending to direct them against the target. These weapons are still definitely in the development stage and although they will be eventually of definite operational value, especially against shipping, it is felt that little tactical study can be made of their present use. They have not as yet been tested to a sufficient extent to furnish the necessary data required to consider them for introduction into the combat theater.

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Orig. Cont. Missiles
AC - 36 - 63(1/3/44)
RL, DEB
M+8

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99 - - 36

(AFDMR-2F)

NDRC
File "Dirigible Bombs"

5 November 1943

MEMORANDUM FOR BRIGADIER GENERAL B. W. CHIDLAW AND
COLONEL R. C. WILSON

SUBJECT: Joint Guided Missiles Conference.

1. Joint meetings with the Navy and National Defense Research Council, called by Brig. Gen. H. M. McClelland for the Army Air Forces and Captain Steadman Teller for the Navy, were held at the Combined Chiefs of Staff Building on 3 and 4 November 1943.

2. The entire guided missiles program was examined and a number of decisions reached. Duplicating projects were dropped in favor of joint projects. Certain devices were given emphasis. Each line of research and development was scrutinized, resulting in much mutual education. In general the results were extremely beneficial to the general effort. An excellent spirit of cooperation prevailed. The working committee for the three agencies involved was:

a. N.D.R.C. - Mr. H. B. Richmond
Dr. H. L. Dryden
Dr. L. O. Grondahl
Dr. J. C. Boyce
Mr. H. H. Spencer

b. Navy - Captain Steadman Teller
Dr. E. R. Piore

c. Army - Brig. Gen. McClelland
Colonel S. P. Wright
Colonel George Holloman
Lt. Col. F. R. Richardson

Lt. R. L. Harrison for the Navy and Major W. I. Norvell for the Army were secretaries.

3. In addition a great many experts were on hand to contribute when called upon. These came from the research laboratories, development centers and Washington headquarters of the services and N.D.R.C. In all about 50 people attended each of the meetings.

4. The subject matter was divided into four parts and a meeting held

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Orig. Cont. Missiles
A2-36-636 (7/3 pp)
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on each. The following summarizes the results:

a. Radio Links:

(1) First the Navy and then the Army [illegible] were examined in detail. Some minor duplications were eliminated. It was agreed that as soon as possible a standard radio transmitter and receiver [illegible] high angle controllable bomb - would be adopted. [illegible] will be used until the Navy is ready with a [illegible] system satisfactory to the Army. This will be standard for [illegible] bombs as well. [illegible] frequency devices for [illegible] for all controllable bombs are to be examined for anti-jamming [illegible].

(2) A cooperative effort was [illegible] agreed upon to develop a pulsed radio -- or [illegible] radio -- system of control. At [illegible] Holloman's suggestion it was agreed that [illegible] radio channels would be standard for both Army and Navy pulsed [illegible]. [illegible] fication and [illegible] installation etc., were [illegible].

Comment: The Navy program [illegible] the Army has not kept up to the [illegible] requirement [illegible] well organized and joint [illegible].

b. Television:

(1) The television [illegible] there was little [illegible] tions and [illegible] were made uniform.

(2) A joint committee was [illegible] television system for the [illegible] bomb. Another [illegible] of setting up the specifications for [illegible] - to replace the present [illegible] to production as soon as possible [illegible] tive tests were decided upon.

Comment: This [illegible] is well in hand and holds great promise for using missiles under conditions of [illegible].

c. Radar:

(1) There was fairly complete agreement in the Navy and Army programs. In general, both have three systems for use in guided missiles and all are adaptable to either glide bombs or powered bombs or the Navy "[illegible]" which is simply a glider carrying a bomb. The [illegible] radar homes on radiation directed to the target by the mother plane, [illegible] radiation emitted by the bomb as it travels towards the target, and the [illegible] - an advanced de-

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velopment system asked for by Materiel Command - is the [illegible]tation of extremely high radar frequencies to a method of following the bomb with respect to the target by radar. The Navy also has a device "moth" that homes on enemy frequencies.

(2) It was decided that [illegible], a joint project, would consist of the Bell Laboratories version since it promised better range than the Radiation Laboratories system. However, in view of the long time it will take to get the Bell Lab set in production the Army reserved the right to continue the Radiation Lab version.

(3) At the suggestion of the [illegible], it was agreed that a joint exploration of the vulnerability of missiles using microwave radar to enemy jamming would be made.

Comment: The outstanding fact of the radar program was its extreme slowness of development. The utmost pressure is needed to get these items into the war theatres.

d. Heat and Light:

(1) Army and Navy programs of homing devices using heat, infra-red and light as target directors are already joint efforts and little remained to be discussed except to consider the large number of development items. It was agreed that there would be an elimination of many items as soon as possible and that meanwhile both services would concentrate on getting the two most promising systems into service. These consist of the Offner thermopile, a reliable device when used over water but of little use over land, and the [illegible] bolometer, a lightweight, small sized set for use in high angle bombs which can be used over land. It was agreed to set up a joint study of heat emission by various targets under all conditions. The Navy will provide a ship and the Army suitable aircraft.

(2) Light systems -- using the photo-electric cell -- are simple and already being produced in small quantities. It was emphasized that these are suitable only for the purpose of learning something about homing techniques as their use is limited to conditions of sharp differentiation of light. However, they will be used, possibly, as a gap filler until other systems are ready.

Comment: The light seeking systems may be a great deal more valuable than the deliberations of the committee might seem to indicate. They are cheap and easy to produce quickly. It may be months before heat or radar devices are available in quantity. Under certain conditions the light seekers will be effective. Otherwise this program seems to be in good shape.

F. H. RICHARDSON
Lt. Colonel, Air Corps.

[redacted]

INTER-OFFICE MEMORANDUM
ARMY AIR FORCES
MATERIEL ~~XXXXXX~~ COMMAND

C
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FEN:mec:54
Wright Field, Dayton, Ohio
Date 2 June 194[illegible]

TO: Chief, Equipment Laboratory, Engineering Division, Wright Field. Attention: Special Weapons Branch.

SUBJECT: Proposed Tactical Use of Glide Bombs against Enemy Dams.

1. There is a possibility that target-seeking glide bombs can be put to tactical use in attacks against dam structures. It is understood that such structures usually are well protected by anti-aircraft installations and are extremely difficult targets to attack by means of conventional tactics and ordnance, since high level bombing is required and extreme accuracy in placing the missile of course is essential.

2. By the use of flares designed to be dropped without extreme accuracy into the dam reservoir and to ignite and remain immovable after drifting into contact with the lip of the dam structure, it will be feasible to direct target seeking glide bombs into the face of the dam at any predetermined level below the flare location. With this plan of attack, both flares and bombs may be launched from positions well out of range of protective anti-aircraft fire.

3. In order for this technique to be feasible, it is necessary that sufficient current shall exist to carry the flare device against the dam structure and that such current shall be properly located relative to vulnerable parts of the structure.

4. Therefore, it is suggested that there be obtained such information as may be available relative to strategically located dams in enemy and enemy-controlled areas in both the European and Asiatic theaters of war. The important consideration is the presence or absense of spillways, their size and location, and the season of the year and length of time they may be expected to provide the maximum current effect.

F. E. NULL
Electrical Engineer
Special Weapons Branch
Equipment Laboratory
Engineering Division

MX-109

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AAFMC-278-WF-5-17-44-20M

File No. 4/

630

REQUEST FOR
MODEL OR TYPE DESIGNATION
CHANGE OF STATUS OF EQUIPMENT

[redacted]

Sheet No.
Item
Date 29 November 1944

1. Name of Article or Requirement Affected Glide Bomb, Controllable Type GB-12 (GB-5C)

Drawing No. XXXXX Specification No.

2. Entry, removal or ~~change in classification~~ ~~of requirement~~ Enter into Experimental Classification

3. New Type or Model New Supplements or Replaces Type or Model None

New Status of Supplemented or Replaced Type or Model None Lab. Charged with Development Equipment Laboratory

4. Estimated unit cost,

5. Indicate concurrence in the proposed action by Technical Services, Technical Committees, and/or Service Board reports None

6. Does item possess required military characteristics Yes
   (a) In what respect is it lacking None

7. Status of related equipment Standard 140

8. REMARKS: (Include a brief resume' of the characteristics of the article or requirement or resume' of reason for entry, removal or change of classification).

GB-12 This device consists of a 2000 pound general purpose bomb incorporated into a high wind monoplane type vehicle comprised of an airframe, including wing and tail assembly sections joined by two longitudinal booms, and an auxiliary nose section. The airframe section includes appropriate control surfaces and is mounted in such manner that the bomb is suspended by means of two straps beneath and slightly forward of the wing, while between the booms to the rear of the bomb is mounted a mechanism housing. The nose section is mounted forward of the bomb and is attached thereto by means of a bulkhead strapped to the forward end of the bomb and a metal plate anchored in place by the flange of the nose fuse. Within the nose section is mounted a Hammond Crosley Marine Seeker (~~GB-5C~~) while within the mechanism housing are mounted batteries, stabilizing equipment, servo-mechanisms for the operation of the control surfaces, control relays electrically connected to the Hammond Crosley Marine Seeker unit and incidental associated equipment.

In operation, light differentials between the target and its background are picked up by the Hammond Crosley Marine Seeker (~~GB-5C~~) to give up, down, right, left signals in accordance with the target location. These signals are utilized to operate the control relays in order to transmit the proper control through the stabilizing equipment to the servo-mechanisms and thence to the airframe control surfaces so that the vehicle is guided into the target.

Approved:

[redacted]

Initiated By A. R. SWANSON, Major, A.C.

Br.-Lab.-Unit Chief

G. V. HOLLOMAN, Colonel, A.C.
Chief Equipment Laboratory Section

Type designation GB-12 has been assigned XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

W. L. SNYDER, Capt.A.
Chief, Spec. Unit
TSESE
aHm
Specification Branch
Production Engineering Section

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No. of pages - 1

ARMY AIR FORCES
AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

TSEPL-3N6/WAS/hle
Date 29 August 1945

SUBJECT: Glide Bomb, Type GB-13, Expenditure Order No. 673-73, Project MX-619.

OFFICE TSEPL-3N6 Contract or Order No.

SERIAL No. TSEPL-3-673-49-B Expenditure Order No. 673-73

A. PURPOSE:

1. To close out Expenditure Order No. 673-73.

B. FACTUAL DATA:

2. Expenditure Order No. 673-73 was initiated to develop a glide bomb incorporating a flare type target-seeking unit.

3. A series of ten (10) experimental drop tests were made at Wendover Field, Utah, during December 1944, January and February 1945. The results of these drop tests are contained in Air Technical Service Command Engineering Division Memorandum Report Serial No. TSEPL-3-673-49-A, dated 10 March 1945. The results consisted of one direct hit, three hits within sixty (60) feet of the target, and one hitting approximately at a predetermined point short of the target.

C. CONCLUSIONS:

4. That the ten (10) experimental drop tests resulted in the successful and satisfactory operation of the type GB-13 Glide Bomb.

5. That no further development and experimental tests are considered necessary at this time.

D. RECOMMENDATIONS:

None - data merely submitted.

NOTE: This Memorandum Report closes out Expenditure Order No. 673-73, Project No. 45-352-A and B.

Concurrence: [redacted]

W. A. Sander, Jr.
Prepared by W. A. SANDER, JR., Capt., A.C.

ex
ewm ______________

Approved by C. O. FRENCH, JR., Lt. Col., A.C.
for Chief, Control Equipment Branch

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Distribution: #3,4,5,6,7
Mat.Div., AC/AS M&S(5)-Tech.Data Lab.EAL-6D

Approved by T. B. HOLLIDAY, Colonel, A.C.
Chief, Equipment Laboratory

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ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
[illegible]
MEMORANDUM REPORT ON

[illegible] 1[illegible] October 19[illegible]

[illegible]: [illegible] Fairchild Marine [illegible]

[illegible]: [illegible]

[illegible]: [illegible]-3-673-58-B [illegible]

A. PURPOSE:

1. To report on a series of experimental tests at Special Weapons Field Test Unit, Wendover Field, Wendover, Utah, demonstrating operating characteristics of the GB-[illegible] when guided by a Fairchild Marine Seeker and to close out Expenditure Order No. 673-65.

B. FACTUAL DATA:

[illegible]. Personnel present at the tests were:

Air Technical Service Command

[illegible] A. [illegible]. Hollerstein
Lt. [illegible] [illegible]precht
Lt. [illegible] R. Stevenson

3. This project was initiated 1[illegible] December [illegible] by authority of the Chief, Engineering Division, and assigned Expenditure Order No. 673-65 and account No. CL-[illegible]A. The project No. is MX-[illegible].

4. Two other Memorandum Reports have been written on this project; Serial No. TSEPL-3-673-58, subject "GB-[illegible] Marine Seeker," dated 1[illegible] April 1945, and TSEPL-3-673-58-A subject "Fairchild Marine Target Seeker," dated 30 June 1945.

5. A series of tests were conducted at Wendover Field, Wendover, Utah, during July and August 1945. The object of these tests was to check the Fairchild Marine Seeker as to its ability to distinguish a light contrast target from its surroundings and to test the navigation which is built into the seeker proper. The same control system and airframe were used as was developed from the GB-13 Flare Seeker.

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MX-611 W-57553-9

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6. Appendix 1 illustrates the GB-5 as tested. A circular hole is cut in the nose section. The front of the seeker fits into this hole and the seeker receives its light energy through the window in the face of the seeker. The seeker moves in a horizontal plane to give azimuth navig tion. Pitch navigation is accomplished by means of a mirror which moves up or down, depending on the signals from the seeker.

7. The control box used is a Hammond Gyro Box containing two gyroscopes, a pitch gyro and a tilted gyro serving as a roll and azimuth gyro. Both gyros, as well as the heaters and the seeker, are warmed up by the carrying aircraft's power supply several minutes before drop-away. The pitch gyro is uncaged electrically by the impulse to the A-2 bomb release. The attitude of the carrying aircraft at the time of uncaging the pitch gyro sets the reference point or line in space, therefore, it is very important that the plane be level at the time of drop-away. A trim correcting pick-off causes the servo to apply the correct elevator control to maintain a given pitch attitude in space during the preset flight. The roll and azimuth gyro is uncaged mechanically as the glide bomb drops away from the airplane. The azimuth gyro trim corrector sends impulses to the rudder servo motor so as to maintain the desired course during the preset portion of the flight. After a pre-determined interval, a time switch closes, permitting signals from the seeker to assume control of the glider. Suitable relays convey signals to capstan motors which change the gyro pick-off positions causing servo motors to apply the necessary control movements to change the bomb's attitude an amount necessary to establish a new and correct flight path. Appendix 2 shows the gyro control box as it is wired up and ready to be used on the glide bomb. Appendix 3 shows the seeker and recorder installation on the nose of the glide bomb. Appendix 4 shows the recorder installation. The four relays record the signals from the seeker, the four arms record the rudder and elevator position, and the pitch and azimuth navigation position. The recorder is attached to the nose of the bomb casing so that it will come off on impact. A Gun Sight Aiming Point (GSAP) Camera is mounted on the left boom. This camera photographs the four signals from the seeker (by means of four lights) as well as the target and an artificial horizon made by four electric lights in line with the target and perpendicular to the bomb run.

8. The only airframe modification was the addition of 7/8 inch to the servo end of the rudder bellcrank and the addition of a second rudder. The follow-up ratio of the entire directional control system was not changed. The relative rudder deflection was increased approximately 35%. These modifications are identical to those for GB-13.

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9. In this series of tests, ten drops were made. The first four bombs were dropped without doing anything to the navigation rates, so as to see just what the bomb would do. The pitch navigation rate was 1/3°/second and azimuth navigation rate was 2/3°/second. These four bombs proved that the seeker worked satisfactorily but the navigation rates were in error.

The next two drops were made with the azimuth navigation cut out and the pitch navigation rate increased to 0.8 degrees per second. This proved to be the correct rate since the range error was very small. The bomb worked very well in azimuth also.

The azimuth navigation rate was changed to 0.3°/second on the last four bombs and pitch navigation rate was maintained at 0.8°/second. These rates appear to be satisfactory in that the bombs came close to the target. Data on each drop are contained in Appendix 6. All range errors were measured on the horizontal plane. Appendix 5 contains a typical trajectory picture.

The general trend is toward an error of approximately 100 feet. The calculation sheet in Appendix 7 shows the probable error and how it was determined. In these calculations, only six of the ten bombs are listed. Four were eliminated because of seeker failure, control box failure or the bomb hanging up on the airplane.

All of the equipment used was procured on Expenditure Orders other than the one assigned to this project.

No drawings are available of the actual airframe and component parts. The airframe is identical to that of the GB-13.

No action has been taken on making up a Technical Order or Technical Manual.

No special tools or test equipment or training aids are necessary.

C. CONCLUSIONS:

10. That the GB-5 can be controlled to a light source sufficiently strong to produce a .001 foot candle at the point where the seeker is to take control. No tests were made using a boat as the target. Ordinary 800,000, CPT-3 flares were used on the target.

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Memorandum Report No. TSEPL-3-673-58-B
17 October 1945

11. That the Fairchild Marine Seeker is a reliable target seeker.

12. That no further development work is necessary.

13. That the correct navigation rates are 0.8°/second in pitch and 0.3°/second in azimuth and a limit switch must be put in the pitch navigation system to limit down travel.

14. That no further development and experimental tests are necessary at this time.

D. RECOMMENDATIONS:

None - data merely submitted.

NOTE: This Memorandum Report closes out Expenditure Order No. 673-65, Project No. 45-32N.

Concurrence:

Prepared by: F. R. STEVENSON, 2nd Lt., A.C.

Approved by: C. O. FRENCH, Jr., Lt.Col., A.C.
Chief, Control Equipment Branch

Approved by: T. B. HOLLIDAY, Colonel, A.C.
Chief, Equipment Laboratory

Distribution:
ACAS-4 (5)
TSEAL-2B, Tech. Data Lab.
TSESE-2G, Aircraft Projects Section
TSEPL-3N6, Equipment Laboratory

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Test File

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Auth: A.C.M.D.
Date: 3/5/42
Initial: F.a.a.

AN ms: 54

WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

MEMORANDUM REPORT ON

Date April 11, 1942

SUBJECT: S. R. B. System

SECTION Experimental Engineering

SERIAL No. ~~EXP-M-54-664-172~~ -14

MX-224

Contract No.
Expenditure Order No. 664-1
Purchase Order No.

DATE
CHF. DIV.
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ADM. EXC.
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PROD. ENG.
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MAINT. COMD.
I. P. S.
OTHERS

A. Purpose.

To report results on a conference with representatives of the National Defense Research Committee at Wright Field.

B. Factual Data

1. A conference on Send-Receive Bomb System (S.R.B.) was held on March 5, 1942.

2. Present at the conference were:

Material Center	National Defense Research Committee
Maj. A. Nyman	Dr. S. H. Caldwell
Maj. D. H. Young	Prof. J. B. Russell
	Dr. F. G. Watson

3. The send-receive bomb system is a project of target seeking devices utilizing microwaves (radar). It consists in general of installing a special radiation system in a controllable bomb for automatically guiding it to the desired target.

4. Different schemes were discussed with the representatives of the National Defense Research Committee concerning the application of radar equipment to the power driven and the glider type of controllable bombs which are being developed at present on project MX-109.

5. The general nature of the apparatus and devices required were discussed, in particular, with regard to the simplicity and reliability required for controllable bombs.

6. The representatives of the National Defense Research Committee were furnished with photostat copies of four (4) alternative schemes of a diagrammatic representation of a send-receive system. XXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXX

[redacted]

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Experimental Engineering Section,
Memorandum Report No. EXP-M-54-664-172
April 11 1942.

7. The National Defense Research Committee representatives agreed to discuss the various possibilities of carrying out this system with the personnel conversant with different phases of the radar development. They agreed to arrange for a conference with Materiel Center representatives within ten days to decide on which particular types of development should be carried out in the National Defense Research Committee organization.

C. Conclusions.

1. That the National Defense Research Committee has been informed of the desirability of the development of a radar system for controllable bombs.

2. That the National Defense Research Committee representatives have agreed to consider this development and its practical execution.

D. Recommendations.

1. That joint recommendation by the National Defense Research Committee representatives and the Material Center representatives be made for the initiation of a development project of an S.R.B. system.

A. NYMAN, Major, A. C.

for W P Lester
RANDOLPH P. WILLIAMS, Colonel, A.C.
Equipment Laboratory

FOC
F. O. CARROLL, Colonel, A. C.
Chief, Exp. Engrg. Section.

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1328

Auth: A.C.M.D.
Date:
Initial: T.A.S.

AFAMC-8

AN:ms:54
December 9, 1942

SUBJECT: Radar Control Equipment.

TO: The Chief Signal Officer,
Services of Supply,
Washington, D. C.

1. In view of recent development on projects in the Radiation Laboratories (Section D-1 of the National Defense Research Committee) in particular the R.R.B. equipment and the A.R.O. equipment, it appears possible to combine certain elements of these two systems to secure an arrangement to accomplish the following purposes:

a. Mounted on a controllable bomb this equipment would set up a scanning radar beam to pick up reflections from targets within the area of scanning and to give directional signals towards the largest target of a selected group. These directional signals would be utilized for controlling the bomb and guiding it to a target.

This system has been designated S.R.B., send-receive bomb. A preliminary test at the Radiation Laboratories has demonstrated the feasibility of this system.

2. It is therefore requested that a National Defense Research Committee project be set up to accomplish the development of an S.R.B. system as outlined above.

3. If the development facilities of the National Defense Research Committee are inadequate to carry this project it is recommended that they cooperate with a contractor experienced in this type of work. For example: The Crosley Radio Corporation of Cincinnati, Ohio, may be considered in this connection.

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The Chief Signal Officer,
Radar Control Equipment.

4. The S.R.B. system was discussed originally with representatives of Section D-1 of the National Defense Research Committee during a conference at the Materiel Center on March 5, 1942. It is therefore requested that eventual procurement of devices developed on this project be handled by Army Organizations.

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HEADQUARTERS [illegible] WARFARE COMMAND

[illegible]

January 1, 1943

AC-51

Subject: Submission of New Research
Problem to N.D.R.C.

To: Major General [illegible]
War Department Liaison Officer with the N.D.R.C.
Room 4E 637, Pentagon Building,
Washington, D. C.

1. It is requested that the following project be submitted for consideration to the National Defense Research Committee:

AC-51 -- Development of a radar system (to be referred to as the SRB) and auxiliary equipment for controlling target-seeking bombs.

2. The N.D.R.C. (Radiation Laboratory) has for some time been working on an Army project for [illegible] for glide bombs. This development has taken the form of a radar receiving unit which will home on reflected radiation from a sea target illuminated by SCR-10 in the mother airplane. This equipment is now developed and undergoing flight tests. The Army will be provided forty (40) such units by N.D.R.C.

3. There is a need for radar homing control which contains its own transmitter as well as receiver and which will pick up reflections from targets within the area of scanning and give directional signals towards the largest target of a selected group. This control would be used for:

a. Installation in power-driven bombs which will be controlled by remote ASV equipped aircraft.

b. Installation in glide bombs to free the mother aircraft from the necessity of illuminating the target during the glide bomb flight.

4. On March 6, 1942, the Radiation Laboratory of N.D.R.C. was requested by the Special Weapons Unit, Material Center, Wright Field to consider the development of such a radar system to be called SRB (Send Receive Bomb). Recent developments in the Radiation Laboratory indicate the feasibility of combining parts of the ARO and RHB to make a satisfactory SRB system.

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Major General C. C. Williams
January 1, 1943
Page #2

5. It is suggested that this request be coordinated with the Signal Corps for the purpose of determining whether it should be submitted to the N.D.R.C. as a joint Air Forces - Signal Corps project.

6. This project will be coordinated for the Army Air Forces by Colonel John T. Murtha, Jr., Materiel Command, Washington, D. C., and Lieutenant Colonel R. H. Young, Equipment Laboratory, Materiel Center, Wright Field, Dayton, Ohio.

/s/ William C. Brown, Lt. Col., A.C.
for B. W. CHIDLAW
Brig. General, U.S.A.
AAF Liaison Officer with the
National Defense Research Committee

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Auth: A.C.M.D.
Date: 1/20/43
Initial: F. O. C.

WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION
ENGINEERING DIVISION
MEMORANDUM REPORT ON

AN:ms:51:18677:18694

central files

SUBJECT: Radar Homing Bomb. (R.H.B.)

Date January 20, 1943

~~SECTION~~ Equipment Laboratory

SERIAL No. ~~ENG-M-51-673-16 J.~~ 1st

MX-224

Contract No. ....
Expenditure Order No. 673-21
Purchase Order No. ....

A. **Purpose.**

1. To report on several conferences concerning the procurement of experimental and production units of R.H.B. equipment.

B. **Factual Data.**

1. A conference was held at the Radiation Laboratories in Cambridge, Massachusetts on November 30, 1942.

2. Personnel present at this conference were:

Material Center

Lt. Col. A. Nyman
Lt. A. R. Swanson

Aircraft Radio Lab.

Lt. H. G. Sennert
Lt. F. L. Holloway

Radiation Laboratories-Massachusetts Institute of Technology.

Dr. E. M. Lyman
Mr. A. K. Edgerton
Dr. R. A. Lamm
Mr. R. Gaither
and others.

United States Navy

Lt. Commander D. Danjunas
Lt. Commander C. R. Runyen
Lt. Commander De Mars
Lt. Merrill
Mr. E. R. Piore
and others.

3. The object of the conferences was to discuss the necessary steps for the procurement of a sufficient number of experimental sets and prepare for the procurement of production units of the R.H.B. equipment. The test results to date were discussed. These included:

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Equipment Laboratory, Engineering Division,
Memorandum Report No. ENG-M-54-673-16 J
January 20, 1943.

a. A series of tests of R.H.B. equipment on AT-11 airplanes at Boston as covered by Memorandum Reports:

ENG-M-54-673-5-X-1 dated December 30, 1942
EXP-M-54-673-5-W-1 dated November 23, 1942
EXP-M-54-673-5-S-1 dated November 3, 1942
EXP-M-54-673-5-R-1 dated October 28, 1942
EXP-M-54-673-16 D dated November 3, 1942

b. Two drops of R.H.B. equipment by Dr. Drydon in cooperation with the Bureau of Ordnance, Navy Department. The results of these two drops were negative. From these tests it appears that although the devices functioned satisfactorily when all conditions of operations were satisfactory, considerable engineering is still necessary to make the device reliable and to verify its operation under actual service conditions.

4. For the above reasons the list of requirements can be set tentatively as follows:

a. Range 10 miles maximum, 500 feet minimum.

b. Radar illuminator to be located not more than 10 miles from the target and to be of 30 kilowatt peak power on a 29 inch spinner (517P set) provided with sector scanning.

c. The target should be equivalent to a 5,000 ton ship for the maximum range.

d. The viewing angle of the R.H.B. equipment is tentatively set at 60 degrees although it was felt that this angle will be susceptible to conditions where a number of targets are present within the viewing angle. However, experimental work is being done on a range gate which may provide the necessary solution of this difficulty. At present the equipment will function satisfactorily only on isolated targets or where the target is the nearest to the illuminator. An increase of the spinner diameter was discussed but it apparently would not prove sufficient.

e. The McNally tube will be used for the receiver oscillator.

f. Horizontal polarization will be used on the R.H.B. equipment in order to increase the contrast. However, this is tentative only.

g. The S.R.B. equipment and its operations were discussed and will be subject to future decisions.

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Equipment Laboratory, Engineering Division.
Memorandum Report No. ENG-M-54-673-16 J
January 20, 1943.

5. The Bureau of Ordnance representatives stated that consideration has been given for procurement to the following companies:

General Electric Company, Bridgeport, Conn.
Zenith Radio & Television Corp., Chicago, Ills.
Emerson Radio & Phonograph Corp., New York, N. Y.
Crosley Radio Corporation, Cincinnati, Ohio.

The Bureau of Ordnance favored the General Electric Company with the Zenith Radio & Television Corporation as special contractor. The design was arranged at a previous conference with Lt. Toner as the Signal Corps representative.

6. Representatives of the Bureau of Aeronautics, the Aircraft Radio Laboratory and the Radiation Laboratory expressed the opinion that the Crosley Radio Corporation would be more suitable in view of the fact that they have more engineering facilities available. The Materiel Center representative stressed the need for very thorough engineering on this project at its present status.

7. The decision with regard to the procurement agency was left for future decision.

8. A second conference was held at the Radiation Laboratories on November 30, 1942.

9. Present at this conference were the same personnel and in addition, Mr. Kaar and Mr. Angus of the General Electric Company, Bridgeport, Connecticut and representatives of the Zenith Radio & Television Corporation. A production schedule was submitted by the General Electric representatives. This schedule included procurement of 200 units for the Materiel Center, 200 units for the Bureau of Ordnance and 450 units for the Bureau of Aeronautics. The procurement of the first 400 units to start at the expiration of six months on a graduated scale. Simultaneously with the procurement of these sets a production unit would be designed to provide production facilities at the expiration of seven months.

10. The delay of procurement of experimental sets appeared to be excessive to the Materiel Center representatives. This was blamed mostly on the delay in the procurement of parts.

11. The procurement of five units in accordance with the General Electric design from the Research Construction Company was discussed without any conclusive decision.

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Equipment Laboratory, Engineering Division,
Memorandum Report No. ENG-M-54-673-16 J
January 20, 1943.

12. It was suggested that the General Electric Company handle only the production procurement and that other arrangements be made for experimental units. The Zenith Radio & Television Corporation representatives did not have authority to permit their Corporation to accept experimental procurement. The production set-up included preparation of tools, one set of which would be available to Zenith Radio & Television Corporation to double the General Electric Company's procurement facilities.

13. A third conference was held on December 1, 1942 at the Radiation Laboratories in Cambridge, Massachusetts.

14. Present at this conference were:

Materiel Center	Radiation Laboratories
Lt. Col. A. Nyman	Dr. E. M. Lyman
Lt. A. R. Swanson	Mr. J. J. Hibbard
	Mr. A. K. Edgerton
	Mr. R. Gaither
	Mr. R. A. Lamm

15. A new cylindrical design was discussed with regard to the possibility of the Research Construction Company building units of this type in place of the rectangular design originally contemplated. Such a design could be carried out with the aid of the engineering staff to be supplied by the Procurement Agency on experimental order as discussed during the second conference.

16. A fourth conference was held at the Research Construction Company on December 1, 1942.

17. Present at this conference were:

Materiel Center	Radiation Laboratories
Lt. Col. A. Nyman	Dr. Lyman
	Mr. A. K. Edgerton

Research Construction Co.

Mr. F. S. Dunlavey
Mr. R. A. Lamm
Mr. Hutchinson

18. The change over from the rectangular unit to the new design was discussed and the engineering features of this construction were outlined.

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Equipment Laboratory, Engineering Division.
Memorandum Report No. ENG-M-54-673-16 J.
January 20, 1943.

19. The Research Construction Company representatives agreed that no serious difficulty would be envisaged.

20. Mr. Lamm agreed to undertake the design of such a unit but anticipated about six weeks delay before this design can be crystalized. The Materiel Center representatives agreed to this delay in delivery of the 40 units to the Materiel Center provided such units would correspond closely to the eventual production unit.

21. Three test flights were carried out at the East Boston Airport on December 1, 1942. During the first test flight a run down battery was discovered. During the second test flight interference from another radar beam prevented utilization of full range of R.H.B. equipment. A test run of 1-1/2 miles indicated satisfactory operation. This interference was stopped for the third flight but other difficulties developed which prevented the operation of the R.H.B. equipment indicating that provisions for suitable test conditions are needed.

22. The above series of tests also illustrate the particular need for thorough engineering of R.H.B. equipment besides provision of suitable test conditions.

23. It was suggested that future tests in Boston be carried out with the air borne illuminator on a B-18 airplane or with the illuminator truck located at Marble Head, Massachusetts sufficiently far from Boston interference. It was also suggested that radio communication be established between the illuminator truck and the AT-11 airplane carrying the Radar equipment.

24. An inspection trip was made to the General Electric Company at Bridgeport, Connecticut.

25. Present at this inspection were:

Materiel Center	General Electric Company
Lt. Col. A. Nyman	Mr. Kaar
	Mr. Angus
	Mr. Ray

26. The General Electric Company representatives discussed the production schedule submitted during conference number two. The Materiel Center representative indicated the need of considerable engineering on the R.H.B. unit before any production design could be made. The General Electric representatives indicated that at least one mechanical and one

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electrical engineer will be available to cooperate with the Radiation Laboratory on the design.

27. The inspection trip showed that the General Electric Company is doing considerable development work within the Laboratory at Bridgeport. Some projects showing the development of a very primative model to a production set.

28. The inspection trip indicated that production methods have been worked out on large scale production of radar units of this type. One unit was being manufactured at the rate of over one hundred a day with careful inspection and test methods applied to the final production.

29. A fifth conference was held at Wright Field on December 5, 1942.

30. Present at this conference were:

<u>Materiel Center</u>

Lt. Col. A. Nyman
Lt. A. R. Swanson

<u>Aircraft Radio Lab.</u>

Lt. H. G. Sennert
Mr. F. L. Holloway

<u>U. S. Navy - Bureau of Ordnance</u>

Lt. Comm. G. W. J. Danjunas
Lt. Comm. Tucker
Lt. Comm. Hicks

<u>Radiation Laboratory</u>

Mr. A. K. Edgerton
Mr. R. A. Lamm

31. The Materiel Center representatives demonstrated that the cylindrical design as discussed on previous conferences would be too large to install on the glide bomb developed at the Materiel Center. Two other designs were demonstrated by the Material Center representatives, one of curved section and the other rectangular. The representatives of the Radiation Laboratories suggested a new design which would consist of the original cylindrical shape with the two opposite sides flattened. It was agreed that a mock-up of this equipment will be sent to the Materiel Center for final check. The representatives of the Bureau of Ordnance related production difficulties on other Navy radar projects with the Crosley Radio Corporation. These experiences indicated lack of engineering skill and delay in deliveries. The representatives of the Aircraft Radio Laboratory indicated that the General Electric Company has failed in deliveries on certain contracts.

32. A conference was held at the Crosley Radio Corporation at which the following were present:

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Equipment Laboratory, Engineering Division,
Memorandum Report No. ENG-M-54-673-16 J.
January 20, 1943.

Material Center

Lt. Col. A. Hyman

Aircraft Radio Lab.

Lt. H. G. Sennert

Crosley Radio Corp.

Mr. Clements
Mr. Felix
Mr. Bailey

U. S. Navy - Bureau of Ordnance

Lt. Comm. G. W. J. Danjunas
Lt. Comm. Tucker
Lt. Comm. Hicks

Radiation Laboratory

Mr. A. K. Edgerton
Mr. R. .. Lamm.

33. The engineering facilities available at the Crosley Radio Corporation were discussed. Mr. Clements indicated that four or five engineers could be assigned to the development of R.H.B. equipment and that these engineers had radar experience and at least one of them would be in authority.

34. The inspection trip indicated further production methods on several radio sets but no production of radar sets was shown.

35. After the inspection trip a conference was held between the same personnel less the Crosley Radio Corporation representatives at which it was decided as follows:

a. That the General Electric Company at Bridgeport, Connecticut be instructed to begin procurement of experimental and production units.

b. That the General Electric Company engineers be available to the Radiation Laboratories for cooperation with the Radiation Laboratories and Research Construction Company in the development of models of the type described above.

c. That the Research Construction Company will leave one type R.H.B. unit with the Material Center and provide the first model of the new design before the end of January.

d. That the Bureau of Ordnance will decide at a future date whether the experimental units delivered to them by the Research Construction Company should be of the cylindrical or rectangular type.

C. **Conclusions.**

1. That a decision has [redacted] with regard to the procurement of experimental R.H.B. units.

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Equipment Laboratory, Engineering Division.
Memorandum Report No. [illegible]
January 20, 1943.

L. Recommendations.

1. That the Aircraft Radio Laboratory representatives at the Radiation Laboratory supervise the design of the new A.H.R. unit and advise the Materiel Center of the following:

a. Results of tests on the development units of A.H.R.

b. Improvements in design peculiar to the new design.

c. Changes in the procurement program of experimental units from the Raytheon Construction Company and the General Electric Company.

d. Coordination of test results obtained with the assistance of the Materiel Center at Eglin Field and other demonstrations on experimental A.H.R. equipment conducted by other groups. (Action to be taken by the Aircraft Radio Laboratory.)

ALEXANDER NYMAN, Lt. Col. A. C.

G. V. HOLLOMAN, Colonel, A. C.
Equipment Laboratory
Engineering Division.

F. O. CARROLL, Brig. Gen. U.S.A.
Chief, Engineering Division.

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Chief of Staff Materiel Command AAF.
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Auth: A.C.M.D.
Date: FEB 22 1943
Initial: T.A.S.

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FEB 22 1943

Director, Aircraft Radio Laboratory, Wright Field.

MX-224

Radar Homing Bomb.

1. Confirming a telephone conversation with Colonel Bayer of your Office the following facts are brought to your attention:

a. The Radiation Laboratories have carried out the development of a system known as R.H.B. (radar homing bomb) at the request of the Chief Signal Officer originating with the Materiel Center first in Boston and during the last month at Boca Raton, Florida.

b. The Materiel Center has taken active interest in this development in so far as it may be utilized in glide bombs. This interest was expressed in frequent conferences, arrangements to supply airplanes and test facilities. In particular an AT-11 airplane has been assigned to this project since July 1942 and a B-17 airplane equipped with ASV since January 1943.

c. Recent tests were arranged at Tampa, Florida to provide a large ship target. Materiel Center representatives were present at these tests. The results were very inconclusive and mostly negative. Other tests attended by Materiel Center representatives in Boston and Boca Raton have been quite successful sometimes and complete failures at other times.

d. In view of the above facts and in order to obtain closer cooperation between Radiation Laboratories personnel and the military forces, it is suggested that a resident Aircraft Radio Laboratory representative at Boca Raton be assigned to observe the progress of the development work of R.H.B. equipment, be present at field and laboratory tests of this equipment and report periodically (preferably weekly) to the Aircraft Radio Laboratory.

e. It is further suggested that the results of his observations be made immediately available to the Engineering Division of the Materiel Center, marked for the attention of the Equipment Laboratory (Dept. 54-7).

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

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BY AUTHORITY OF THE CHIEF SIGNAL OFFICER
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WAR DEPARTMENT
HEADQUARTERS, SERVICES OF SUPPLY
OFFICE OF THE CHIEF SIGNAL OFFICER
WASHINGTON, D.C.

SPSRB-3
May 11, 1943

RB 413.44 RC-171

MEMORANDUM FOR: Chief, Electronics Branch

SUBJECT: Conference on Radar Glide Missiles.

1. A conference was held on the above subject at the Naval Bldg., Bureau of Ordnance on May 4, 1943, which was attended by representatives of the Bureau of Ordnance, headed by Comdr. Tucker; Bureau of Aeronautics; NDRC, Radiation Laboratory, headed by Drs. Ridenour and Lyman; Bureau of Standards, headed by Dr. Dryden, and numerous other representatives of commercial concerns and the interested services.

2. The general position and a broad outline of future developments was first given by Comdr. Tucker for the following projects:

(1) The Pelican

(a) This large size glide projectile is designed at present for a 600 lb. pay load, to be carried by a PBM or PBY, and a small size 325 lb. pay load, to be carried by a TBF, PBM or PBY. The main use is considered to be against submarines or undefended merchant shipping since the range of the projectile is limited at present, being of the order of 3,000 yards.

(b) The problems which are at present involved in the project are:

a. Take-Off Mechanism. The present devices for launching from wings or fuselage are not entirely satisfactory, but no great difficulties are expected in solution.

b. The Hunting of the Projectile. This difficulty is still not completely solved although there are several anti-hunting devices under consideration. At present, the most promising of these is the so-called anticipator circuit, which should feed voltage of reverse sign to the servo mechanisms, as the projectile swings toward the collision course.

c. Possible use of Free Gyro. This device has been used with considerable success in various projectiles and the development is being followed with the idea of adapting its use to the Pelican.

d. Inaccuracy Due to Drift in Target Velocities. A computer is being developed for setting in lead angles before launching; however, this problem has received little attention.

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e. Radar Problems. The two remaining radar difficulties are confusion of targets and minimum range. The first is being solved by the use of the walking range gate discriminator circuit for which much promise is held. The minimum range problem however does not seem much nearer any solution other than the conventional ones.

(2) The Bat

(a) This device is simply the Navy version of the Send-Receive Bomb. For the development of this project, the Navy has approved Bell Telephone Laboratories, and in view of previous experience, has retained the Radiation Laboratory as advisor. It is planned to design two of these bombs, preferably with the 1,000 and 2,000 lb. pay loads. The heavy bomb could be used attached one each under the wings of a PBM, whereas the lighter type might be adapted for use with the TBF. It is hoped that a range of ten miles may be obtained using the technique developed for the SRB, and it is further hoped with some propulsion more range and hence greater safety of the carrier plane might be obtained. For this longer range, up to twenty miles, it is hoped to use the gyro to hold the projectile Bat to ± 5° for the first ten miles until the radar takes control; likewise, it is hoped to build into the computer, a device for striking below the water line.

(3) The Falcon.

(a) This device is simply a powered Bat or Pelican and little or no work has been done on it. The Navy hopes to use jet devices or Rocket Motors to obtain long range. In this connection, the Bureau of Aeronautics pointed out that they have obtained recent samples which should enable the Pelican to make assisted take-offs, at its necessary speed of 150 m.p.h. from slow blimps.

(4) Miscellaneous Projects

(a) These include the Rand Auto-Gyro, the Los Angeles Glider Project, the "Sniffer", and the "Super-Sniffer". The Bureau of Aeronautics has obtained some success with the "Sniffer" and is now also putting the "Super-Sniffer" into production. This later model uses FM for homing onto the target and the Doppler effect for azimuth variation. The advantages are obvious since the minimum range problem does not exist and CW lends itself to much lower voltages in the projectile.

(b) The other devices are in various stages of initial development and the Los Angeles Project (now called "Roc") seems the most interesting since it is designed for storage in standard bomb bays.

3. Various technical problems were discussed briefly without going into specific details. Dr. Dryden expressed optimism over the possible solution of the problem of hunting or rolling at about 1 c.p.s. This roll is inherent in the type of restrained gyros used; however, he believes the instability of the free gyro to more than off-set the above difficulties. The lead computer problem would also introduce more hunting, and will undoubtedly take considerable

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experimenting to solve. In connection with the radar and electrical parts of the equipment, Dr. Dryden also pointed out the great difficulties due to interference of the motors in the presence of "Hash" in the sensitive radar receiver.

(1) Dr. Lyman discussed briefly the relative merits of the free and restricted gyros pointing out that a slight dropping error with a free gyro in SRB type projectile might easily reduce the theoretically greater range by 50%. Also he stated that very complicated searching circuits, as well as other predictor devices would be needed for long range launching. Dr. Lyman also discussed the latest results on the walking range gate. He said that flight tests in various planes showed that its use might increase the output range on a 4,000 ton boat from 2 miles to as much as 10 miles.

(2) The present status of "Roc" seems very hopeful to the Bureau of Aeronautics and models are being built by Douglas with the radar being developed by Bendix. Flight tests are promised next month. The use of two separate high speed motors for maneuvering is regarded as very promising, and several different agencies are collaborating on this project.

(3) Dr. Lyman discussed the history and present status of SRB. He pointed out that the preliminary research and development was completed in October, 1942, and only in the last few weeks has interest been shown in further development. The original SRB making use of the LHTR components yields reliable ranges of five miles; however, with the new light weight magnetrons, 16 miles is probable and certainly a reliable ten miles. The possibility of using of X-band equipment was also discussed but very little work has been done. The SRB models are being produced at present, but NDRC pointed out that a development contract was needed in order to get the light weight magnetrons produced.

(4) In connection with the Bat Project, the Navy hopes to by-pass much research and development work and hurry the equipment into production by making use of the ASH components and previous Pelican experience. In this connection it is important to point out that Dr. Ridenour of the Radiation Laboratory considered it advisable for his group to stop work on the SRB since the Navy has placed a contract with the B.T.L. for the Bat.

(5) Finally, considerable undirected discussion on the relative merits of FM in radar was held. Various representatives with experience in both lines of altimeter and projectiles discussed the difficulties of FM. It was generally agreed that very great deal of basic research and development would be necessary before this method could be used for direction of Pelican or similar projectiles. A representative who was present at the dropping trials on the Rand Auto-Gyro Bomb gave the following results:

(a) Two (2) failed mechanically.

(b) Four (4) definitely operated dirigibles throughout the way to the target giving sufficient time to steer the projectile and good accuracy.

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The results seemed interesting for possible use with "Moth" and Major Allis expressed interest for Army development.

4. Recommendations.

(1) The work on the Pelican should be followed more closely and it is essential that ARL assign the project engineer who has been requested several times.

(2) The proposal of Dr. Ridenour that Radiation Laboratory drop all work on SRB should be discussed at length with interested parties and action taken as soon as possible.

(3) The optimistic results on FM in the "Super-Sniffer" project of the Bureau of Aeronautics should be examined and evaluated carefully.

James H. Sawyer
1st Lt., Signal Corps

JHS:be

[redacted]

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Auth: A.C.M.D.
Date: 6/1/43
Initials: LPS.

WAR DEPARTMENT
AIR CORPS, ~~MATERIEL DIVISION~~ XXXXXXXX COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

AN:me:54:16012.

SUBJECT: Radar Target Seeking (R.H.B. & S.R.B.)

Date June 1, 1943.

~~XXXXXX~~ SECTION ~~Equipment Laboratory~~

SERIAL No. ~~EXP-M-673-5-X-2~~

MR-224

Contract No.
Expenditure Order No. 673-13
Purchase Order No.

A. Purpose.

1. To report on a visit to the Radiation Laboratories in Cambridge, Mass. and on tests at the East Boston airport.

B. Factual Data.

1. A conference was held at the Radiation Laboratories in Cambridge, Mass. on May 11, 1943.

2. Present at the conference were:

Materiel Command	Radiation Laboratories
Lt. Col. A. Lyman	Dr. E. M. Lyman
	Dr. Hibbert
Signal Corps	Mr. Lamm
Lt. Coon	

3. The progress in the development of a production model of R.H.B. equipment was discussed and the model shown as arranged for the use of the U. S. Navy.

4. Rearrangement for installation on G.B.1 was discussed. It was the opinion of the representatives of the Radiation Laboratories that only the sled type nose has sufficient space to accommodate this device. Drawings and a sample of this nose were requested by these representatives.

5. A second conference was held at the Radiation Laboratories on May 12, 1943.

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Engin. Div. Memo Report No. ENG-54-673-5-K-2
June 1, 1943

6. Present at this conference were:

Materiel Command

Lt. Col. A. Nyman

Signal Corps

Maj. W. H. Bennet
Maj. Dodge
Lt. Coon

Radiation Laboratories

Dr. E. M. Lyman
Mr. R. A. Lamm
Mr. J. C. Sheridan
Mr. S. Mc Grath
Dr. R. E. Hillger
Mr. J. J. Hibbert

Section 5 of N.D.R.C.

Mr. H. H. Spencer
Dr. J. C. Boyce

7. Discussion concerned the development of S.R.B. equipment in particular with regard to:

a. Flight characteristics of the carrying vehicle: the glide bomb G.B.1.

b. Characteristics of the S.R.B. equipment.

c. Tactical procedure in the use of S.R.B. equipment.

8. It was agreed that the S.R.B. equipment will have at least a 5 mile range, that it will have a preset target selector locking on the target after a period of flight on a fixed preset line in accordance with the existing practice for G.B.1, and that the viewing angle of the S.R.B. will be sufficient to steer the bomb to the target from this range. The available maximum range is of the order of 10 to 15 miles.

9. Dr. Lyman suggested the use of an air speed device to determine the attitude adjustment of the viewing head in relation to changing the angle of attack. It was agreed that available devices of this nature be studied at the Materiel Command.

10. It was suggested, and later agreed, that the Radiation Laboratories invite Zenith Co. engineers to study and plan a practical design of S.R.B. equipment for installation in the glide bomb G.B.1.

11. It was agreed that depending on successful demonstration of the available model, about 50 units of S.R.B. be requested by the Materiel Command for the purpose of service testing on G.B.1.

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June 1, 1943

12. A demonstration of S.R.B. equipment was given on May 14, 1943. The S.R.B. equipment was mounted in the nose of an AT-11 airplane No. 41-27612 provided with indicator lights on the pilot panel to indicate the direction of the target as observed by the S.R.B. equipment.

13. The tests consisted in flying the airplane towards a marine target. When the target was definitely indicated on a scope, an electrical gate called target selector was locked on this target and indicator lights turned on. From that moment the pilot guided the airplane in accordance with the indicator lights.

14. Present during the flight tests were:

Materiel Command	Radiation Laboratories
Lt. Col. A. Nyman	Mr. J. J. Hibbert
	Dr. R. E. Hillger
East Boston Airport	
Maj. Holmes (pilot)	

15. Of ten flights carried out, one was a failure due to a broken connection which had to be repaired before the tests could be resumed. The remainder indicated hits for ranges from 3 to 7 miles depending on the size of the target and the skill of the operator in observing the operation of the target selector. A 5 1/2 mile operation was obtained against a 150 ft. mine sweeper. In one test, a ship was selected in a convoy of about 20 ships. The target selector maintained the indication on this ship.

C. Conclusions.

1. That S.R.B. equipment is ready for coordination with the requirement of G.B.1 as carrying vehicle.

2. That additional development is needed of presetting of target selector and an attitude adjuster.

3. That S.R.B. equipment gives satisfactory performance when flown on an airplane against marine targets at ranges from 3 to 7 miles depending on the size of the target and the skill of the operator.

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Engin. Div. Memo Report No. ENG-54-673-5-K-2
June 1, 1943

D. Recommendations.

1. That the engineers of a commercial concern (preferably Zenith Co.) be invited to assist in adapting S.R.B. equipment to G.R.1 (Action by Radiation Laboratories).

2. That the development of presetting of target selector and of attitude adjustments be continued (Action by Radiation Laboratories).

3. That procurement of 50 service test models of S.R.B. equipment be initiated (Action by A.R.L.).

A. NYMAN, Lt. Col. A.C.

G. V. HOLLOMAN, Col. A.C.
Equipment Laboratory
Engineering Division

F. O. CARROLL, Brig. General, U.
Chief, Engineering Division.

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N.D.R.C. Lia. Office; N.D.R.C. Div. 5
Material Division, AC/AS-MM & D
A.R.L.; Central Files.

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C O P Y

2 This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, U.S.C. 50:31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

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DC-DNR-061443

June 14, 1943

Dr. K. T. Compton, President
Mass. Institute of Technology
Room 3-208
Cambridge, Mass.

Dear Dr. Compton:

You will recall that at the meeting of Division 5 of the NDRC held last Wednesday we discussed the status of the various radar homing projects now under way at the Radiation Laboratory. You suggested at that time that I write you a memorandum for possible submission to Dr. Bush, so that he could take action to straighten out the rather confused situation which has grown up regarding these projects. This is intended to be that letter.

Work at the Radiation Laboratory on Radar Target-Seeking Devices

Two general types of radar homing equipment are now under development at the Laboratory. The first has a radar receiver only and depends upon a radar set carried in an aircraft for illuminating the target during an attack. This is referred to as the RHB equipment. An order of 100 of these sets on R.C.C. is now being completed, and further small production order for 400 equipments of improved design has been divided between Zenith and the General Electric Company by the Navy. The Radiation Laboratory has been requested to act as consultant with regard to this contract and is actively engaged in doing what it can to help with all phases of the engineering which precedes production.

The second type of equipment which is being worked on at the Laboratory is the so-called SRB equipment. This is a radar homing device whose target selector is identical with that used in the RHB equipment and whose receiver is very similar; however, a transmitter is incorporated also with the expendable radar equipment included in the bomb. Three different types of this equipment have been contemplated, two operating on the S-band and one on the X-band. Of the two operating on the S-band, the first uses the Lighthouse transmitter-receiver unit (LHTR) which forms the basis of the radar system for the SCR-728, which is now in procurement, plus the target selector and antenna units of the RHB, which is now in production. This combination has already been satisfactorily test flown and appears to be suitable for application to glide bombs. It is probably not suitable for application to drones because it contains no provisions for automatic frequency control and probably would not stay in tune over long periods of time.

The second type of S-band SRB equipment is one exactly similar in principle to that just described, but employing a lightweight magnetron

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as transmitting oscillator instead of a Lighthouse tube. The ten-fold increase in power thus provided should increase the range performance by a factor of two or so.

Finally, an SRB equipment in which the transmitter is the X-band lightweight magnetron is now being worked on. The target selectors in all these units are identical and similar to that employed in the RHB equipment.

A full report which covers the present status and future possibilities of each of these equipments is attached as an appendix to this letter.

Other Radar Target-Seeking Devices

Two other types of radar target-seeking devices are now under development elsewhere, so far as I know. At R.C.A. a frequency-modulated CW device which provides homing in azimuth only is being developed on a contract with the Navy. This is the equipment which is referred to as the "Super-Sniffer".

On a Navy contract initiated by the Bureau of Ordnance, Bell Telephone Laboratories is working on the development of an X-band SRB equipment which will be very similar to the last one described in the preceding section. The Radiation Laboratory is advisor to the Bureau of Ordnance on this contract.

NDRC Project Requests on Radar Homing Assigned to Division 14

Four official requests for development of this equipment have been received by the office of Division 14. These are the following:

AC-42	-	RHB equipment
AC-51	-	SRB equipment
NA-109 (Part)	-	Equipment for Navy drone program
NO-115 (part)	-	RHB equipment for Pelican

The primary responsibility on NO-115 was assigned by the NDRC to what is now Division 5 of the NDRC, and the activities of Division 14 in connection with this request are as a sort of sub-contractor of Division 5. The relations between Division 5 and Division 14 in carrying out this work, which concerns the Navy's project Pelican, have been most amicable and satisfactory, and a considerable degree of progress has been made.

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Programs on Development of Guided Missiles

The development of radar homing apparatus cannot be considered apart from the vehicle which is to be steered to its target by the use of such devices. The characteristics of the vehicle and of the flight control equipment affect profoundly the requirements which must be placed on the target-seeking mechanism. In what follows I have attempted to recapitulate the aims and the present state of the various programs leading toward the development of guided bombs.

I. Program of the Bureau of Ordnance

The Bureau of Ordnance of the Navy Department has undertaken a rather considerable program in this field. The first missile which is being developed is the so-called Pelican, which is an eight-foot scale model of the vehicle designed by Dr. Dryden to carry a 2000-pound bomb. The pay load of the target is about 500 pounds. About thirty experimental drops of this vehicle employing radar homing equipment have so far been had, and the development of the entire missile is proceeding in a very promising way.

This has encouraged the Bureau of Ordnance to undertake a program of development looking toward the employment of larger models of the same Dryden glider and the use of SWB type of radar homing equipment. Commander D.P. Tucker has stated that the Bureau of Ordnance holds the view that this may be as important as the development of the torpedo was to surface warfare.

As has already been indicated, the Bureau of Ordnance has suggested that the participation of the Radiation Laboratory in this program be limited to the RHB development for the Pelican project.

II. Program of the Bureau of Aeronautics

Partly under the Bureau of Aeronautics and partly under Naval Operations, a very considerable program is being carried on by the Navy in the development of assault drones. The homing means which are to be provided to bring these vehicles to their targets are foreseen now as being principally television and the frequency-modulated CW homing device being developed by R.C.A. and mentioned above. There seems to be general agreement on the part of those connected with this program that the pulse type of radar homing equipment such as is being worked on in the Radiation Laboratory is not particularly suited for this application.

The Bureau of Aeronautics of the Navy Department also has a program for the development of glider bombs, towed vehicles which could be launched by loosing their tow, and could then home in on a target. I

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do not know what type of target-seeking mechanism is contemplated for these gliders, but the question of using the pusle type of radar homing equipment developed here in these vehicles has never been raised by the Bureau of Aeronautics.

III. Army Special Weapons Program

The Special Weapons Unit of the Equipment Laboratory at Wright Field has a rather considerable program of work going forward on glide bombs of various types. Their principal interest in this development centers on the pre-set glide bomb and a bomb controllable by direct sight means. The homing equipment which they are chiefly interested in uses infrared radiation. Their rather considerable interest in radar homing means is subordinate to all these other possibilities that I have mentioned.

At the present time there seems to be evidence that the type of glide bomb being employed by the Army will not fly stably when control impulses from the homing device are applied to it, if it has been altered to accommodate the bulk of the radar equipment. This defect can probably be cured by proper attention paid to the aerodynamic design of the vehicle, but so far it has not been remedied.

IV. Program of NDRC, Division 5

Division 5 is helping with the Pelican and Bat programs of the Bureau of Ordnance (the Dryden vehicle with SFB type equipment installed is referred to by Bureau of Ordnance as BAT). This work is under the general direction of Dr. Dryden and is going very satisfactorily as has already been indicated.

The high-angle controllable in azimuth only has also been developed by Division 5 and is regarded by the Army as being very promising. A development is contemplated to adapt this vehicle to control in two dimensions instead of azimuth only, but radar homing devices will not be suitable for use with this device because it falls at so steep an angle that target discrimination cannot be secured.

Division 5 has also in hand the development of a medium-angle glide bomb of novel design which is being worked on at the Douglas Aircraft Company. The ultimate application of radar homing devices to this bomb is a distinct possibility, but the state of its development is still so early that it will not be ready for trials with radar homing gear for a good many months to come.

Conclusions and Recommendations

In the light of the situation as it has been outlined in the

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foregoing sections, I should like to suggest that the following recommendations be made to Dr. Bush:

1. Primary cognizance on all project requests having to do with radar homing equipment should be assigned to Division 5 instead of Division 14. This is suggested because of the fact that the radar homing control depends in such a fundamental way on the characteristics of the vehicle which is to be guided.

2. Work in the Radiation Laboratory should now be restricted to making the SWB equipment successful in its application to the Pelican vehicle. All other work on radar pulse homing at the Radiation Laboratory should be stopped. This suggestion is made because of the fact that the principal work required in making radar homing equipment successful in a guided vehicle comes after the vehicle, plus flight control, plus homing device, has been assembled and is available for test. A very considerable amount of work has already gone into bringing the Pelican to its present state, and it is still not entirely finished with its tests and development. The completion of a successful guided missile program involving one vehicle and one type of control equipment only is a very large job indeed, and we feel strongly that it cannot be accomplished unless the principal attention of all concerned is focused on a single end. This is the case with regard to the Pelican project; it is not the case with regard to the other guided missiles in the program just outlined. As far as the Bureau of Ordnance is concerned, the primary responsibility for the SWB equipment has been placed with the Bell Telephone Laboratories. The Bureau of Aeronautics has never shown any interest in the application of pulse radar homing equipment to their vehicles. The Special Weapons Unit of the Army has a number of possibilities which it is examining for control of guided missiles, and radar is not thought to be the most important of these. Pulse radar homing equipment is fundamentally not applicable to the high-angle bomb of Section 5.2 of NDRC. It is probably applicable to the Douglas bomb, but the development of this vehicle is still in so early a stage that it would be fruitless to commence work on the application of radar to its control at the present time.

3. The attention of the Special Weapons Unit of the Army should be drawn to the fact that the Bell Telephone Laboratories are now engaged in developing an SWB type of equipment on contract from the Bureau of Ordnance. The Radiation Laboratory feels that it would be very wasteful for a parallel development to be carried on under its auspices in view of this fact. The future of guided missiles in general, and of guided missiles employing pulse radar

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homing equipment in particular, is so dubious at the present state of their development that the proved importance of many other projects now under way at the Radiation Laboratory makes it necessary not to indulge in the type of duplication which would be involved were we to proceed with our SRB program.

I shall be very grateful for your comments on this letter.

Sincerely yours,

LOUIS N. RIDENOUR
Assistant Director

LNR:emv

cc: Mr. H.B. Richmond, Division 5, NDRC
Dr. J. G. Trump
Dr. E. M. Lyman
Dr. T. W. Bonner
Dr. L.A. DuBridge

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NATIONAL DEFENSE RESEARCH COMMITTEE
of the
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
Division 5
30 State Street
Cambridge 39, Massachusetts

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Rec'd
AUG 1943

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CO:ELM

July 8, 1943

Mr. Edward L. Moreland, Executive Officer
National Defense Research Committee
1530 P Street, N.W.
Washington 25, D.C.

Dear Dean Moreland:

This is an acknowledgment of your letter of July 5th in regard to three decisions arrived at by NDRC concerning the requests made by Division 14 because of the great demand made on the Radiation Laboratory by projects other than those from Division 5. While your letter covers the understanding that had been arrived at between Divisions 5 and 14, a considerable number of persons are involved who have not had the benefit of all of the discussions, and in order that they may be informed I am taking this occasion to confirm the three decisions arrived at as being in accord with the general understanding, and also to elaborate somewhat so as to provide adequate reference background.

1. In the transfer of primary cognizance from Division 14 to Division 5 of all projects having to do with radar homing equipment it is understood that the actual supervision of the personnel involved at the Radiation Laboratory continues under the jurisdiction of Division 14, but the supervision of the program, the arrangement for tests, and the manner in which they are to be conducted become the responsibility of Division 5. Specifically this falls under Section 5.5 (Dr. Boyce). It will, however, come under the general direction of Mr. Spencer, a Division Technical Aide.

As my own relationship as Chief of Division 5 is on a part-time basis, and because of the demand for increased production of electronic equipment at the company with which I am associated, it is increasingly difficult for me to give detailed attention to the rather extensive test program required for the work of Division 5. It has accordingly been arranged that Mr. Spencer will be relieved from practically all administrative work and will devote his entire time to the scheduling and method of conduct of the test program within the Division. In this regard Mr. Spencer will represent me on a basis comparable to that of Vice Chairman of the Division, and acting in my absence. I will, however, continue to give the general work of the Division and the program as a whole my direct attention.

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Mr. E. L. Moreland — 2 — 7/8/43

2. Work in the Radiation Laboratory should be restricted to RHB equipment as far as its relationship with Division 5 is concerned. Your letter is slightly inacctrate in that it is stated that this RHB equipment is limited to the Pelican vehicle. This is not the case and the work is equally for any type of glide bomb now developed or anticipated. It applies just as much to the vehicle being developed at Wright Field as to Dr. Dryden's vehicle.

The immediate application to Pelican (Dryden vehicle) is due to the fact that it has never been shown to this date that a vehicle equipped with radar for homing purposes, with the target illuminated from the dropping or other aircraft, can be made to home. It is anticipated that this can be accomplished and those working on the problem at the Radiation Laboratory have been very optimistic about the prospects of this being accomplished. Factually, no glide bomb equipped and illuminated in the method above described has actually hit a target. We know from experience that the Dryden vehicle is capable of being made to hit a target when given the proper information. Therefore, by confining immediate tests to this vehicle, we think we are eliminating one of the variables, and just as soon as a Pelican hits a target when controlled in the manner described, we are ready to place the equipment on other vehicles. Momentarily, however, the test is for radar rather than the vehicle.

While the Wright Field vehicle performs satisfactorily for certain types of work, it has not been clearly demonstrated that it is adapted to the peculiar condition required from signals supplied through a radar receiver. It is, however, anticipated by those working on the Wright Field vehicle that it will be ready to receive radar as soon as it can be proven that radar is a satisfactory-homing device. This separating of the variables involved in the test program will, in the opinion of the Division, provide an answer more quickly for all vehicles than will the scattering of the effort.

3. The third decision, namely, that the Special Weapons Unit of the Army should have its attention drawn to the fact that the Bell Telephone Laboratories are now engaged in the development of SRB equipment, is already a fact. This development program was handled by the Bureau of Ordnance of the Navy. It is understood to have resulted from the fact that the Radiation Laboratory felt that they did not have sufficient personnel available to attack this problem simultaneously with the RHB problem. It is also understood that the Special Weapons Unit of the Army Air Forces has arranged with the General Electric Company to investigate the SRB problem. It is further understood that while the Radiation Laboratory under Division 14 is unable to engage in SRB, reports on work already done are to be available through the Navy Bureau of Ordnance and the Special Weapons Unit at Wright Field to the Bell Telephone Laboratories and the General Electric Company in connection with their respective contracts on SRB.

Yours very truly,

H B Richmond

H. B. Richmond
Chief, Division 5, NDRC

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OFFICE FOR EMERGENCY MANAGEMENT
NATIONAL DEFENSE RESEARCH COMMITTEE
OF THE
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

30 State Street
Cambridge 39, Massachusetts

July 12, 1943

Lieutenant Colonel W. G. Brown, A.A.F.
Room 5D-860
Pentagon Building
Washington, D.C.

Dear Bill:

Although this is a personal letter to you and unofficial, I am taking the liberty of sending a copy to Colonel Holloman because of the very vital interest that he and his staff have in this problem. I am also enclosing an extra carbon that you may turn over to Major Allis if you so desire.

While I have not had the opportunity of talking with Spencer since he saw you on Thursday, I have talked with him by long-distance telephone to Vermont where he is now, following up one of our problems. He told me of his discussion with both you and Major Allis regarding the handling of the radar testing and said that you were both quite concerned for fear that the Air Forces were not getting proper attention in the program. He said that he had fully explained the situation to you and he felt that you understood what had happened. In order that there may not be any misunderstanding in this matter I thought it best to write you personally just where we stand.

In regard to radar homing Division 5 finds itself in a somewhat embarrassing position. The Division initiated none of the contracts and has just recently been given cognizance of the work at the Radiation Laboratory and only after a none too pleasant situation has developed there. Frankly, I am personally very much disappointed at the inability or unwillingness of the Radiation Laboratory to prosecute this radar homing in a more vigorous manner. I tried to get it done but was told that the Laboratory really wanted to get rid of the whole project but would continue actively on the RHB project on which they have been working for over a year.

In taking over the supervision of the test program of RHB we have endeavored to straighten out those things which were giving the greatest trouble and which appeared to us to be preventing the program from reaching

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fruition. One of these appeared to be shotgun methods of attack. You have already received a copy of my letter to Dean Moreland outlining our position. I have given that letter quite wide circulation because I feel that all liaison personnel should understand that the situation is not of Division 5's making or even liking, and that the Division is trying to straighten out a difficult matter.

At the expense of again being taken to task by Dr. Compton for what he felt to be an over-frank statement on my part regarding certain Radiation Laboratory personnel, I would like to repeat vigorously that in spite of all of the promises that I have heard since being associated with the work, I know of no one associated with NDRC who has seen a guided missile hit a target, using RHB, where the target has been illuminated from a plane. In fact, I think this can equally be extended to include ground illumination from a truck. Good promise appears to be under way but there is something in radar homing that has not be solved.

I do not say this in disparagement of the Radiation Laboratory personnel. Radar homing may be one of those illusions which appears to be workable but, because of some fact not clearly understood, may be far more difficult than anticipated. We have seen similar analogies in electronic circuits and in chemical processes. It is to try to ferret out this situation that the present program has been set up. To prevent the personnel from scattering their efforts, and in order to interpret the test data without having to make allowances for unknown variables, it seemed best to conduct the tests in the immediate future on the one vehicle that is known to be capable of homing with the type of signal given by radar, namely, Dryden's device. Very complete instrumentation and recovery methods have already been worked out, and now that the tests will be run under the supervision of the Division rather than by the Navy, we feel that the very best interpretive results can for the moment be obtained with this program.

Just as soon as we know that RHB is a reality, then tests can be made on all vehicles. It is felt that in this manner answers can be available more quickly than by using several vehicles simultaneously. The results of the tests are available to all interested parties, and any group wanting an observer for any test may have such a person present. The Division looks upon this program as a universal one, and not a particular Army or Navy program. However, just as soon as radar homing is established, then interested groups can of course do anything they want with the information and equipment available.

The Division also is fully cognizant that radar homing of a glide bomb originated with the Air Force. It comes under the original "Bomb through Overcast" directive.

While I may be somewhat over-disturbed at Spencer's report that there was feeling both at Wright Field and by you that we may not be pushing

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the Air Force project as vigorously as we should, in favor of other activities, I want to assure you that this is in no way the case.

I hope it will not be necessary for me to come to Washington for about another three weeks. There has been a terrific amount of work to be done here in connection with my own business so that I have been trying to stay out of Washington, if possible, for the month of July. When I do get down, however, I certainly will come over to Pentagon to see you and to discuss the status of the program as it is then set up.

Cordially yours,

H. B. Richmond
Chief, Division 5, NDRC

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In duplicate
cc. Col. G. V. Holloman

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BY AUTHORITY OF [illegible] CHIEF SIGNAL OFFICER [illegible]

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WAR DEPARTMENT
HEADQUARTERS, SERVICES OF SUPPLY
OFFICE OF THE CHIEF SIGNAL OFFICER
WASHINGTON, D. C.

SPSRP [illegible] SUB

[illegible]

MEMORANDUM [illegible]

S U B J E C T: Meeting on [illegible]

1. On Saturday, [illegible] July 1943, at [illegible] the following met at Major [illegible] office to discuss the [illegible] bomb.

[illegible]	[illegible]
Major [illegible]	[illegible]
Mr. [illegible]	[illegible]
Lt. [illegible]	[illegible]
Lt. Tuckerman	[illegible] Wright Field
Dr. Patterson	[illegible]
Lt. [illegible]	[illegible]
[illegible]	[illegible]
Mr. Roberts	[illegible]

FILE DATE [illegible] Elect

2. Lt. Tuckerman and Dr. Patterson described the [illegible] projects.

a. [illegible] is a [illegible] bomb which is [illegible] except for the [illegible] components. It is to employ a light weight [illegible] centered on a frequency of [illegible]. The equipment will [illegible] mately [illegible] lbs.

Bell Telephone [illegible] has been [illegible] for the project. [illegible] Laboratory [illegible] It is expected that the first model [illegible] some time [illegible]. No estimate could be made [illegible] into production.

b. [illegible] radar homing device [illegible]. The Navy is particularly [illegible] of Pelican will be limited [illegible] the fact that the [illegible] not have enough angular coverage [illegible] target illuminated [illegible] satisfactorily answered.

[illegible] had not [illegible] the [illegible] that [illegible] will probably [illegible] the first to [illegible] for further [illegible].

BUY UNITED STATES WAR BONDS AND STAMPS

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SECRET

SECRET

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[illegible] for File, [illegible], [illegible] 1943. P.2

4. [illegible] that there was considerable difference between the [illegible] the greatest part of the problem was not the radar [illegible] of the glider by the radar signals. For this [illegible] could best be carried on independently.

5. [illegible] Air Forces did have a requirement for this type of [illegible] continue the [illegible] development for the following [illegible]:

a. [illegible] vehicles, which required the [illegible] of control equipment.

b. [illegible] be developed sooner than BAT. (The [illegible] many obstacles to be overcome [illegible] this type of equipment.)

c. [illegible] much lighter in weight than [illegible]

6. [illegible] did not approve or disapprove development [illegible] authority to procure a developmental quantity of fifty [illegible] send Major [illegible] a letter [illegible]

7. [illegible] that it would be desirable for the Army [illegible]

8. [illegible] Major [illegible], Lt. Swanson, Lt. [illegible] proposed military characteristics [illegible]

9. [illegible] would be immediately forwarded [illegible] requesting that the development be [illegible]

[illegible signature]

[illegible]
[illegible], Radio Engineer

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AAFMC-266-WF-8-8-42-100M

AC-51
3-1/2 pp
NDRC

1563

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Auth: A.C.M.D.
Date: 4 September 1943
Initials: T.A.S.

ARMY AIR FORCES
MATERIEL ~~CENTER~~ COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

ARS:ms:54

Date 4 September 1943

SUBJECT: S.R.B.

~~SECTION~~ Equipment Laboratory

AC-51

SERIAL No. ENG-54-673-6-E-1

Contract No.
Expenditure Order No. 673-15
Purchase Order No.

A. Purpose.

1. To report a conference held before the Joint Radio Board in Washington, D. C. 23 August 1943, regarding the S.R.B. radar equipment.

B. Factual Data.

1. A meeting was called by Major W. L. Norvell, AC/AS, M.M.& D. before the Joint Radio Board to determine whether the Army Air Forces proposed S.R.B. development program paralleled the Navy's Bureau of Ordnance existing development project of "Bat".

2. The following personnel were present:

S. M. Schram	Captain, Signal Corps	Joint Radio Board
F. S. Barton		Joint Radio Board
C. A. Bell	Gr. Capt., R.A.F.	Joint Radio Board
G. H. Randle	Gr. Capt., R.A.F.	Joint Radio Board
J. H. Mayberry	Lt., U.S.N.R.	Joint Radio Board
A. R. Swanson	Capt., Air Corps	Special Weapons, W.F.
W. L. Norvell	Maj., Air Corps	AC/AS MM&D
G. R. Runyen	Lt. Comdr., U.S.N.R.	Bureau of Aeronautics
M. E. Goulder	Lt. (JG) U.S.N.R.	Bureau of Aeronautics
I. G. Boehm		AC/AS MM&D
E. M. Roberts		OCSigO
F. F. Seifert	Capt., Signal Corps	Aircraft Radio Lab.
P. C. Sandretto	Lt. Col., Air Corps	AC/AS MM&D
F. B. Gunter	Capt., Signal Corps	OCSigO
A. B. Pitts	Colonel, Air Corps	Joint Radio Board
W. C. Schults	Comdr., U.S.N.	Joint Radio Board
E. R. Piore		Bureau of Ships

3. Colonel A. B. Pitts, chairman of the Joint Radio Board was the presiding officer. He stated the purpose of the meeting; which in addition to determining the similarity of the proposed S.R.B. program and "Bat" development, the following too were to be discussed:

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3-43pp

~~39~~ 1564

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a. Army and Navy liaison should be very close with regard to electronic equipment for all controllable missiles so that persons interested in development and eventual production of this equipment may be cognizant of changes and stage of development.

b. Army and Navy personnel directly connected with development and production of electronic equipment for all controllable missiles meet periodically before the Joint Radio Board to discuss and inform others of their developments.

4. In answer to the intimation that similarity exists between the existing "Bat" development program and the proposed S.R.B. project. Capt. Swanson of the Materiel Command informed the Board that despite the apparent similarity of the projects, such definite differences as these exist:

a. The S.R.B. has been almost fully developed at the Radiation Laboratories and now requires engineering for production primarily. The "Bat" development is entirely new.

b. The S.R.B. makes use of an existing lighthouse tube for an oscillator; whereas the "Bat" is using a new light weight magnetron.

c. The S.R.B. is making use of components and circuits already in use, such as the transmitter-receiver (A.R.O.) unit. The "Bat" must develop all of its components and circuits first.

d. The S.R.B. unit is of lower power and less weight than the "Bat".

e. The S.R.B. should be ready for use in a comparatively short time, whereas the "Bat" is a relatively long time development.

5. It was pointed out by Comdr. W. C. Schultz, Dr. E. R. Piore and Capt. A. R. Swanson that close liaison already exists between Army and Navy on development of electronic equipment for controllable missiles. Further, that reports are submitted by Army Air Forces Liaison Officers, and if Army personnel concerned with these developments, are not informed it is because of an internal problem of distribution of these reports.

6. Mr. I. G. Boehm stated that he didn't feel a meeting of Army and Navy personnel before the Joint Radio Board was necessary inasmuch as the projects involved had not reached the production stage as yet. Further that Army and Navy exchange of information is adequate.

7. Col. A. B. Pitts called for a meeting before the Joint Radio Board of representatives of the Army Air Forces, Signal Corps, Bureau of Ships and Bureau of Aeronautics, this meeting to be held 10 A.M. 3 September 1943 in Washington, D. C.

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NDRC

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Engin. Div. Memo. Report No. ENG-54-673-6-E-1
4 September 1943

C. Conclusions.

1. That the proposed S.R.B. development does not parallel existing "Bat" development.

2. That Army and Navy liaison with regard to electronic equipment for controllable missiles is very close and regular.

3. That Army personnel concerned with electronic equipment for controllable missiles, who are not informed of changes and stage of development, should correct an internal situation which prevents these personnel from receiving the reports.

4. That a meeting will be held before the Joint Radio Board at 10 A.M., 3 September 1943 in Washington, D. C. of Army and Navy personnel concerned with electronic equipment for controllable missiles.

Concurrence:

Prepared by A. R. SWANSON, Captain, A.C.
A. R. Swanson

Approved by: G. F. HOLLOMAN, Colonel, A.C.
Chief, Equipment Laboratory
Engineering Division.
J. H. Krasnow Major AC

Approved by: H. Z. BOGERT, Colonel, A.C.
Acting Chief, Engineering Divisio
H. George Francis Lt Col AC

Distribution:

Materiel Division, AC/AS, M.M.& D.
ARL; Navy Liaison.

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3 pages

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36-3PR

34 [redacted]
1216

Auth: A.C.M.D.
Date: 28 SEP 1943
Initials: T.A.S.

Address reply & ENVELOPE to:

Commanding General,
AAF Materiel Command,
Engineering Division,
Reference: AM:ms:54,
Wright Field, Dayton, Ohio.

7812

XXXXXXX COMMAND

EW 795

Wright Field, Dayton, Ohio.

28 SEP 1943

S. R. B. Equipment.
(Send-Receive Bomb)

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Asst. C/AS, MMD.

1. The S.R.B. (send-receive bomb) designation refers to a radar target seeker applicable to controllable bombs, wherein the bomb carries both the transmitter and the receiver.

2. The following facts are brought to the attention of your Office in order to suggest means for expediting this and other developments involving radio equipment:

a. Original suggestion for S.R.B. was given to Division 14 of N.D.R.C. at a conference on 5 March 1942. The technical personnel of that organization preferred a modified system using a transmitter on the carrier plane. A program for this development was therefore initiated under the title of R.H.B. (radar homing bomb).

b. The R.H.B. development has been carried out with the testing facilities furnished by the Materiel Command. The Bureau of Ordnance of the Navy had expressed concurrent interest in this development and initiated a procurement of service test model of R.H.B. with the consent of Signal Corps representatives. A portion of this procurement has been allotted to the Materiel Command.

c. Tests of R.H.B. equipment have revealed one serious tactical difficulty, that of maintaining the transmitter beam on the target during evasive maneuvers of the carrier plane after release of the bomb. Solutions of this difficulty are being studied but will not be available before the middle of 1944.

d. Meanwhile since November 1942 considerable work was done by N.D.R.C. in applying A.R.O. equipment (Aircraft range only) to the elements of R.H.B. to secure the effect needed for S.R.B. system. This development was very actively sponsored by this Office. On 14 May 1943 a very satisfactory demonstration was given to Lt. Col. Nyman and a few days later a similarly satisfactory demonstration was given to Lt. Col. D. H. Young, the officers in charge of this development.

COM. GEN.
TECH. EXC. ab
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG. A.N.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
F. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS
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CENTRAL FILES

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Commanding General Army Air Forces
S.R.B. Equipment (Send-Receive Bomb)

28 SEP 1943

e. This S.R.B. equipment appeared to be compact, reliable, adaptable to use on glide bombs and power driven bombs, with a range only slightly inferior to R.H.B., but entirely free from the above mentioned tactical problem.

f. As the facilities of N.D.R.C. were inadequate to procure service test models, steps were immediately taken to have the Aircraft Radio Laboratory place contracts with manufacturing concerns familiar with these types of devices. It was indicated that approval of the Chief Signal Officer was needed for this purpose. A letter requesting this procurement was therefore sent to the Assistant Chief of Air Staff, Materiel Maintenance and Distribution, Communications Equipment Office on 10 July 1943 recommending the General Electric Company of Bridgeport, Conn. and the Zenith Corporation of Chicago, Illinois as possible sources. Without these service models no further progress could be made with the one available experimental model. To date no contract has been issued for this equipment nor have any negotiations been started.

g. To expedite action the following steps were taken:

(1) Several conferences were held with the Aircraft Radio Laboratory Electronic Branch to familiarize them with the Materiel Command requirements and to coordinate with prospective manufacturers.

(2) A conference was held with personnel of M.M.& D. at O.C.& R. to familiarize them with the Materiel Command requirements and facilitate approval of military characteristics required by the Chief Signal Officer before any action could be taken.

(3) Complete military characteristics were submitted by the Materiel Command in cooperation with the Aircraft Radio Laboratory on 31 July 1943 and agreed to by representatives of the Communications and Equipment Office and the Office of the Chief Signal Officer.

(4) A conference was held before the Joint Radio Board on 23 August 1943 to determine that S.R.B. does not parallel the Navy "Bat" development which the Bureau of Ordnance of the Navy had independently initiated with the Bell Telephone Laboratories based on the N.D.R.C. development of S.R.B. A further conference of the Joint Radio Board was scheduled on 3 September and since then indefinitely postponed.

h. While the "Bat" can be eventually adapted to the use of the Materiel Command controllable bombs, this development is still in its initial stage while S.R.B. is a working and a tested article.

i. The Chief Signal Officer had referred the subject S.R.B. equipment to the Army Service Forces, which organization has declined to recommend

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Commanding General, Army Air Forces.
.B. Equipment (Send-Receive Bomb)
18 SEP 1943

its procurement since the personnel of this organization are not conversant with the details of the development nor its relation to the general program of controllable bombs.

j. Thus 3-1/2 months of valuable time has elapsed without any action taken, or any in prospect, on a request of the Engineering Division for a tested article with characteristics most suitable for accurate bombing by controllable glide and power driven bombs, without anyone actually voicing objections to the device but merely through the complexity and number of organizations that must give their approval before any further work on this experiment can be done.

3. In the nature of experimental work the personnel directly concerned are most familiar with the necessary steps for carrying it out, yet it appears that any element of this experimental work which happens to include radio devices is subject to the approval of so many agencies not familiar with this experimental work that an unnecessary delay of several months takes place before all persons involved can look into it and be persuaded of the need of these experimental devices.

4. If the decision on procurement of experimental devices is left to other agencies outside of the Engineering Division, the function of the latter is clearly invaded. It becomes impossible to schedule a program of development if essential steps can be blocked by outside agencies.

5. It is suggested that for experimental radio equipment a more direct channel be designated. The Aircraft Radio Laboratory was established for the express purpose of procuring such experimental radio equipment. Through internal reorganization of Signal Corps the authority for such procurement has been placed in the Chief Signal Officer, who in turn accepts the recommendations of various operating and tactical units, which are not fully conversant with the program of the Engineering Division.

6. In order to revert to the spirit of the original purpose of the Aircraft Radio Laboratory a direct channel to the Chief Signal Officer is needed and a directive for the latter to be guided by the recommendation of the Engineering Division for procurement of experimental radio equipment should be issued.

For the Commanding General:

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

[redacted]

MX-224

AAFMC-278-WF-5-17-44-20M

File No. 1/1 631

REQUEST FOR
MODEL OR TYPE DESIGNATION
CHANGE OF STATUS OF EQUIPMENT
[redacted]

Sheet No.
Item
Date 29 November 1944

1. Name of Article or Requirement Affected: Glide Bomb, Controllable Type GB-7 - (RHB (GB-7A)

Drawing No. ...... Specification No. ......

2. Entry ~~or Change of Classification or Requirement~~: Enter into Experimental Classification

3. New Type or Model: New
   Supplements or Replaces Type or Model: None
   New Status of Supplemented or Replaced Type or Model: None
   Lab. Charged with Development: Equipment Laboratory

4. Estimated unit cost. ......

5. Indicate concurrence in the proposed action by Technical Services, Technical Committees, and/or Service Board reports: None

6. Does item possess required military characteristics: Yes
   (a) In what respect is it lacking: None

7. Status of related equipment: Standard

8. REMARKS: (Include a brief resume' of the characteristics of the article or requirement or resume' of reason for entry, removal or change of classification).

[redacted]-7 This device consists of a 2000 pound general purpose bomb incorporated into a high wing monoplane type vehicle comprised of an airframe, including wing and tail assembly sections joined by two longitudinal booms, and an auxiliary nose section. The airframe section includes appropriate control surfaces and is mounted in such manner that the bomb is suspended by means of straps beneath and slightly forward of the wing, while between the booms to the rear of the bomb is mounted an auxiliary housing. The nose section is mounted forward of the bomb and is attached thereto by means of a bulkhead strapped to the forward end of the bomb and a metal plate anchored in place by the flange of the nose fuse. Within the nose section is mounted a radar receiver sensitive to signals in four quadrants while within the mechanism housing are mounted batteries, stabilizing equipment, servo-mechanisms for the operation of the control surfaces, control relays, electrically connected to the Radar receiver and incidental associated equipment. 160

In operation the target is radar illuminated from the mother airplane and the return signal differentials between the target and its background are picked up by the radar receiver to give up, down, right, left signals in accordance with the target location. These signals are utilized to operate the control relays in order to transmit the proper control through the stabilizing equipment to the servo-mecahnisms and thence to the airframe control surfaces so that the vehicle is guided into the target.

Approved: [redacted]

[redacted]

Auth: DIR., ATSC
Initials JAG
Date 29 November 1944

Initiated By A. R. SWANSON, Major, A.C.

Br.-Lab.-Unit Chief ......

G. V. HOLLOMAN, Colonel, A.C.
Chief Equipment Laboratory Section

Type designation GB-7 has been assigned ~~and an Authority for Change of Status~~
~~equipment in accordance with AR 850-25 is being initiated.~~

W. L. SNYDER, Captain, Air Corps
Chief, Specifications Unit, TSESE4D4
Specification Branch
Production Engineering Section

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AAFMC-276-WF-5-17-44-20M

File No. 41

REQUEST FOR
MODEL OR TYPE DESIGNATION
CHANGE OF STATUS OF EQUIPMENT

Sheet No. ....
Item ....
Date 29 November 1944

[redacted]

1. Name of Article or Requirement Affected .... Glide Bomb, Controllable Type GB-14 (SRB GB-7B)

Drawing No. .... Specification No. ....

2. Entry, ~~removal~~ ~~change of~~ Classification .... Enter into Experimental Classification

3. New Type or Model .... New — Supplements or Replaces Type or Model .... None

New Status of Supplemented or Replaced Type or Model .... None — Lab. Charged with Development .... Equipment Laboratory

4. Estimated unit cost, ...

5. Indicate concurrence in the proposed action by Technical Services, Technical Committees, and/or Service Board reports .... None

6. Does item possess required military characteristics........ Yes

(a) In what respect is it lacking .... None

7. Status of related equipment .... Standard

8. REMARKS: (Include a brief resume' of the characteristics of the article or requirement or resume' of reason for entry, removal or change of classification).

GB-14 This device consists of a 2000 pound general purpose bomb incorporated into a high wing monoplane type vehicle comprised of an airframe, including wing and tail assembly sections joined by two longitudinal booms, and an auxiliary nose section. The airframe section includes appropriate control surfaces and is mounted in such manner that the bomb is suspended by means of straps beneath and slightly forward of the wing, while between the booms to the rear of the bomb is mounted an auxiliary housing. The nose section is mounted forward of the bomb and is attached thereto by means of a bulkhead strapped to the forward end of the bomb and a metal plate anchored in place by the flange of the nose fuse. Within the nose section is mounted a radar receiver sensitive to signals in four quadrants which operates in association with radar illuminating equipment mounted within the vehicle structure. Within the mechanism housing are mounted batteries, stabilizing equipment, servo-mechanisms for the operation of the control surfaces, control relays electrically connected to the radar receiver and incidental associated equipment.

In operation the target is radar illuminated from the vehicle itself and the return signal differentials between the target and the background are picked up by the radar receiver to give up, down, right, left signals in accordance with the target location. The signals are utilized to operate the control relays in order to transmit the proper control through the stabilizing equipment to the servo-mechanisms and thence to the airframe control surfaces so that the vehicle is guided into the target.

Approved [redacted]
Auth: DIR., ATSC
Initials asy
Date 29 November 1944

Initiated By A. R. SWANSON, Major, A.C.

Br.-Lab.-Unit Chief .... G. V. HOLLOMAN, Colonel, A.C.
Chief, Equipment Laboratory Section

[redacted]

Type designation GB-14 has been assigned ~~XXXXXXXXXXXXXXXXXXXXXXX~~
~~XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX~~

W. L. SNYDER, Captain, Air Corps
Chief, Specifications Unit, TSESE
Specification Branch
Production Engineering Section

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

EHW:jjb:HQP
Wright Field, Dayton, Ohio.
20 January 1944

MX-224

TECHNICAL INSTRUCTIONS

Serial No.: CTI-1563

Subject: Procurement of Complete SRB (BAT) Units.

[redacted]
AUTH: C. G., AAF Materiel Command
DATE: 1/31/44
INITIALS: EHW

To: Production Division

1. Problem Presented:

a. The Office of the Assistant Chief of Air Staff, MM&D, has directed that procurement be made of five hundred (500) complete SRB (BAT) Glide Bomb units from the Navy.

2. Factual Data:

a. Action has already been initiated through the Signal Corps for procurement of five hundred (500) SRB (BAT) electronic units from the Navy.

3. Authority:

a. Commanding General, Army Air Forces. By letter dated 14 January 1944, subject as above, received from Chief, Development Engineering Branch, Materiel Division, Office, AC/AS, MM&D.

4. Action Desired:

a. That the Production Division take necessary action to procure from the Navy Bureau of Ordnance the balance of the equipment necessary to carry the BAT equipment and make it operational. This will include the airframe, servo-unit, gyros, shackle units, etc., for the five hundred (500) units. The airframes shall be identical to the equipment now used by the Navy for the same purpose.

b. That the Production Division make arrangements with the Navy to have the five-hundred (500) Signal Corps procured units installed in the five hundred (500) Materiel Command procured equipments and have deliveries made from the Navy to the Army Air Forces as complete units, ready to be used operationally.

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

EHW:jjb:HQP
Page -2-
~~WASHINGTON, D.C.~~
Wright Field, Dayton, Ohio.
20 January 1944

TECHNICAL INSTRUCTIONS

Serial No.: CTI-1563 (Continued)

Subject: Procurement of Complete SRB (RAT) Units.

To: Production Division

4. Action Desired: (Continued)

c. Thirty-five (35) of the above quantity of five-hundred (500) units are to be secured from the Navy as pre-production models for use by the Materiel Command.

d. That the Production Division secure a delivery schedule from the Navy on their earliest possible delivery of the thirty-five (35) pre-production models and the remainder of the five hundred (500) order.

e. These delivery schedules should be furnished through the Technical Executive Office to the Chief, Development Engineering Branch, Materiel Division, Office, AC/AS, MM&D. The Materiel Command has been requested to expedite this procurement.

f. Delivery locations will be furnished to the Materiel Command from the Chief, Development Engineering Branch, Materiel Division, Office, AC/AS, MM&D, at a later date.

By Command of Major General BRANSHAW:

E.H.W. Capt AC
for T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

Distribution:
Engineering Division
Ordnance Office
Aircraft Radio Laboratory
Air Service Command (3)

24 Jan 44 - Dist by Prod Div
Orig & cy to Glider Branch
CC: Aero. Equip. Branch (2)
Chief, Airplane Projects
Resources Cont. Section
Production Division File

W. E. DONNELLY
Asst. to Chief,
Production Division

[redacted]

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U-AD-600

AUTH: C. G., AAF
Materiel Center
DATE: 4/24/44
INITIALS: E.H.W.

ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

[redacted]

TECHNICAL INSTRUCTIONS

EHW:cjt:HC
Wright Field, Dayton, Ohio
25 April 1944

Serial No.: CTI-1563, ADDENDUM NO. 1
CB

27 Apr 44 - Dist by Prod Div
Orig & cy to Glider Branch
CC: Aero Equip Branch (2)
Chief, Airplane Projects
Resources Cont. Section
Prod. Division File

W. E. DONNELLY
Asst. to Chief,
Production Division

Subject: Procurement of Complete SRB (BAT) Units

DB-7B

To: Production Division

MX-224

1. Problem Presented:

a. The Office of the Assistant Chief of Air Staff, Materiel, Maintenance and Distribution has directed that procurement be made of five hundred (500) complete SRB (BAT) Glide Bomb units from the Navy.

2. Factual Data:

a. Action has already been initiated through the Signal Corps for procurement of five hundred (500) SRB(BAT) electronic units from the Navy.

b. Reference is made to letter dated 24 February 1944, from the Engineering Division, subject, "Procurement of "Bat" equipment and Dryden 12 ft. (2000#) Glider", to Materiel, Maintenance and Distribution and reply thereto, dated 23 March 1944, which gave approval to the Materiel Commands request that procurement of the 12 ft. Dryden gliders be made directly from the contractor and not through the Naval Bureau of Ordnance.

Radar AN/APG-11
Navy Mark 31
Model 1

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 14 ~~January 1944~~, subject as above, and letter dated 23 March 1944, subject, "Procurement of "BAT" Equipment and Dryden 12 ft. (2000#) Glider", both from Chief, Development Engineering Branch, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution.

4. Action Desired:

a. That the Production Division take necessary action to procure the balance of the equipment necessary to carry the BAT equipment and make it operational. This will include the airframe, servo units, gyros, shackle units, etc., for the total 500 units.

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

[redacted]

EHW:cjt:HQP
Wright Field, Dayton, Ohio
25 April 1944

TECHNICAL INSTRUCTIONS

Serial No.: CTI-1563, ADDENDUM NO. 1

Subject: Procurement of Complete SHD (BAT) Units

To: Production Division

b. That the Production Division make necessary arrangements to have the 500 Signal Corps units installed in the 500 Materiel Command procured equipments in order that deliveries may be made to the Materiel Command as complete units, ready to be used operationally.

c. Thirty-five (35) of the above quantity of 500 units are to be secured as pre-production models to be used by the Materiel Command.

d. That the Production Division secure a delivery schedule on the earliest possible delivery of the thirty-five (35) pre-production models and the remainder of the 500 order and that these delivery schedules be furnished through the Technical Executive Office to the Chief, Development Engineering Branch, Materiel Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution.

e. Delivery locations will be furnished to the Materiel Command from the Chief, Development Engineering Branch, Materiel Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution, at a later date.

f. That the Engineering Division advise the Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution through the Technical Executive Office of the present status of this project and the contemplated date at which procurement can actually be made.

g. These Technical Instructions cancel and supersede basic CTI-1563.

By Command of Major General BRANSHAW:

cc: Engineering Division
Ordnance Office
Aircraft Radio Laboratory
Air Service Command

[redacted]

T. A. Sims
T. A. SIMS
Colonel, Air Corps
Deputy Chief of Staff

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MX-224
CR-7 Test Group
National Bureau of Standards
Washington, D.C.

To: Special Weapons Branch, Equipment Laboratory, Wright Field, Dayton, Ohio

Subject: Division 5, NDRC

ATT: Lt. Col. A. Nyman

1. Division 5, NDRC has been requested by the Army Air Forces to design, engineer, and establish production of RC-171 (RH) radar receiver for use as intelligence in a guided missile. However, no formal request has been made for their services in conducting expermental tests after the production receiver has been delivered to the Army Air Forces, nor has any request been made of them to provide materials, equipment and personnel necessary in plane installations of experimental and production equipment, also assist in tests.

2. At present installation in AAF B-17 # 41-191?? at W.F. of plane monitoring equipment is progressing. Two members of Division 5 NDRC are at Wright Field supervising this installation. 300 feet of RC54U microphone cable and other materials were needed for this installation, which is being provided by Mr. R. A. Lamm from NDRC stock. These materials are extremely difficult to procure and can only be obtained by an agency which is in close contact with manufacturers and which is streamlined and not burdened with undue procurement regulations. This example is brought to light only that it will be typical of future happenings, in that the A.A.F. will depend to an even greater extent upon NDRC for materials, personnel, and information as the radar guided missile program progresses.

3. It is requested that Dr. Richmond, Mr. Spencer, Dr. Dryden, and Mr. Lamm be contacted by A.A.F. Officers to review the present Army-NDRC Division 5 relationship and that a formal request be initiated asking for further consulting services, and if possible the assignment of two persons who are thoroughly trained in "RHB" and "BAT" equipments to the A.A.F. program. Further that funds be transferred to Division 5 NDRC, if necessary, to cover expenditures not anticipated by them for the A.A.F.

Arthur R. Swanson
Arthur R. Swanson
Capt. A.C.

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TSC Form No. 10-1 (17 Oct 44)

188 [redacted]

Initials DAS
Date 6 Feb 45

ROUTING AND RECORD SHEET. AIR TECHNICAL SERVICE COMMAND

this form for inter-office correspondence this headquarters. | Use authorized office symbols to designate addressor and addressee. | Place initials of dictator and typist, telephone number and location to right of signature.
entire width of sheet, both sides. | Number all comments consecutively. | Separate comments by horizontal lines across page.

SUBJECT Hot Projects

TO TSTIX
Att: Capt. J. H. Ober

FROM TSENG (TSEPL-3E)

DATE 6 Feb. 1945 COMMENT NO. 1.

JHO

PERMANENT ☒ TRANSITORY ☐

The following report on Hot Projects as pertain to the Equipment Laboratory are listed below for inclusion in the next weekly report.

AIR TO AIR REMOTELY CONTROLLED MISSILE, T. I. 2003 ADD. 3 (TIAMAT)

a. No change. (Reported 23 January 1945)

b. The 100-pound general purpose bomb will be used on Tiamat as this is the only suitable bomb that can be made available by ordnance within the next eight months. Development of a more effective bomb of the same general dimensions as the 100-pound general purpose bomb will be undertaken by ordnance.

c. Calculations have not been completed to set up the control requirements for Tiamat, but it appears that the required rate of response will exceed the rate of our present electric servo-motors. Investigation is being conducted to see if Jack & Heintz air servos are more suitable.

Monsanto Chemical will attempt to produce a combination booster and sustaining rocket for Tiamat. The complete rocket will be housed within fuselage. Drawings have been received and ground firing tests are expected to be made in April.

Although late developments on availability of technical personnel for work on R.H.B. (Radar Homing Bomb), equipment, indicate that the seeker development may lag considerably behind the aircraft development, work is expected to continue on the pilotless aircraft with use of direct sighting methods and MIMO (Special Television Equipment) equipment as alternates.

d. Pressure distribution tests for the Griswold design will not be made until other important tests are completed in the five-foot wind tunnel. Further work will not be undertaken until the place of this design in the pilotless aircraft field can be determined. The high speed wind tunnel tests that were expected to be conducted at Moffett Field cannot be made because facilities of the tunnel will not be available until June, due to higher priority projects. It is expected that wind tunnel tests may be run on one of the flying models if this is found necessary.

e. No change.

for W. E. Goll. Lt Col, AC
P. H. ROBEY,
Colonel, A. C.,
Chief, Propulsion & Access. Section,
Engineering Division.

ADS:ap
Ext. 2-9282
Bldg. 45

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WF, Area B-10-20-44-1 Mil. (CONTINUE ON OTHER SIDE)

agd 613-... - Guided Missiles

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WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

24 Feb. 1945

SUBJECT: Employment of Bomb Mark 57, Project named BAT, in Pacific Theater of Operations.

TO: President
Army Air Forces Board
Orlando, Florida

1. The Navy is currently making firm plans for the employment of the bomb Mark 57 in the Pacific Ocean Area commencing in about March or April 1945.

2. The missile will be carried by the PB4Y-2 type land-based patrol bombers, and it is contemplated that on each mission the carrying aircraft shall have one BAT mounted under each wing.

3. It is planned that three PB4Y-2 Squadrons, as indicated below, will be equipped for the BAT project:

VPB 109
VPB 123
VPB 124

4. This Headquarters considers it would be very desirable to have a liaison officer attached to this project to study in detail methods of operation so that full benefit can be obtained from the Navy experience. It is felt that this experience will provide an extremely valuable background for future Air Force guided missile projects of similar nature.

5. A request is being made to the Navy for permission to attach a liaison officer to the project. A further statement will be made as soon as an answer is received. It is planned that the Army Air Forces Board furnish a suitable officer of field grade qualified to represent the Air Forces in this project.

By command of General ARNOLD:

/s/ William F. McKee
WILLIAM F. McKEE
Brigadier General, U.S.A.
Acting Asst. Chief of Air Staff Operations, Commitments and Requirements.

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SAVE

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

IN REPLY REFER TO:

(AFDMA-2G)
31 March 1945

SUBJECT: Employment of Bomb Mark 57, Project ~~Named~~ BAT ~~in Pacific~~ Ocean Theatre of Operations

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

3/31/45 L.T.B.

Attention: Pilotless Aircraft Branch (TSESM-2G)

MX-224

1. Lt. Colonel R. . Craig, AAF Board, has been nominated to accompany the subject project.

2. The readiness date for this project was estimated as Spring, 1945, but is not yet available.

3. The ATSC has the responsibility of maintaining liaison with development projects conducted by other services that might be of potential value to the Army Air Forces and of reporting progress on such projects to this Headquarters in order to determine whether an AAF requirement should be established.

4. No report has been received from the ATSC on the BAT project.

5. A complete report is requested on the BAT project, giving the details of the device, pictures, results of tests, and the potential value to the AAF.

6. This report should also include the comparison of the operational characteristics of this device, and its heavier 2000 lb version, in comparison to the GB-14.

7. This report should also include a statement on the possibilities of using the SRB type of seeker with:

a. A jet-propelled missile.

b. A missile carrying a torpedo and designed for torpedo entry into water in sufficient time to permit arming.

By Command of General ARNOLD:

L. T. Broadway Lt. Col. AC.
D. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engineering Br.
Office, Asst. Chief of Air Staff
Materiel and Services

CENTRAL FILES
TSESF 2G/LT

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ADDRESS REPLY TO: COMMANDING GENERAL, ARMY AIR FORCES, WASHINGTON 25, D. C.

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ARMY AIR FORCES
~~MATERIEL COMMAND~~ SERVICE COMMAND
MEMORANDUM REPORT ON

TSEPL-31/ARS/me
Date 21 April 1945

D72.31/S-215

Page 1
Pages 4
X-108560
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of the "Pelican" glide bomb. The major components of the "Pelican" are as follows:

a. Airframe - SWOD (Air Stabilizer) Mark 12, Mod. 0

b. R.H.B. - SWOD (Radio Receiver) Mark 1, Mod. 3

c. Gyros - SWOD (Gyro Panel) Mark 6, Mod. 0

d. Servos - SWOD (Servo) Mark 4, Mod. 3

e. Demolition Outfit - Mark 117

f. Fuzes - Mark 235 and 236

g. 500-pound General Purpose Bomb AN/M-64

5. The glider has a glide ratio 3.5:1 to 5.5:1, and is launched at 130 to 200 knots. The Navy used the PBJ (AAF type B-25) and the PV-1 (AAF type B-34) as carrying aircraft. Three "Pelicans" were carried on each airplane. These airplanes were equipped with stabilized radar search sets, AN/APS-2E. Stabilization was effected in both azimuth and pitch.

6. Drop tests were conducted of this vehicle using the "James Longstreet", a "Liberty" type ship, as the target. A number of direct hits were scored on this target as well as many near misses. The evaluation of the drops made indicated a probability of 30 to 40% hits.

7. The U. S. Navy planned on sending two squadrons of PV-1 airplanes overseas with this missile during the middle of 1944. The crews were formed and training of them was begun as well as modification of the aircraft. However, the crews were disbanded and modification of the aircraft was stopped when it was learned that the PV-1 when fully modified, equipped, and loaded with three "Pelican" glide bombs had insufficient range to reach enemy targets. Further, the "Bat" glide bomb, SWOD (Special Weapon) Mark 9, Mod. 0 was showing much promise and in addition carried a 1000-pound bomb as against a 500-pound bomb for the "Pelican". It also had the advantage of not requiring illumination after its release.

8. The "Pelican" was then sent to the Special Weapons Test and Tactical Evaluation Unit (SWTTEU) at Traverse City, Michigan, for further test and evaluation. It was decided, however, that the missile should not be further tested and evaluated since the "Bat" missile was nearing the test stage. The status of the "Pelican" has not changed.

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Memorandum Report TSEPL-3-673-48-B
21 April 1945

C. CONCLUSIONS:

1. That the U. S. Navy, Bureau of Ordnance Experimental Unit at the National Bureau of Standards, Washington, D. C. has developed and tested the "Pelican" glide bomb.

2. That the drop tests made indicated a probability of 30 to 40% hits against a "Liberty" ship.

3. That the "Pelican" development is at present at SWTTEU, Traverse City, Michigan. Further testing and evaluation of this project is awaiting directives from higher headquarters, U. S. Navy.

D. RECOMMENDATIONS:

1. It is recommended that the following action be taken by the organization designated below:

a. Engineering Division, Air Technical Service Command

(1) That this project be closely followed. (action to be taken)

(2) That the AAF obtain a service test quantity of these missiles for service tests, only in the event that the evaluation tests at SWTTEU, Traverse City, Michigan are satisfactory. (action to be taken)

Concurrence:

Prepared by ARTHUR R. SWANSON, Major, A.C.
(Name)

Approved by P. H. ROBEY, Colonel, Air Corps
Chief Propulsion and Accessories Subdivision

Approved by F. O. CARROLL, Brig. General,
Chief, Engineering Division.

Distribution: Asst. C/AS, M&S, Mat.Div. (5)
U.S.Navy BuOrd Exp.Unit, Wash.D.C.
TSESE-2G, Maj.Kotcher
TSEAL-6D5
TSEPL-3

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Pilotless airc. Gen. 633

AAFMC-266-WF-4-7-44-50M

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ARMY AIR FORCES
AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

TSEPL-3I/ARS/se
Date 23 April 1945

SUBJECT: U.S. Navy "BAT" Glide Bomb, SWOD (Special Weapon) Mark 9 Mod 0.

OFFICE Equipment Laboratory Contract or Order No.

SERIAL No. TSEPL-3-673-50-D Expenditure Order No. 673-69

A. PURPOSE:

1. To report on a trip to the U. S. Navy, Bureau of Ordnance Experimental Unit, National Bureau of Standards, Washington, D. C. with reference to the subject equipment.

B. FACTUAL DATA:

1. The Bureau of Ordnance Experimental Unit was visited on 11 and 12 April 1945 to obtain information on the U. S. Navy "Bat" glide bomb.

2. Personnel present were:

Air Technical Service Command	Bureau of Standards
Major Arthur R. Swanson	Dr. H. L. Dryden

U. S. Navy

Cmdr. L. P. Tabor
Lt. Cmdr. L. P. Tuckerman
Lt. C. M. Dill
Lt. D. H. Larmee
Lt. J. W. Sheetz

3. A booklet was obtained from the Bureau of Ordnance Experimental Unit giving complete description, electrical and mechanical operation, and tactical operation of the "Bat" glide bomb. This booklet is titled, "(Preliminary) Notes On SWOD (Special Weapon) Mark 9, Mod. 0 And Associated Control Equipment", dated 9 March 1945, 51 pages.

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4. To this date a total of 45 drop tests have been made of the "Bat" glide bomb. These drops were made against corner reflectors on land, corner reflectors on water, the 10,000 ton "Liberty" ship, James Longstreet, and against the Carisco, a 180' long and 28' beam ship. Many of these drops were made to check the effects of various optical axis settings, additions of destructors and arming mechanisms, and folding vertical stabilizer surfaces. An evaluation of this glide bomb was made on the basis of ten drops which are tabulated below:

DATE	BOMB NO.	ELEV at RELEASE	AZIMUTH MISS	RANGE MISS	HIT	TARGET
5 Nov	27V	5400'	100' Right	0'	No	"Longstreet"
6 Dec	95V	4730'	0'	100' Short	Skip Hit	"Carisco"
6 Dec	101V	4750'	0'	0'	Yes	"
7 Dec	56V	——	10' Left	0'	No	"
9 Dec	32V	2800'	100' (?)	0'	No	"
9 Dec	53V	3900'	0'	30' Short	No	"
22 Dec	93V	5000'	0'	30' Short	Skip Hit	"
22 Dec	103V	5000'	0'	25' Short	No	"
26 Dec	104V	5000'	0'	1000' Short	No	"
26 Dec	39V	6000'	0'	180' Left	No	"

5. The target ship "James Longstreet" is a 10,000 ton "Liberty" ship, 416' long with a 56' beam. The "Carisco" target ship is a smaller ship, only 180' long and a 28' beam. The ten tabulated drops include one direct hit and two skip hits. When the evaluation was made of this glide bomb the information obtained from the ten drops was used to determine the probable hits if all the glide bombs were dropped against the larger target, the "James Longstreet". The probable hits were calculated as 30 to 40%.

6. Three combat "Bat" squadrons of PB4Y-2 (AAF type B-24) of 15 airplanes each and crews are now at Pearl Harbor preparing for missions. Modification of the airplanes is being done at Pearl Harbor. Technicians from Division 5, N.D.R.C. and Bell Telephone Laboratories are at this site to assist in any technical difficulties.

C. CONCLUSIONS:

1. That the U. S. Navy, Bureau of Ordnance Experimental Unit at the National Bureau of Standards, Washington, D. C. has developed and tested the "Bat" glide bomb.

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Memorandum Report TSEPL-3-673-50-D
23 April 1945

2. That the evaluation made indicated a probability of 30 to 40% hits against the 10,000 ton "James Longstreet" ship.

3. That three "Bat" glide bomb squadrons have been formed and are now preparing themselves at Pearl Harbor for missions.

D. RECOMMENDATIONS:

1. It is recommended that the following action be taken by the Organization designated below:

a. Engineering Division, Air Technical Service Command

(1) That this project be closely followed. (Action to be taken)

(2) That the AAF obtain a quantity of these missiles for service tests, only after the U. S. Navy initial production needs are met and provided that the combat evaluation of this missile is satisfactory. (Action to be taken)

Concurrence:

Prepared by ARTHUR D. SWANSON, Major, A.

Approved by P. H. ROBEY, Colonel, Air Co
Chief Propulsion and Accessori
Subdivi

Approved by F. O. CARROLL, Brig. General
Chief, Engineering Division

Distribution: Asst. C/AS, M&S, Mat.Div. (5)
BuOrd Experimental Unit, U.S.Navy,
National Bureau of Stds, Wash.D.C.
TSESE-2G, Maj.Kotcher
TSEAL-6D
TSEPL-3I (2)

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ATSC Form No. 43 (14 Sep 44)

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AUTH: DIR., ATSC
INITIALS ER
DATE 24 April 1945

"Reports and Possible Trials of Navy "Bat" and "Pelican".

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

ATSC 1st Ind. TSESE-20/CWQ/kt

HQS., AAF ATSC Wright Field, Dayton, Ohio. 24 April 1945.

TO: Commanding General, Army Air Forces, Washington, D. C.
Attention: Asst. C/AS, M&S, Development Engineering Branch.

1. Reference is made to a letter from Hqs., Army Air Forces, dated 31 March 1945, subject "Employment of Bomb Mark 57, Project Named "Bat" in Pacific Ocean Theatre of Operations" and basic communication from Hqs., Army Air Forces dated 13 April 1945.

2. The following Memorandum Reports have been written and are being sent through channels:

a. TSEPL-3-673-48-B dated 21 April 1945, subject: U. S. Navy "Pelican" Glide Bomb, SWOD (Special Weapons) Mark 7, Mod 0.

b. TSEPL-3-673-50-D dated 23 April 1945, subject: U. S. Navy "Bat" Glide Bomb, SWOD (Special Weapons) Mark 9 Mod 0.

c. TSEPL-3-673-50-C dated 21 April 1945, subject: U. S. Navy 2000-Pound "Bat" Glide Bomb, SWOD (Special Weapon) Mark 10, Mod 0.

d. TSEPL-3-673-50-B dated 21 April 1945, subject: SWOD (Special Weapon) Mark 11, Mod 0, "Kingfisher".

3. Unofficial copiesof the above reports are attached.

4. Also attached are copiesof the following Memorandum Reports:

a. EXP-M-54-673-5-W-1 dated 23 November 1942, subject: Radar Homing Bomb.

b. ENG-54-673-25-L dated 10 December 1943, subject: "Pelican".

5. There is also attached a booklet from the Bureau of Ordnance Experimental Unit, Hydraulic Building, National Bureau of Standards, Washington, D. C. titled, "(Preliminary) Notes on SWOD(Special Weapon) Mark 9 Mod. 0 and Associated Control Equipment", dated 9 March 1945, 81 pages.

6. The attached information gives the results of tests, pictures and details of the "Bat" and "Pelican" glide bombs. Also the status of the "Bat" 2000-pound glide bomb and the "Bat" torpedo glider is covered.

7. Recommendations are made in the Memorandum Reports covering the "Pelican" and "Bat" glide bombs, that a quantity of each be obtained for service tests by the Army Air Forces Board. However, it is recommended that these articles be obtained only after the Navy has completed its tests

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"Reports and Possible Trials of Navy "Bat" and "Pelican". 1st Ind.
Commanding General, Army Air Forces, Washington, D. C. Attention:
AC/ AS, M&S, Development Engineering Branch. 24 April 1945.

and evaluation is satisfactory. In the case of the "Bat", it is recommended that the Army Air Forces Board Tests be initiated only after evaluation of the results obtained in the use of this missile in the Pacific Ocean Theatre.

8. No operational comparison of the 2000-pound "Bat" glide bomb and the Army Air Forces GB-14 can be made since the Army Air Forces have dropped only one GB-14, and the Navy has dropped no 2000-pound "Bat" glide bombs. However, since both of these glide bombs employ the same homing system (SRB) as the 1000-pound "Bat", the accuracy should be approximately the same. Tests on the 1000-pound "Bat" indicate that an average of between 30% and 40% may be anticipated.

9. The use of SRB type seeker in a jet-propelled missile is contemplated in several projects now under study. It is expected that an improved design of the seeker will be required.

10. A missile carrying a torpedo and using a SRB type of seeker is under development by the U. S. Navy Bureau of Ordnance Experimental Unit. Information on the status of this project is given in Incl. 4.

FOR THE DIRECTOR:

For L Hotcher Mg Ac

VICTOR R. HAUGEN,
Colonel, Air Corps,
Chief, Aircraft Projects Section,
Service Engineering Subdivision,
Engineering Division.

7 Incls.
1. MR TSEPL-3-673-48-B,4-21.
2. MR TSEPL-3-673-50-D,4-23.
3. MR TSEPL-3-673-50-C,4-21.
4. MR TSEPL-3-673-50-B,4-24.
5. MR TSEXP-M-54-673-5-W-1,11-23-42.
6. MR TSENG-54-673-25-1,12-10-43.
7. Bklt. 3-9,(Preliminary)Notes on SWOD(Special Weapon) Mark 9 Mod.0 and Associated Control Equipment.

SECRET
AUTH: DIR., ATSC
INITIALS
DATE

CENTRAL FILES
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attached: bt

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Memorandum Report No. [illegible]
[illegible] August 1945

[illegible]

Central [illegible] Branch

Approved: [illegible]
Chief, Equipment Laboratory

[illegible]
Aircraft Projects Section, [illegible]
Equipment Laboratory, [illegible]

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THE ARMY AIR FORCES BOARD
Orlando, Florida

[redacted]
By authority of
CG AFPGC
9-20-45
Date Initials

20 September 1945

ARMY AIR FORCES BOARD PROJECT NO. 4785

OPERATIONAL AND TACTICAL SUITABILITY TEST
OF NAVY SWOD MARK 9

I. OBJECT:

To observe employment of SWOD Mark 9 (Bat) by U. S. Navy PB4Y-2 squadrons against Japanese ships, and to report technique, results, and other pertinent details to Headquarters, Army Air Forces.

II. FACTUAL DATA:

a. Description of the Equipment. SWOD Mk 9 is a radar controlled target seeking glider with a one thousand (1,000) pound bomb carried internally. The glider is eleven (11) feet six (6) inches long, has a wing span of ten (10) feet, and the fuselage is two (2) feet six (6) inches in diameter at the largest cross-section. The designed glide ratio is between 3.5 to 1 and 5.5 to 1. The SWOD Mk 2 radar system is installed in the nose of the glider to automatically track the pre-selected target and to furnish directional control signals to the glider so as to cause it to home on the target. The SWOD Mk 2 radar set is a functionally complete unit with its own transmitter and receiver. A suitable target is selected by the Bat operator, stationed in the mother aircraft, who has an auxiliary "A" scope, which displays the target signals received by the SWOD Mk2 radar. The Bat operator is aided in selecting the target by the operator of the search radar in the mother plane (AN/APS-2, in this case). Both pilot and Bat operator also have a target Left-Right, Up-Down indicator, which is operated by the SWOD Mk 2 video signals after the target has been locked. After the target has been selected, the Bat operator locks the SWOD Mk 2 tracking circuits to this target when at a range less than fifteen (15) miles. Thereafter, the SWOD Mk 2 radar set tracks the selected target exclusively. The Bat is released from the mother plane when within certain range and altitude limits, and at one hundred and eighty

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(180) knots speed or over. After the Bat is released, the radar set and the glider controls are operated on power from three (3) storage batteries carried in the glider. After release the SWOD Mk 2 radar set takes over complete control of the glider, causing it to home on the target.

b. The Army Air Forces Board furnished a liaison officer to observe use of this weapon by the U.S. Navy, as directed by letter from Headquarters, AAF, subject, "Employment of Bomb Mark 57, Project Named Bat, in Pacific Ocean Theater of Operation" dated 24 February 1945 (Inclosure A). This is the final report of the liaison officer as directed by letter from Headquarters, AAF subject "Navy Bat Project" dated 27 August 1945 (Inclosure B).

c. Bat was employed by one PB4Y-2 squadron (VPB-109) based in Palawan for a month and by this same squadron and two other PB4Y-2 squadrons (VPB-123 and VPB-124) based on Okinawa for 3 months. These three patrol bombing squadrons are the only squadrons equipped with SWOD Mk 9.

d. Data were gathered of 33 Bats expended, from records or by personal observation by the AAF liaison officer. Preliminary observations were made of training carried out by Fleet Air Wing 2 at Kaneohe Naval Air Station, Oahu, T.H.

III. CONCLUSIONS:

It is concluded that:

a. SWOD Mk9 in its present form is not suitable for combat use by the AAF.

b. SWOD Mk9 is not sufficiently accurate for use against pin-point land targets.

c. Range of the automatic tracking system is insufficient.

d. It is too difficult to pick out the exact target from among several adjacent targets on the SWOD scope.

e. Bat is satisfactory only for use against single ships or 2 or 3-ship convoys out in the open sea away from rocks and islands and other radar targets.

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IV. RECOMMENDATIONS. It is recommended that;

a. SWOD Mk9 technical and operational information be made available to the Air Technical Service Command for evaluation and use in the developmental program of Air Force pilotless aircraft.

V. DISCUSSION.

a. Construction. The SWOD Mk9 consists of a plywood air-
frame measuring 11'6" in length, 10' wing span, 2'6"
in diameter at the thickest part. Weight with 1000-pound
bomb is 1660 pounds. Inside the airframe are all the
working parts except the 2 spinners that arm the special
side-arming fuzes. Most of the components of the radar
system are mounted on a circular bulkhead in the forward
end of the airframe. The radar spinner is located in
the nose. The three 14-volt storage batteries and the
inverter are located amidships.

b. Explosive Component. The 1000-pound G.P. bomb is held in
the airframe by straps. It is entirely inclosed by
removable plywood sections of the airframe, thus making
the missile fairly clean aerodynamically. Special
fuzes are used that arm from the side by means of
connections with spinners on the under side of the air-
frame. Arming wires are attached to the rack.

c. Installation of Equipment. Modification of the PB4Y-2
(Consolidated "Privateer") to enable carrying Bat is
fairly simple. Kits are furnished and one plane can be
modified in two days or less, or about 300 man hours.
One Mark 51 Mod. 7 rack is mounted outboard of each
outboard engine. The Bat is listed by two Mk9 bomb
hoists operated on top of the wing with the cables ex-
tending down through holes in the wing. The rack installa-
tion caused aileron snatch until a small fairing was
riveted on the leading edge of the strongback on top of
the wing. The Bat operator's equipment is located on the
flight deck behind the pilot. SWOD equipment can be
mounted on almost any type of plane, and is easily removed.

d. Radar System.

(1) The radar system is the SWOD Mk2 made by Western
Electric and is a complete S-band system. Frequency
is 3000 Mcs. A strong pulse of radio frequency
energy, with a duration of 0.75 microsecond, is
transmitted every 500 microseconds from a rapidly
revolving paraboloidal reflector (spinner) and a

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fixed dipole antenna. The resulting conical beam illuminates the target area. Any target within this area reflects a small portion of the original radiated energy. This reflected energy is received by the reflector and antenna just mentioned and is then directed into the radar receiver circuits. The resulting video signals are displayed on a Type A oscillo-scope with horizontal sweeps of 10 and 25 miles. This oscilloscope is located at the Bat operator's position.

(2) After a suitable target has been selected by observing the scope (and by coordination with the search radar operator), the control switches and knobs are manipulated so as to cause the radar equipment to track the selected target. A movable 0.75 microsecond "time gate" is adjusted until it coincides (in terms of time delay after the transmitter pulse) with the target echo. The circuit is then switched to a condition which causes it to track the target automatically. The gated video signal is used to actuate the directional control elements and also to energize a directional indicator which tells whether the target is above, below, right, or left of the axis of the radar antenna system. This indicator is the same one used in blind landing to establish course and glide angle. There is one installed for the SWOD operator and one on the pilot's instrument panel.

(3) The Automatic Volume Control (AVC) system controls the receiver sensitivity in accordance with the signal strength of the pip selected with the step. As the range closes and the target echo increases in strength, the receiver sensitivity is decreased to prevent the target echo pip from reaching the saturation level of the receiver. AVC concentrates the receiver on the target pip on which the Bat is locked, and prevents changing to another target.

(4) Maximum range of the equipment when searching is 25 miles. Locking on a target can be accomplished at about 15 miles under very good conditions. However, it usually cannot be done at more than 12 or 13 miles. Fifteen miles is the present maximum range of the automatic tracking system. Small targets do not reflect a signal of sufficient strength for locking at long range.

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[redacted]

e. Power System. After being released by the operator by means of an electric switch, the Bat operates from its own storage battery system, and homes on the target. Two 14V batteries furnish power for the radar, and the other 14V battery operates the control servos. Although duration of flight is only a very few minutes, the batteries are capable of operating the equipment continuously for 15 - 30 minutes, depending upon battery condition and temperature.

f. Design of the missile is such that the glide ratio (slant range to altitude) must be between 3 1/2 and 5 1/2 to 1. For example, on an operation flown at one mile altitude, release must be made between 3 1/2 and 5 1/2 miles slant range. The control scope is provided with a simple computor which enables the operator to determine when the glide ratio is within the allowable limits.

g. This equipment is designed to operate at temperatures between -40°F and /131°F (-40°C and 55°C), and to withstand any relative humidity up to 95 per cent, and any atmospheric pressure from sea level to 30,000 feet. A dehydrating unit (silica-gel) is installed to take excess moisture from air entering the radar compartment. This was suitable during good weather, but was not sufficient for the very rainy conditions encountered. Best dropping speed is about 180 knots. A search radar (AN/APS-2 in this case) is used in conjunction with the Bat radar in picking out targets.

h. Results. (See Inclosure C).

(1) Thirty-three Bats were expended during the period 1 April 1945 - 15 July 1945. The results were as follows:

Hits	4
Near misses	4
Misses	7
Failures	3
Jettisoned	14
Unobserved	1
Total Expended	33
% hits	12.1%

Of the 4 hits, only 1 was on the desired target--on May 27, a direct hit blew off the bow of a destroyer which later sank. The other three hits were obtained on small ships during attempts to hit a large ship. One release was observed while at Kaneohe. One Bat was released from 4000 feet and it hit 20 feet short

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of the target (a 6' x 6' corner reflector mounted on a sea sled).

It should be noted that almost half the missiles expended were jettisoned. Engine trouble and gasoline shortage were the two main reasons for this.

(2) The discouraging results were due to several reasons:

(a) Failure of Bat mechanism in flight, either before or after release.

(b) Jettisoning due to engine trouble or fuel shortage.

(c) Difficulty in picking out desired target pip (on Bat scope) on which to lock the automatic tracking system.

(d) Short range of automatic tracking system. Maximum is 15 miles, normal is about [illegible]

(e) Failure of search radar -- target is picked first by this set, and the operator then helps the Bat operator identify it on the Bat scope.

(f) Maintenance of Bat units was hampered, at [illegible] intervals, by excessive temperature and humidity, mud, dust, fungus, and a lack of spare parts.

(g) Low availability of airplanes.

(h) Some Bats were damaged while being flown to the forward area. (If they had not been flown, there probably would not have been any Bats available until too late to be of value.

(i) Lack of suitable targets.

(j) Range Coordinator. A device known as a "range coordinator" was developed in an effort to solve the problem of picking out the right target pip on the SMCD scope. The radar operator sets an indicator on his scope to mark the pip from the desired target. The Bat operator then presses a button on his panel, causing a downward pip to appear on the Bat scope opposite the pip of the desired target. This device has

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[illegible]

ROBERT W. WALKER, Jr.
1st Lt., Air Corps,
Recorder.

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AFDMA-2C/VSR/sjr/6901

HEADQUARTERS ARMY AIR FORCES
Office, Asst. Chief of Air Staff, Materiel & Services

Inter-Desk Memorandum

MEMORANDUM FOR COLONEL FRED. R. DENT, Jr. DATE 28 Jul 45

SUBJECT: Status of Development of Control Systems for Guided Missiles

1. The attached ITM by Major Lambert is a good factual report on the status of development of guided missiles guiding systems. It should be noted, however, that there are several gaps in the program. Further, this section does not concur with the recommendations of 6a and 6b.

2. The more serious gaps are as follows:

a. Nothing is being done for AA and other short range guided missiles. Recent trials of the Navy "Little Joe" (anti-Baka) missile have confirmed previous opinions that optical control of AA guided missiles is impossible, due to smoke, errors in range estimation and speed of closing, and other human factors.

b. Nothing is being done for air-to-air missiles. This can probably be done by modifications to some of our existing airborne radars, both for bomber and fighter launched missiles.

c. Very long range work is now confined to the Carnegie Institution Magnetic System. This is not an adequate solution, because of its limited accuracy, and the restriction of its use to certain areas of the earth's surface. ATSC has dismissed Loran and other long range radio systems as costly, cumbersome, and subject to error, but regardless of such disadvantages, it is believed that these systems offer some real promise. They are, at least, better than nothing, and should be developed regardless of difficulty. Astronomical, gyroscopic, and other navigational systems have not been adequately investigated.

d. Satisfactory target seekers are not available. The history of development of this item has been one of dropping developments when they ran into difficulty. Heat seekers and television are in the best status at present but the fact still remains that <u>satisfactory target seekers are not available.</u>

e. Countermeasures should be more seriously considered. This problem is admittedly difficult, as is the seeker problem, but this does not reduce the need for jam-proof control systems. The German wire control system has been studied and dismissed by ATSC as not applicable to AAF missiles. In addition to jam-proofing American equipment, the fact that other countries are taking an active interest in the development of

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offensive guided missiles makes necessary a comprehensive program of defensive countermeasures against enemy guided missiles.

3. Pointing out the gaps in the program to ATSC is not enough in itself; there are a number of ways of attacking the problem that should be suggested:

a. Drive home to ATSC the philosophy of intensifying and redoubling effort, rather than losing interest and tapering off work when serious obstacles arise.

b. Get more young and fresh minds to thinking and working on the tougher problems, such as seekers and accurate long range navigation. This can probably be done only by an extended missionary campaign among universities and colleges.

c. A thorough survey of the whole field in the presence and with the help of a group of competent contractors, engineers and representatives as a means of getting a comprehensive program established and arousing contractor interest.

d. Increasing personnel, facilities, and priorities assigned to the guided missiles program. This is, of course, a perennial war cry, and the problem, except for priorities, may be best attacked by more indirect means.

4. Most of the remarks of paragraph 3 apply alike to the control projects and to the guided missiles program as a whole. It is believed that the control equipment program is generally in better condition than the remainder of the guided missiles program.

1 Incl
Memo fr. Maj Lambert 14 Jul 45

V. A. STACE
Lt Colonel, Air Corps

[redacted]

CONFIDENTIAL

Gen. Gardner/ss/4544

3 July 1944

MEMORANDUM FOR SECRETARY OF WAR FOR AIR - MR. LOVETT AND
COMMANDING GENERAL, ARMY AIR FORCES - GENERAL ARNOLD

SUBJECT: Procedure Decided on This Afternoon to Expedite the Production of German Pilotless Aircraft

1. Will arrange a teletype conference with personnel in theater to make sure they understand our requirements for information.

2. Dr. Bowles will direct either Dr. Ridenour or Dr. Fraenckel to return immediately with maximum amount of information, including sketches and, if possible, pieces of light equipment such as instruments, etc.

3. Dr. Bowles will direct either Dr. Fraenckel or Dr. Ridenour (the one who does not return immediately) to return with drawings as soon as they are completed in England.

4. Dr. Bowles will request his representative, on Gen. Eisenhower's staff, to take action to have the best available missile recovered to date shipped to us immediately.

5. AC/AS, MM&D (Col. Phillips) will select a manufacturer and arrange to have his representative sent to England immediately to get engineering information on the ground.

6. Competent manufacturer will be directed to make ten (10) exact copies of German missile and if future study indicates that it is desirable, ten (10) additional will be made incorporating parts of German missile combined with one (1) of our own glide bombs.

7. Staff study now being presented by MM&D recommending increase in Materiel Command Special Weapons Unit should be approved in order to insure parallel project problems under development in this Country be expedited.

8. In as far as the production of these aircraft is concerned, the project must not be classified higher than "Restricted."

/s/
GRANDISON GARDNER, BRIG. GEN., U.S.A.
Commanding General,
Proving Ground Command.

copy

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INTER-OFFICE MEMORANDUM
ARMY AIR FORCES
MATERIEL CENTER
Office of The Commanding General

SECRET

P. B. Smith WIM:50
Ext. 23230

Wright Field, Dayton, Ohio
Date 12 July 44

SECRET

TO: Deputy Chief of Staff
Att: Technical Executive

SUBJECT: Request for CTI on Development of Jet Bomb.

1. In compliance with M.C. Regulation No. 80-2, it is requested that appropriate technical instructions be issued to formalize the verbal directive as given by the Commanding General, Materiel Command, to the Chief, Engineering Division on 4 July 1944, with regard to the development of a special jet bomb.

2. Based on the information obtained during conferences with the Commanding General on 4 and 5 July 1944, it is suggested that the technical instruction be issued substantially in accordance with the following.

a. Problem Presented. To develop and procure at least (13) special jet propelled bombs, including (2) ground launching sets. These bombs shall be in the form of expendable aircraft capable of being launched from the ground [illegible] to remote targets by pre-setting of control elements.

b. Factual Data. The jet bomb shall have a high speed of from [illegible] to [illegible] mph at a flight altitude of 2000 to 5000 feet and shall carry an explosive load of approximately [illegible] pounds for a distance of approximately 200 miles.

The bomb or bombs employed shall be of standard design.

At least one of the jet bombs shall be arranged for carrying a pilot to permit the necessary checks on flight and control characteristics.

Design features, materials and processes involved in the construction of these jet bombs shall be such as to lend themselves to easy and rapid production.

c. Authority. Commanding General, Materiel Command, ~~by~~ verbal directive of 4 July 1944.

d. Action Desired. That the Engineering Division proceed immediately under high priority with the development of jet propelled bombs as set forth in general terms in 1 and 2 above.

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CENTRAL FILES

Deputy Chief of Staff
Request for CTI on Development Of Jet Bomb
12 July 1944 The subject [redacted]

This development comprises only one phase of the general project of expendable aircraft. Detail instruction on other phases will be included in subsequent and appropriate amendments to these instructions.

Although this project concerns primarily guided missiles, there are a considerable number of items involved that require close coordination and proper timing within the Engineering Division and the suggestion is made that the project be monitored by the Technical Staff of the Engineering Division.

The project should be classified as "Secret."

2. It is requested that a CTI based on the above be issued immediately so that all concerned will be aware of the authority and high priority for this project.

F. O. Carroll
F. O. CARROLL,
Brig. General, U.S.A.
Chief, Engineering Division.

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[illegible]
Wright Field, Dayton, Ohio.
15 July 1944

SECRET

AUTH: [illegible], Mat. Command
DATE: 15 July 1944
INIT: [illegible]

[illegible]-1731

Development [illegible] Jet Propelled Bomb

[illegible] 1944

1. Problem Presented:

a. To develop and procure at least thirteen (13) special jet propelled bombs, including two (2) ground launching sets. These bombs shall be in the form of expendable aircraft capable of being launched from the ground and directed to remote targets by [illegible] of control elements.

2. Actual Data:

a. The jet bomb shall have a high speed of from 450 to 500 mph at a flight altitude of 2000 to 5000 feet and shall carry an explosive load of approximately 4000 pounds for a distance of approximately 200 miles; the bomb or bombs employed shall be of standard design; at least one of the jet bombs shall be arranged for carrying a pilot to permit the necessary checks on flight and control characteristics; design features, materials and processes involved in the construction of these jet bombs shall be such as to lend themselves to easy and rapid production.

3. Authority:

a. Commanding General, Materiel Command.

[illegible]
4 July 1944

4. Action Desired:

a. That the Engineering Division proceed immediately under high priority with the development of jet propelled bombs as set forth above.

b. The subject development comprises only one phase of the general project of expendable aircraft. Detail instruction on other phases will be included in subsequent and appropriate amendments to these instructions.

By Command of Major General MEYERS:

T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

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cc: Production Division
Air Service Command (1)
CENTRAL FILES

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[redacted] Colonel [illegible] /mc/71406 - AF[illegible]/M

5 November 1944

MEMORANDUM FOR [illegible], Chief, Requirements Division.

Subject: Guided Missiles.

1. On 2 November 1944, a meeting was held between [illegible], and other interested parties for the purpose of reviewing all projects concerning guided missiles and the associated equipment.

2. At the conclusion of this meeting, I was impressed with the large number of projects and the vast amount of engineering necessary to carry along such a program. It seems evident that we have spread our talents too thin and now is probably the time to carefully survey this whole picture in an effort to focus all attention on those projects which have the promise of being valuable tactical weapons during the present war. I feel that we can at this time survey these projects very carefully and arrive at a reduced list which will constitute those weapons to be used in the present war. If we can do this and if we can cause an agreement to be reached by all interested parties we will relieve ourselves of a tremendous engineering load which is now being carried by the Air Technical Service Command, [illegible], and our various testing agencies. That development which of necessity must be continually carried upon in order to improve "the art" can still be carried on by the Air Technical Service Command under the provisions of AR 850-25.

3. I am attaching a brief summary of the various controlled missile projects (Tab A). Tab B is a tabulation listing by type, name, size, priority, classification, quantity on hand, and requirements stated. This list has thirteen (13) projects marked with an asterisk. These projects are shown in Tab C by name, type, and method of control. This list constitutes what I believe to be those projects on which we should focus our attention and effort. It is also important that we arrive at a statement of our requirements for these weapons at the earliest moment possible.

4. The use of special missiles usually involves an extensive selling program in order to convince the "using service" that the special missile is worth the time, trouble and training effort required in its employment. It follows that those special missiles requiring a minimum of such additional effort in their employment will be more readily received by the "using service". This automatically makes the VB type of missile, which can be carried internally, an easy article to "sell," as well as a more versatile weapon. The minimum angle type VB missiles must be carried externally, a feature which detracts somewhat from their use. The gliders in turn must be carried externally and require considerable modification to the carrying aircraft. This means that additional effort, time and men must be devoted to the preparation of a mission utilizing such special weapons. This feature detracts from the usefulness and versatility of such weapons.

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Lee. Sec, ACO

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5. In view of the above remarks it becomes apparent that other factors must be considéred in the evaluation of guided missiles such as the degree of accuracy achieved in comparison with standard weapons and the degree of safety or the protection achieved by the dropping aircraft when employing the various types of missiles. Considering these two points in turn we find that it is now possible to achieve extreme accuracy with VB's homing on infra-red or heat sources and brillant light sources such as flares. The visually controlled VB's are subject to limitations of all line-of-sight devices. The same limitations apply to the GB's. When we consider the protection offered to the dropping aircraft, we then must give first place to the GB type missile which can be dropped from a point out of range of the anti-aircraft defending the particular target under attack.

6. To summarise, when considering those missiles dropped from aircraft, it appears that first order of importance should be given to VB-6, VB-5, VB-11, GB-6A and GB-5D with the second order of importance being VB-3, VB-4, VB-12 and VB-8 in order of desirability from an operational viewpoint (maintenance, loading, additional time consumed, etc.).

7. It is felt that the XBQ-3 should be fully explored for the benefits which might be derived from such information. The BQ-7 and BQ-8 will fulfill all our needs for this type of missile. In the preset type of missile, it is felt that JB-2 should be considered to the exclusion of the JB-1. This decision is based upon the fact that the JB-1 is an expensive article constructed to aircraft standards and it is felt that even though the range is not as great, the JB-2 can accomplish the same missions as could be accomplished by the JB-1. There is always the possibility of remotely controlling the JB-2 in which case we would have an inexpensive controlled missile possessing considerable striking power. Such missiles in combination with the use of BQ-7 and BQ-8 will form our "all weather" Air Force.

8. This reduced list of controlled missiles has been informally discussed with Colonel Wilson, who feels that such a step would be very much in the right direction and would free engineering effort so that we can immediately apply this effort towards the increased development and earlier production of those items on this list, and in addition, it would allow the application of certain amount of effort on those missiles which must be developed in order to meet the presently approved military characteristics for ground to air, air to air, and ground to ground guided missiles.

CLARE W. BUNCH,
Colonel, Air Corps

Incls
Tab A
Tab B
Tab C

[redacted]

MDAC-5-WF-3-5-42-500M [redacted]

LT.Col.C.D.Seftenberg,
CDS:ru:HCP
2-1214

TELETYPE MESSAGE

PRIORITY

DATE 31 JULY 1944

FROM
CHESTER D. SEFTENBERG,
Lt.Col., Air Corps,
Technical Executive,
Office, Deputy Chief of Staf:

ATTENTION: ASST. CHIEF OF AIR STAFF,
MATERIEL & SERVICE,
WASHINGTON, D. C.

M/ 543

ATT: MAJOR GENERAL O. P. ECHOLS.

EXP-722.....IN ACCORDANCE WITH YOUR TELEPHONE CONVERSATION WITH ME, YOU ARE INFORMED THAT MATERIEL COMMAND WAS VERBALLY DIRECTED BY GENERAL MEYERS, DEPUTY DIRECTOR, M & S TO PURCHASE ONE THOUSAND PRODUCTION ARTICLES. NEGOTIATIONS WITH CONTRACTORS WERE HAD AND A FOR P's WERE INITIATED BY MATERIEL COMMAND. THESE ARE NOW BEING HELD UP BY MATERIEL COMMAND BUDGET OFFICER BECAUSE HE WAS SPECIFICALLY INFORMED BY GENERAL MILLER, AAF BUDGET OFFICER THAT ONLY FIFTY EXPERIMENTAL ARTICLES HAD BEEN AUTHORIZED AND THAT NO FUNDS HAD BEEN MADE AVAILABLE FOR PRODUCTION QUANTITY. WE ARE NOW STYMIED IN ACCOMPLISHING GENERAL MEYERS' DIRECTIVE UNTIL DIRECTIVE AUTHORIZATION TO GENERAL MILLERS' OFFICE IS ISSUED BY HIGHER AUTHORITY. WE ARE INFORMED THAT GENERAL MEYERS PERSONALLY TELEPHONED GENERAL MILLER 29 JULY SO HE IS FAMILIAR WITH THIS MATTER. IN MEANTIME WE ARE CONTINUING INFORMAL NEGOTIATIONS WITH CONTRACTORS PENDING RELEASE OF FUNDS TO ENABLE THE COMPLETION OF FORMAL CONTRACTS, BUT SETTLEMENT OF THIS MATTER IS IMPERATIVE IF THIS PROJECT IS TO BE ACCOMPLISHED EXPEDITIOUSLY. REQUEST YOUR ASSISTANCE IN OBTAINING NECESSARY RELEASE OF FUNDS. END AFAMC

WOLFE - MATERIEL COMMAND.

cc: Col. Sims
Gen. Wolfe.

[redacted]

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ASHE C. G., AAF
Materiel Center
10 Aug 44
ENW

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FHW:ear:HGP
Wright Field, Dayt.
7 August 1944

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CTI-1802

Procurement of Rocket Bomb (JB-2) MX544

Production Division

MX-544

1. Problem Presented:

a. The Office of the Assistant Chief of Air Staff, Materiel and Services, has directed that action be taken by Materiel Command to procure one thousand jet bombs (JB-2), a suitable number of launching devices and other applicable items of equipment for the testing and use of the one thousand (JB-2) equipments.

2. Factual Data:

a. Reference is made to teletype WAR 73833, dated 1 August 1944 which authorized the expenditure of funds for these items of equipment and which was delivered to the Materiel Command Budget Fiscal Officer.

b. These technical instructions confirm action already taken by the Production Division and the Engineering Division in procuring one thousand (JB-2) equipments plus an additional five hundred spare engines.

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3. Authority:

a. Commanding General, Army Air Forces by teletypes WAR 73833, dated 1 August 1944 and (AFDMA-1) WAR 76944, dated 7 August 1944, from Chief, Materiel Division, Office, Assistant Chief of Air Staff.

4. Action Desired:

a. That the Production Division take immediate action to procure one thousand (JB-2) equipments, plus an additional five hundred spare engines, a suitable number of launching devices and any other applicable items of equipment for the testing and use of the one thousand jet bombs.

Classification changed
Of change [redacted]
AUTH
BY

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[illegible]
Wright Field, Dayton, Ohio
7 August 1944

STI-[illegible]

Procurement of Rocket Bomb ([illegible]) [illegible]

Production Division

b. That the Engineering Division furnish to the Production Division, engineering data, drawings, specifications, etc., that are necessary for the procurement of the [illegible] of equipment listed in paragraph 1a above.

c. That the Engineering Division [illegible] responsibility for the development and testing of the [illegible] equipments.

d. [illegible] project [illegible] in these technical [illegible] is assigned [illegible] 1 [illegible].

By Command of Brigadier General [illegible]:

[illegible]
Colonel, Air Corps
Assistant Technical Executive

cc: Engineering Division
Inspection Division
Air Service Command
Aircraft Ordnance Section

COM. GEN.
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AFHAQ
Colonel Giffin/ek/4027
Written 21 Aug 44

COPY

Date

SUBJECT: Pilotless Aircraft--Method of Employment, Organization and Training

TO: President, Army Air Forces Board, Orlando, Florida

1. One thousand (1,000) pilotless aircraft, similar to the German robot bomb recently initiated against the London area, are now under development and production by the Materiel Command. It is essential that determination of the method of employment, the organization required for their operation, and the type of training required be determined coincident with the development of the munition itself.

2. It is desired that the Army Air Forces Board undertake as a second priority Board Project the determination of the method of employment, the type of organization required, and the extent of training necessary to place the pilotless aircraft in operational use. At the same time, it is desired that the Board undertake to develop and man a pilotless aircraft demonstration unit capable, should the occasion arise, of introducing this weapon into operational use in Europe.

3. For your information, this Headquarters considers that the necessity for utilizing this weapon in its present state of development will be unlikely, except as a means of obtaining experience for future applications. There has been an exchange of cables between this Headquarters and that of General Spaatz, gist of which is as follows:

General Spaatz and General Eaker early in July could foresee no immediate requirement for the use of pilotless aircraft. This Headquarters, having initiated procurement of 1,000 Chinese copies of the German pilotless aircraft and feeling that an opportunity might present itself for their use on the Continent (if only to gain experience for future reference), requested the comments of General Spaatz apropos the proposal to utilize these weapons on the Continent as soon as possible. Suggestion was made that, in such a case, a demonstration unit would be supplied the Theater but that Theater means should be utilized for placing the weapon in use. General Spaatz in reply stated only that the rapidity with which the war is going coupled with our air superiority makes it unlikely that suitable opportunities will arise for the use of pilotless aircraft unless a stiff German stand brings about a stabilized ground situation in which German industrial targets are within range of pilotless aircraft. In answering this radio, we are informing General Spaatz that a second priority Board Project is being established as stated above.

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4. The close contact established between General Gardner and the [illegible] on the pilotless aircraft project should assure that you obtain pilotless aircraft for experiment and test at the earliest date which may prove practicable.

5. The Secret Directive issued to the President, AAF Board under date of [illegible], 1944, subject: "Development of Pilotless Aircraft," is [illegible] to corresponding classification and priority.

By command of General ARNOLD:

/s/ H. A. CRAIG
H. A. Craig
Major General, U. S. Army
Asst. Chief of Air Staff
Operations, Commitments & Requirements

[redacted]

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND
OFFICE, CHIEF OF ENGINEERING AND PROCUREMENT

Maj. B. W. W. Zingg:
amo:/C-10 2-7203

Inter-Office Memorandum

Wright Field, Ohio
7 September 1944

TO: Deputy Director
Air Technical Service Command

SUBJECT: Status Report on JB-2 Robot Bomb and Launching Accessories

MX-544

1. In compliance with your request of the progress being made on the robot bomb program the following summary is herewith presented.

2. The schedule for the complete robot bomb has been established at:

1	September	1
30	September	24
	October	100
	November	200
	December	200
	January	200
	February	200
31	March	75
		1000

Classification cancelled or changed to

Letter of contract #33-038 ac-4480 was given to Republic Aviation Corporation, Farmingdale, L. I., New York, 2 August 1944. The first article is being assembled for initial inspection this week. This inspection is scheduled to be completed by Friday, 8 September.

3. The Ford Company was awarded letter contract #33-038 ac-4483 2 August 1944. The first engine was delivered the middle of August to Wright Field and tests have been conducted. Trouble has been experienced with fuel carburetion. However progress has been made on this difficulty which will assure satisfactory performance for initial launching tests. The delivery schedules, including 10% spares, will conform with the air-frame schedule as presented in the preceding paragraph.

4. Jack & Heinz Company is progressing satisfactorily on the control assemblies including gyro assemblies, magnetic compass, servos, barometric altitude control, plumbing, and other minor accessories. Letter contract #33-038 ac-4482 was awarded 2 August, and negotiations have been completed with the Jack & Heinz Company, and recommendation for formal contract was made 19 August.

5. The pressure vessels are being manufactured by the Alloy Products Co., Waukesha, Wisconsin, on letter contract #33-038 ac-4484 dated 2 August. At the present time this is the only component required which

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may not be available for installation at Republic to meet the airframe schedule in September. These vessels are constructed of special alloy steel which is available only from the Great Lakes Steel Company. Enough sheet stock was initially supplied from stock for September requirements, but because of difficulties encountered in the drawing process owing to inclusions, laps, and other irregularities in the sheet stock, the first bottles drawn were unsatisfactory. Great Lakes Steel requires approximately five weeks to process this special alloy steel. However allocation is being made from steel now in process, and it is expected that this will be available to Alloy Products Company for processing by 18 September.

6. The pressure regulators being supplied by the Air Reduction Sales Corporation on letter contract #33-038-ac-4701 dated 12 September will be available to meet the airframe schedule.

7. The launching rocket appears at this moment to be the limiting factor if production should be immediately accelerated. However, sufficient quantities will be available for the testing program and the following delivery schedule is promised: 2 in September, 25 in October, and 40 per month thereafter. These rockets are being obtained through the NDRC from the Monsanto Chemical Company, Dayton, Ohio. Confirmation has been obtained from AC/AS, M & S, that 40 per month is considered sufficient at the present time, and if at a later date additional facilities might be required that such facilities are not to be provided by this Command but rather will be handled by the Ordnance Department.

"Tiny Tim" rockets, which are similar to the Monsanto type are now being obtained as rejects from Navy orders and will be available at Muroc on the 10th of September. This rocket is to be used only for testing the launching car and will not be used for launching the robot bomb.

8. Northrop Aircraft Corporation will deliver two launching cars 10 September, one each to Muroc and Eglin Fields. Six additional cars are now being fabricated by Northrop. Since it is anticipated that the launching cars may be used for only one launching, Mr. Jack Northrop has been instructed this date to continue building the launching car at the rate of 40 per month. The design for adapting the initial car to a production of this quantity is now being checked. Upon determination of these details procurement will be initiated with Northrop Aircraft Corporation for the additional quantities required.

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Deputy Director, ATSC
Status Report on JB-2 Robot Bomb
7 September 1944

9. Launching sites.

a. At this date the grading has been nearly completed at Eglin Field and concrete is being poured on the 10% grade inclined runway, and the track is being laid on the level runway. It is anticipated these runways will be completed by the latter part of the coming week. The hutments and shop facilities are also being constructed.

b. Contact with Muroc representatives advises that the track will be completed 12 September and the testing of the launching car will be initiated 15 September.

10. Two dummy warheads will be delivered to Republic this week by the Ordnance Department, and the remaining 23 will be delivered prior to the 30th of September.

11. The installation of the detonators supplied by the Ordnance Department is being studied at the Republic plant this week. This item is used to sever all the control and functioning mechanisms and for locking the control surfaces to throw the robot into a dive position. No difficulties are expected on the supply of this item.

12. Arming details in connection with the fusing of the warhead are likewise being worked out by Ordnance representatives at Republic this week.

13. It is planned to furnish radio transmitter AN/ART-19 for each of the first 100 bombs for tracking purposes. Ten percent has been established as satisfactory for the remaining 900 bombs. 335 sets have been procured from John Mack Industries, Plymouth, Indiana, by the Signal Corps, and will be delivered at the following rate:

10 . . . . . September	100 . . . . . November
75 . . . . . October	150 . . . . . December

14. Although the initial robot bomb will be available 15 September at Eglin Field, it is planned to withhold the firing tests until a total of six bombs are available at that Field, which it is expected will be the last week in September.

J. M. GILLESPIE
Colonel, Air Corps
Deputy Chief,
Engineering and Procurement

cc: Prod. Eng. Sect., Lt. Col. E. J. Gujer
Res. Con. Sect., Col. K. P. Royce
Eng. Divn., Col. M. S. Roth
Gen. O. R. Cook
Col. J. M. Gillespie

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MDAC-301-B

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ADDRESS REPLY & ENVELOPE TO
DISTRICT SUPERVISOR
ATTENTION: Production
Resources Section

AIR TECHNICAL SERVICE COMMAND
ARMY AIR FORCES
EASTERN PROCUREMENT DISTRICT
67 BROAD ST., NEW YORK 4, N. Y.

J.A.Burden,Maj.,A.C.:las
Production Resources Off.

23 September, 1944

Subject: Republic Aviation Corporation
Farmingdale, Long Island, N. Y.
Project MX-544

To: Chief of Engineering and Procurement
Air Technical Service Command
Wright Field, Dayton, Ohio
Att.: Dept. TSBPR3H

1. With further reference to teletype from your office, Ref.: PES-4426, dated 21 September and teletype from this office, Ref.: NYPRS-694-JAB, dated 22 September, a meeting was held at the plant of the Republic Aviation Corporation, Farmingdale, L. I., N. Y., at which there were present a representative of this office, the AAF Resident Representative, Mr. Hart Miller, Vice-President and Works Manager and Mr. Hans Lasker of subject company.

2. In confirmation of production schedule on subject units as noted in reference wire, namely:

September	-	25
October	-	100
November	-	200
December	-	300
January	-	450
February	-	600
March	-	800
April	-	1000
May	-	1400
June	-	1900
July	-	2500
August	-	3500
September	-	5000

subject company's representatives submitted the following statement of sources to be utilized in this production:

Months	Republic Aviation	Willys Overland Company: Now Under Contract	Willys Overland Company: Have Available Space and Equipment for Schedule Listed Below	Existing Facilities to be Located or Space & Equip. to be Provided With Gov't. Funds for Production Listed Below	Totals
Sept.	25				25
Oct.	50	250	50		50
Nov.		200	200		200
Dec.		200	300		300
Jan.		200	450		450
Feb.		200	600		600
March		75	800		800
April			1000		1000
May			1000	400	1400

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no action

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Months	Republic Aviation	Willys Overland Company Now Under Contract	Willys Overland Company Have Available Space and Equipment for Schedule Listed Below	Existing Facilities to be Located or Space & Equip. to be Provided With Gov't. Funds for Production Listed Below	Totals
June			1000	900	1900
July			1000	1500	2500
August			1000	2500	3500
Sept.			1000	4000	5000

3. Subject company's representatives confirmed above schedules provided:

a. That letter contract for additional units and authority to accelerate schedules is received immediately.

b. That all necessary GFE items are received at least thirty days in advance. This includes the power unit which is being supplied by Ford Motor Car Company.

c. That the AAF will sponsor government financed facilities to meet the increased schedule after May, 1944 if existing facilities having the necessary equipment cannot be located.

4. Representatives further advised that the September schedule of 25 will not be met on account of the fact that only one set of GFE items had been received by 22 September. One unit will be shipped on 23 September and approximately 14 units can be shipped during the remainder of the month provided all GFE items are received in time. No list of required GFE items has yet been received.

5. The representative from this office was informed that subject company has only received a letter contract for 1000 units and that at the time the contract was received Republic advised Procurement Section, ATSC, that with the exception of a few initial hand made units, Republic had no available space or facilities to accomplish the contract and that the entire amount would have to be subcontracted. Although schedule on P-47 plane is reduced to 250 per month from February, 1944 on, requirements on the P-72, P-47N and the XF-12 will absorb all productive equipment and space available. In spite of this condition, the contract was placed with Republic as it was the desire of the Procurement Div. that the responsibility for production be placed on Republic.

6. Subject company's representatives advised that they have not been informed of the desire of the AAF for an increased number of units nor an accelerated schedule and that if they are so directed immediately it is quite possible that the schedules noted above can be improved, as up to this date Republic has made no effort to find additional sources. For instance, Republic Aviation Corporation's plant at Evansville has available from 50,000 to 75,000 sq. ft. and probably sufficient equipment to reach a schedule of 200 per month.

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7. The following estimates were submitted by Mr. Lasker in reply to a request for total amount of space and equipment required to meet a production schedule of 5000 per month; 1000 per month; and 200 per month:

a. 5000 Per Month

Final sub-assembly and assembly areas	75,000 sq.ft.
Packing and shipping	25,000 " "
Storage for complete assemblies	25,000 " "
Equipment, parts manufacturing and bench area	50,000 " "
Total Space Required	175,000 sq.ft.
New Equipment, including presses, monorails, spot-welding, etc.	$ 635,000.00
Tooling	$ 2,500,000.00

b. 1000 Per Month

Space Required	100,000 sq.ft.
New Equipment	$ 450,000.00
Tooling	$1,750,000.00

c. 200 Per Month

Space Required	50,000 sq.ft.
New Equipment	$ 150,000.00
Tooling	$1,000,000.00

8. Request information whether any further action is desired by this office.

For the District Supervisor:

James A. Burden
JAMES A. BURDEN
Major, Air Corps
Production Resources Officer

cc:Lt.Col.Hajek
Capt.Wessoleck

Speech delivered by Lt. D. A. Craven, Project Engineer on JB-2 Launching, before the American Society of Mechanical Engineers, in New York City, 2 April 1946.

JB-2 ROBOT BOMB

During the past five years we have seen a vast improvement and advancement in aviation. We have seen the development of planes and winged missiles capable of attaining supersonic speeds, ranges varying as high as 3 to 4 thousand miles, and altitudes into the stratosphere some sixty miles high. We have seen the vast destructive power of atomic bombs; therefore, we can look to the future - to the near future - to see further advancements in the field of rocket propulsion and jet propulsion.

A nucleus to this field and one of the first successful types of powered guided missiles is the V-1 German Buzz Bomb also known as the JB-2 Pilotless Robot Bomb. In July 1944 the Air Technical Service Command at Wright Field undertook this project of copying and improving the features of the German missile, and the first bomb was in the air at Eglin Field, Florida, on 12 October 1944.

Many problems were encountered with the control unit, the jet intermittent engine, the explosives, and the launching procedure, because very little data were available.

This version of the American jet propelled bomb was developed into a successful missile by the engineering efforts of the personnel of the Engineering Division at Wright Field, and Ordnance Department, and the Corps of Engineers. Difficult problems were presented and were undertaken by many industries to aid in the development and to add to the accuracy of the missile. These included structure and airframe problems by Republic Aviation Corporation; the jet intermittent engine and fuel metering unit by Ford Motor Company; the auto pilot, servo motors, and gyro operating compass by Jack and Heintz, Inc.; and the launching problems by Babcock and Wilcox

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Company, Monsanto Chemical Company, Northrop Aviation, and General Tire and Rubber Company.

JB-2 BOMB

The JB-2 bomb is a pilotless, jet-propelled, midwing monoplane lacking ailerons but incorporating conventional fin, rudder, stabilizers, and elevators. The general characteristics and performance data include the following:

1.	Gross weight	5[illegible]5 pounds
2.	Wing area	55.7 square feet
3.	Wing loading	[illegible] pounds per square inch
4.	Span	17 ft. 8-1/2 in.
5.	Length	27 ft. 1-1/16 in.
6.	Maximum rate of climb	1500 ft. per min.
7.	Maximum speed at 200 ft.	[illegible] mph
8.	Service ceiling	[illegible] feet
9.	Range	150 miles

The nose section of the bomb is divided into two parts for convenience of servicing. The air log is located on the forward end, and is used to pre-set the range. It measures the air miles traveled and sends electric impulses to the vector-root counter at intervals of 15 revolutions of the blade. Each air log is calibrated to give approximately thirty counts per mile; so if the predetermined range for the bomb is 100 miles, then the vector-root counter is set at 3000. As the impulses are sent to the counter, the numbers subtract, and when the dial reads 9999 then the dive-in mechanism starts to function.

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The magnetic compass assembly is located to the rear of the air log, and it is sensitive to deviations of the bomb from pre-set true compass headings. A turn can be pre-set in the course of the bomb by rotating the compass, and [illegible] of the turn is approximately 3 to 4 degrees per minute.

The next section is the warhead which carries approximately [illegible] pounds of explosives. Several types of detonators and switches have been tested [illegible], and these included external vanes to [illegible] electrically, inertia switches, and contact switches. [illegible] that were tested at Eglin Field, Florida, contained [illegible] of TNT in the warhead section. The bomb [illegible] internal [illegible]. It was completely successful.

Aft of the warhead section is a [illegible] gallon pressurized fuel tank and two spherical bottles for storage of compressed air. The initial pressure of these bottles is [illegible] pounds per square inch and the air is regulated to the gas tank, 100 psi, and to control units of the automatic pilot.

The automatic pilot consists of three gyro units; one displacement (free) gyro assembly installed in a movable cradle with its rotor axis inclined at [illegible] degrees to the horizon, and two fixed rate gyros. Signals are transmitted to the rudder and elevator servos to keep the bomb in a stable attitude in flight. A timer box assembly is installed in conjunction with the auto-pilot unit, and consists of a spring-actuated 5-minute delay clock and a [illegible]-second clock for turns. The 5-minute clock can be set for any delay up to five minutes, and the 60-second clock energizes the right or left steering coils causing the bomb to turn at a rate of approximately 55 to 60 degrees per minute.

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were unsuccessful due to launching failures.

The vibration of the bed caused the rockets to detonate and also mal-functions of the rockets caused failures; so the sliders were enlarged and the rocket circuits and grains were given closer inspections, and thereby successful launchings were attained.

Later it was discovered that by changing the angle of the rockets so that the thrust passed below the composite center of gravity of the missile and the launching sled, launchings could be attempted from a minimum length ramp - fifty feet. A six degree inclined three rail ramp was fabricated on a 40 foot trailer bed. Launchings were attempted and the bomb was propelled into the air similar to a skyrocket. After the rockets were expended the sled merely dropped away leaving the bomb airborne. Eighty launchings were made from this portable ramp and seventy-two were successful. Inasmuch as this ramp is portable, the tactical advantages are greatly increased. For example, the trailer can be turned whereby the bomb can be launched in any direction, the pitch angle can be increased by merely adjusting the front of the trailer, and the trailer is mobile over most types of terrain. This launching method is one of the improvements made over the German method, whereas their sites were permanently installed, were 160 feet in length, weighed approximately 50 tons, and were subjected to the firepower of our fighter and bomber aircraft.

Trailer launching and long ramp launchings took a tremendous supply of rocket powder - 480 pounds per launching. Therefore, a mechanical system was attempted and also one using less rocket powder.

The Multiple Cartridge ramp was constructed by the American Bridge Company. The catapult is a German Type, slotted tube launcher, 160 feet in length and 11-1/2 inches in diameter. A piston in this slotted tube is propelled down

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the tube and the bomb is attached above the piston by a fin extending through the slot in the tube. A [illegible] plug prevents gas leakage through the slot. Seven powder charges are attached at various intervals along the catapult tube. The first cartridge which is positioned just behind the piston is fired electrically; the subsequent charges are actuated by the gas pressure behind the piston. The total weight of the powder charge is approximately [illegible] pounds, and the pressure inside the tube varies between 900 and 1000 psi.

Twenty-four [illegible] and the 5000 pound dummies to simulate the bombs were launched from the catapult. The difficulties encountered consisted of weak launching bars and leakage in the slot of the tube. These difficulties were remedied by using piston bars with a yield of 65,000 psi. as compared to [illegible],000 psi., and different methods were incorporated in sealing the slot in the tube. Successful launchings were obtained from this catapult and the maximum acceleration recorded was [illegible] g's.

Due to the limited amount of available rocket powder, development work was done to substitute steam pressure for the split tube catapult instead of pressure from the burned rocket powder. [illegible] Company was requested to develop a boiler installation capable of developing approximately 1000 pounds of steam pressure to insure the successful launchings of the 5000 pound missile at 200 mph. This installation was assembled at Eglin Field, Florida, and complete engineering tests and hydrostatic tests were made satisfactorily. This complete installation, including development, fabrication, assembly, and testing, was all done within a period of three months.

Flights were then attempted from the catapult, and 5000 pound dummies and JB-2 Bombs were used. The unsuccessful launchings were accredited to the upward force at the end of the launching ramp which placed the bomb in an unstable attitude. The sealing tube which closed the slot in the ramp was replaced several times and extended so that the entire length of ramp would be sealed. Two quick-operating control valves were used for emitting the steam into the slotted tube; these included one from Consolidated Valve Division of Manning, Maxwell, and Moore, and one from the Ludeman Valve Division of the [illegible] Engine Company. For the performance characteristics of the catapult sixteen dummies and seventeen JB-2 bombs were used. Of the seventeen bombs that were tested, seventy per cent were successfully launched, with five of them having engine malfunctions upon launching.

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IMMEDIATE ACTION

[redacted]
By Authority of the Com. Gen., AAF-13 Sep 44 HCP AFDAO-4

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON 25, D. C.

AAF 471.6 (13 Sep 44) 13 Sep 1944

SUBJECT: Robot Bomb, JB-2

To: Chief of Ordnance, Research & Development Service, Wash. 25, D. C.

Thru: Commanding General, Army Service Forces.

1. A limited procurement of Chinese Copies of the German robot flying bomb is being made by the Army Air Forces in accordance with a directive from the Chief of Air Staff. Reference is made to letter AAF 471.6 (9 Aug 44), subject, "Flying Bomb", to the Chief of Ordnance, Research & Development Service, and letter O.O. 471.62/2448(s), subject, "Duplication of German Robot Bomb", to the Office of Assistant Chief of Air Staff, Materiel, Maintenance & Distribution, Army Air Forces, Washington, D. C., dated 31 July 1944.

2. In view of potential further production requirements for the robot bomb, Materiel Command nomenclature JB-2, a study is being made by the Army Air Forces Air Technical Service Command on the following expanded programs:

a. A production program of 200 JB-2 flying bombs per month with the necessary number of launching sites to make this number of experimental launchings.

b. An expansion of a production program of 1,000 JB-2 flying bombs per month with 50 launching sites.

c. An expansion of a production program of 5,000 JB-2 flying bombs per month with 250 launching sites.

3. The Ordnance Department has indicated the problems involved in loading high explosives in the present thin case war heads and the hazard of shipping these containers within the continental United States and to the theaters. 185

4. The Chief of Ordnance is requested to make an immediate study of the loading and handling problems involved in the production of the JB-2 flying bomb war heads, the equipment required for transportation within the continental United States and the theaters of operation, such as special

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IMMEDIATE ACTION

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IMMEDIATE ACTION

Ltr. to Ch/Ord thru CG, ASF, AAF 471.6 (13 Sep 44), subject, "Robot Bomb, JB-2". (Cont'd)

tractors, trailers, and prime movers the tools and equipment required for the assembly of the warheads to the flying bombs, and the storage problems incident to storage and issue of the items in the theater by Aviation Ordnance personnel. It is also desired that the Chief of Ordnance make recommendations as to whether field loading plants adjacent to the launching sites are required for field loading.

5. The problems that are incident to the rocket-assisted takeoff are also to be considered and recommendations are to be made for the loading and handling, and assembly equipment required for the rockets that will be used in assisting the takeoff of the robot bomb from the launching site.

6. This study is to be submitted prior to 2 October 1944 on the basis of the production program indicated in paragraph 2, above. It is is impossible to complete the study on quantities of 1,000 and 5,000 JB-2 bombs per month by this date, a preliminary report is requested based on the production quantity of 200 JB-2 flying bombs per month.

For the Commanding General, Army Air Forces:

R. C. COUPLAND
Brigadier General, U. S. Army
Air Ordnace Officer

Ref ltr - 4 Dec 44
Ref R & R dtd 7 Dec 44
24 Jan 45

1st Ind - 14 Sept 44
2nd Ind - 30 Sept 44
3rd Ind - 2 Oct 44
4th Ind - 4 Oct 44
5th Ind - 16 Oct 44
6th Ind - 21 Oct 44
7th Ind - 27 Oct 44
8th Ind - 1 Nov. 44
9th Ind - 6 Nov 44
10th Ind - 6 Nov 44
Ref ltr dtd 9 Oct w/4 Inds thereto
Ltr dtd 5 Feb, Ltr 13 Nov

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Y-108583

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SUBJECT: Robot Bomb, JB-2 PEC/vmp
6214

SPROP (13 Sep 44) 1st Ind.

Headquarters, Army Service Forces, Washington, D. C. 14 Sep 44

To: Chief of Ordnance
Attention: Research and Development Service, Rocket Development Division.

1. It is desired that the Chief of Ordnance prepare and submit to the Commanding General, Army Air Forces, through this office the study and recommendations indicated in paragraphs 4 & 5, basic correspondence.

2. Attention is directed to the target date stated in paragraph 6.

For the Commanding General:

/s/ R. M. Osborne

R. M. OSBORNE,
Colonel, General Staff Corps,
Director, Research and Development Division.

2nd Ind. - 30 Sept 44
3rd Ind. - 2 Oct 44
4th Ind. - 4 Oct 44
5th Ind. - 16 Oct 44
6th Ind. - 21 Oct 44
7th Ind. - 27 Oct 44
8th Ind. - 1 Nov 44
9th Ind. - 6 Nov 44
[illegible] Ind. - 6 Nov 44

[redacted]

Basic dtd 13 Sept 44
[illegible] dtd 9 Oct [illegible]
[illegible] 44

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SUBJECT: Robot Bomb, JB-2
O.O. 471.6/1279(s)
ASF. 471.6 (13 Sep 44)

2nd Ind.

Army Service Forces, Office, Chief of Ordnance, Washington 25, D. C.
30 September 1944

TO: Office, Assistant Chief of Air Staff, M & S, Army Air Force
Washington, D. C. Attn: Air Ordnance Officer

THRU: Headquarters, Army Service Forces, Washington 25, D. C.
Attn: Research & Development Division

1. In accordmance with the request made in the basic letter by the Commanding General, AAF, and with the directive of the Commanding General, ASF, the following study and recommendations have been prepared by the Office of theChief of Ordnance concerning the production of the War Head and the Assisted Take-Off motors for JB-2.

2. The recommendations made by Ammunition Development Division, Research and Development Service, OCO, regarding the War Head are given below. this study was requested in paragraph 4 of the basic letter.

1.) In accordance with the initial demand for JB-2 War Heads of light-gage steel and maximum explosive capacity, the Ordnance Department is designing sufficiently rugged packing for the loaded War Heads to reduce as far as possible the hazards involved in transporting them to the assembly sites. In addition, each loaded War Head will be provided with a substantial carrying band equipped with hoisting lugs to facilitate handling, probably by means of a tractor crane, after its removal from the packing box and during its assembly to the remaining units of the entire missile.

2.) As a step toward further minimizing the hazards involved in loading, transporting, and handling the War Heads, in the event of quantity production beyond the current limited procurement, the Ordnance Department is making a study of the practicability of manufacturing the War Heads of heavier gage metal, and the production rates that may be expected on this basis. Calculations of the probable increase in weight, change in location of center of gravity, loss in weight of explosive charge, and probable change in blase effect that may be expected as a result of increased metal thickness are being made and will be submitted for consideration.

3. Loading of the War Heads at field loading plants adjacent to the proposed launching sites, or at any point other than at established loading plants staffed by experienced operating personnel, is not recommended. Adequate plant capacity to meet the requirements of the proposed

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Subject: Robot Bomb, JB-2

expanded programs will be available at existing Ordnance Department loading plants when and as required.

4.) Since the assembly of the War Heads to the other parts of the complete unit involves no operations other than the insertion of standard bolts and machine screws and the attachment of the necessary electrical conductors to standard binding posts on terminal boards, no special hand tools are expected to be required.

5.) For transportation of the loaded and crated War Heads, other than by railroad, the standard or the Cargo Truck, 2-1/2-tons, 6x6, and the Truck, 2-1/2-ton, 6x6, Bomb Service M27 can be used both within the continental limits of the United States and in the theaters of operation. The Tractor, Crane, 2-Ton, M5: and the Lift Truck, M22, can be used for lifting the crated War Heads in storage and the uncrated units during assembly. The Trailer, Bomb Service, M5; or any flat-bottom type trailer of the 1-1/2-Ton capacity or greater, with sufficient loading space, can be used for transport around storage depots, launching sites, etc.

3. The problems incident to the rocket Assisted Take-Off are discussed below with recommendation so far as requested in paragraph 5 of the basic letter.

SUMMARY

For 1000 launchings per month, which it is understood informally is the most significant figure:

Propellant: Composite type 218-B by Monsanto Chemical Company. Production to be set up at an Ordnance Works with Monsanto as contractor -- time, 6 to 8 months; cost, $5,000,000. Fine granulated ammonium picrate from Naval Powder Factory, Indian Head, Maryland, with supplementary production to be set up at Maumelle Ordnance Works, Little Rock, Arkansas, at cost of $500,000.

Metal Parts of Motor: Design by N.D.R.C. (Allegany Ballistics Laboratory) for production under RAD Contract probably with National Tube Company, Pittsburgh. Schedule -- estimated production of metal parts will in every case be ahead of powder production. Continuing research and experimental work on motor design by Allegany Ballistics Laborary in close cooperation with research by Division 8 and Monsanto. Until experience proves to the contrary, 100% replacement of motors will be provided.

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Subject: Robot Bomb, JB-2

Loading: At the propellant production plant.

1.) Study of Problems:

a.) General: No AAF requirements have been written on the ATO units, but requirements have been received verbally and it is not anticipated that any difficulty will arise through misunderstanding. The understood requirements are:

Burning time = 2 sec.
Launching distance = 400 ft. (for initial launchings 100 additional feet)
Velocity at end of burning = 200 mi/hr.
Thrust per motor = 10,000 lbs.
Number of motors = 5
Aero-pulse motor will assist launching.
Proper release depends on deceleration of ATO cart.
Low dependence of burning rate on ambient temperature.
Weight of cart + bomb + half of propellant = 6900 lbs.
Weight of propellant per motor = 120 lbs.

It is understood that AAF will procure the cart and therefore this study is restricted to the ATO motors. The AAF anticipates a requirement for 1 sec. burning time to obtain launching in 200 ft. but this requirement has not yet been formally expressed and is not considered herein.

b.) Propellants Considered are:

Composite type 218-B developed by N.D.R.C., manufactured by Monsanto Chemical Co.

Russion composition rocket powder, or other slow burning double base powders.

GALCIT asphalt base composites (these have very poor temperature range).

The temperature dependence of burning time is the severest requirement on the powder since burning time is critical with present cart design. Verbal information from AAF is that a decision has been made to use the Monsanto composite. The decision was a wise one. This propellant has the best temperature dependence of any now available, will burn evenly at low pressure, and can be obtained without interfering greatly with programs on other propellants. However, if objections not anticipated should arise, Russian powder should be quite satisfactory. At first a considerable portion of powder, up to 40%, should be used for experimental work and for proof firing. Rights to the powder composition belong to the United States.

c.) The Cart: Some factors of the cart design will be considered because of their connection with design of the motors.

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c o p y

Subject: Robot Bomb, JB-2

The most urgent problem is the restriction put on the burning time of the motors by the cart design. It is strongly recommended that proper release of the bomb should not depend on deceleration of the cart, particularly if no provision is made for that deceleration other than drag after end of burning. If one motor should continue to burn for a slightly longer time than planned, the launching might well be abortive. To provide safety, such a release mechanism would impose severe (and unnecessary) restriction on the length of track or on the burning time of the powder. Since burning time depends on temperature, to obtain accuracy in burning time would require much narrower limits in storage temperature.

Tentative AAF design shows the motors in two rows on the same level, three in rear, two in front, echeloned. To prevent loss of thrust by impingement of part of the jet on the rear motors it would be desirable to have motors placed in one row.

d.) Motor Design: It is recommended that until experience has proved to the contrary allowance be made for 100% loss of motors after launching the bomb. This is based both on the damage which may result from stopping the cart and on the changes made in the steel by the intense heat of the gases acting for two seconds. Therefore, motors should be as simple and inexpensive as possible. Commercial tubing will be used. No outside cut should be taken in order not to interfere with the artillery shell program. Accurate construction of the nozzle should not be necessary since slight malalignment of the jet diection may be permitted. A nozzle separate from the body is recommended in ordor that nozzles may be salvaged if possible.

At best, the procurement of tubing and of the maching capacity for working it into rocket motors may cut into the bomb program.

Regarding Safety, it is considered preferable to thicken the motor walls rather than to rely on a relief device, such as a safety groove (unless the AAF puts in an explicit requirement for such a device). Since the mean total weight of the bomb is 6900 lbs. an increase in motor weight would be relatively minor. If necessary the increase could be counterbalanced by adding powder, opening up the throat a little. Any relief device that wasted thrust might be objectionable as increasing the likelihood of mis-launching and could be as serious as a normal type of motor blow-up.

e.) Ignition of powder: Though provision is made to withstand a large side thrust such as might result from late ignition of one motor it is considered very desirable that certain ignition be secured with small variation in ignition delay. Two electric squibs will be placed in each motor. Ignition accuracy within 40 milliseconds should be attainable.

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Subject: Robot Bomb, JB-2

2.) Production Study and Plans:

a.) The Present Set-up Capacity is as follows: There is a pilot line at Dayton, Ohio, owned by N.D.R.C., and operated by Division 8, N.D.R.C. and Monsanto Chemical Company. The Army Air Forces, through ATSC, Wright Field, has a verbal understanding with Dr. R. A. Connor, Chief, Division 8, under Project AC-75, that a fixed amount of the production of this pilot line will be turned over to AAF for ATO units for JB-2. The present capacity of the pilot line is 80,000 lbs. per month and the net production after testing is 48,000 lbs. per month, which is the amount needed for 80 launchings of the JB-2. The verbal understanding of AAF with N.D.R.C. is that 50% of the line's capacity will be held for other AAF projects (hydrobomb, etc.). Therefore, available capacity is for 40 launchings per month. It is our understanding that Air Forces by their own priority assignment do not wish to change this allocation of the powder production. Regarding metal parts for motors, Division 8 has contracted through small manufacturers in Pittsburgh to procure 10 motors in September, 1944, 100 in October, 200 in November and each month thereafter up to 1000 total motors (200 launchings). Transfer of funds from the AAF to Division 8 has been made for the metal parts beginning 1 October. All the powder is given AAF by N.D.R.C. without reimbursement. The design of metal parts for this limited manufacture is not considered to be satisfactory for large production.

b.) It is evident that present production facilities are inadequate even for the lowest figure of 200 launchings per month. By present agreement, Air Forces has accepted this condition and would prefer it to any change in the operation of pilot line, although ATO production would necessarity fall far behind the schedule for production of JB-2 units as already set up for 1000 units (total) by April 1945.

Informally, the requirements of the basic letter requesting this study were amplified to this extent:

Instead of merely making a study, Ordnance should actively plan to set up the details of production of the ATO units, since it is quite certain Ordnance will be requested to take over immediately their production.

Ordnance would take over the AAF agreement concerning the pilot line production. Efforts would be made to find production capacity elsewhere up to 200 launchings per month to satisfy the minimum immediate demand, with the future schedule to be 1000 launchings per month. Subsequent plans of production are to be considered in this light.

c.) Production plan for propellant manufacture as submitted by Industrial Service, OCO:

Raw materials are available.

Sites are available to take this plant.

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Subject: Robot Bomb, JB-2

It will probably be recommended that the New York Ordnance Works, Baldwinsville, N.Y. (13 miles from Syracuse) be used, asking Monsanto Chemical Company to take over production and construction for this job, because of their previous research and pilot plant facilities. This plant is in standby condition, has necessary administration buildings and facilities.

Time was not available for a complete study, but the following conservative estimates can be given:

A plant large enough to prepare propellant for 1000 launchings per month will cost about $5,000,000.

If steps are taken at once to proceed and funds are made available the plant will be complete and ready for operation in six to eight months.

Some modifications will have to be made in the plant manufacturing ammonium picrate to secure the fine granulation necessary. Based on judgment at this time the modifications will cost $5000,000, which will include the cost of refrigeration and modification of crystallization equipment. The plant selected will probably be Maumelle Ordnance Works.

It is believed sufficient presses can be obtained from the smokeless powder industry which, with modification, will permit their use in this work.

The modifications will be major and probably interfere with artillery shell and heavy artillery production as well as with present rocket extruded powder production.

This office is proceeding with a site letter and letter of intent asking Monsanto to take over production.

It is believed that for two million pounds per month the same recommendations will be made, with these changes: Additional expenditure of $3,000.000 will be required. The second million pounds per month will mean construction of new presses not obtainable until 1 July 1945. It is estimated that the existing plant will turn out powder for 80 launchings per month and if necessary that amount can be obtained, but would require modification of the Air Forces' agreement with N.D.R.C.

It is estimated that an increase to 200 launchings per month would require going to New York Ordnance Works and could not be obtained for 4 to 5 months.

No change in production methods of the pilot line should be made in going into large scale production unless thoroughly tested beforehand.

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d.) Manufacture of igniter consisting of black powder envelope with two squibs inserted will be set up at the powder production plant. Loading of the propellant and igniter into the metal parts of the motor will be made at the powder plant.

e.) Metal Parts Manufacture: Preliminary plans would be for 100% replacement of motors on each firing. This figure may be lowered by experience or by Air Forces' request for a specific number to the Ordnance Department. The production set up with the present design will be retained. Production of metal parts can be expanded as necessary, while awaiting the large scale production, to meet any deficit that might arise in metal parts as compared with powder.

The design of a production model motor is being drawn up by Allegany Ballistics Laboratory of Division 3, N.D.R.C. in consultation with Division 8, based on the best judgment of both. It will be designed in accordance with standard practice and with test models already proven on internal design with this powder and granulation so that its performance should be without question. Production will be set up under a Research and Development contract of the Research and Development Service, OCO, probably with National Tube Company, Pittsburgh. It is expected that production capacity up to 5,000 units per month (for 1000 launchings) will be ready within 90 to 120 days. But to attain anything but small lot production priority must be secured for some machines now engaged in the bomb program.

3.) Storage and Handling: The assembled motors will be sealed to be moisture proof. This would be urgent if sodium nitrate were used and even with potassium nitrate as planned might be desirable.

It is understood that in preliminary test work the Army Air Forces plan to control the temperature range of the storage magazine at Eglin Field to within a range of 20°F. This range is considered more than adequate. Final temperature range for storage is yet to be determined but it is anticipated that uncontrolled temperature storage will be adequate, i.e., storage under shelter only from rain and sun and from the ground beneath. Rounds should be store with nozzle end up.

4.) Recommendations on Launching: Each loaded motor should weight about 340 lbs. A cart may be desirable, but is not necessary, to bring the motors to the laucching sled.

Firing will be electrical, and should be done from a pill-box control house, with all personnel under cover.

For the Chief of Ordnance:

G. M. BARNES
Major General, Ordance Department
Chief, Research and Development Service

Y-108583

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[redacted]

Subject: Robot Bomb, JB-2

For Concurrence: ______________________
R. E. HARDY
Brig. Gen., U.S.A.
Chief, Ammunition Div., I.S.

____
I. A. LUKE
Col., Ord. Dept.
Chief, Ammun. Dev., Res. & Dev. Serv.

____
G. W. TRICHEL
Col., Ord. Dept.
Chief, Rocket Dev., Res. & Dev. Serv.

Basic dtd 13 Sept 44
1st Ind - 14 Sept 44
3rd Ind - 2 Oct 44
4th Ind - 4 Oct 44
5th Ind - 16 Oct 44
6th Ind - 21 Oct 44
7th Ind - 27 Oct 44
8th Ind - 1 Nov 44
9th Ind - 6 Nov 44
10th Ind - 6 Nov. 44

[illegible] 4 Oct 44 [illegible]
[illegible] 4 Dec 44

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SUBJECT: Robot Bomb, JB-2

SPROP (13 Sep 44) 3rd Ind. PEC/vmp 6214

Headquarters, Army Service Forces, Washington, D. C. 2 Oct 44

To: The Commanding General, Army Air Forces
Attention: Air Ordnance Officer,
Office, Assistant Chief of Air Staff, M & S

1. The study set forth in 2nd Indorsement has been prepared at your request.

2. Attention is invited to the statement on page 6, 2nd Inforsement, that the expansion of propellant facilities will probably interfere with artillery shell and heavy artillery production. The latter program is of the highest priority and to date no projects have been authorized which would threaten to impede it.

3. It is requested that this Headquarters be furnished the firm requirements of the Army Air Forces for components of the JB-2 Bomb which the Ordnance Department will supply. For the reasons mentioned in paragraph 2 above, it is requested that the requirements be kept at the lowest possible figure. Upon receipt of these requirements, this Headquarters will render to the Commanding General, Army Air Forces, an estimate of the best production possible without interfering with projects of greater urgency.

For the Commanding General:

R. M. OSBORNE
Colonel, General Staff Corps,
Director, Research and Development Division.

M. M. IRVINE
Colonel, Coast Artillery Corps
Deputy Director, Research & Devel. Division

Basic dtd - 13 Sept 44
1st Ind - 14 Sept 44
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9th Ind - 6 Nov
10th Ind - 6 Nov
[illegible]

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t.Col.J.M.Gruitch/med 71175
Wrtn: 4 Oct 44

SUBJECT: Robot Bomb, JB-2

AAF 471.6 (13 Sep 44) 4th Ind. AFDAO-4

HEADQUARTERS ARMY AIR FORCES, WASHINGTON 25, D.C.

TO: Chief of Ordnance, Research & Development Service, Wash. 25, D. C.

THRU: Commanding General, Army Service Forces, Wash. 25, D.C.

1. A limited procurement of one thousand (1,000) Robot Bombs, JB-2, has been authorized by the Army Air Forces in letter, file AAF 471.6 (9 Aug 44), subject, "Flying Bomb", to the Chief of Ordnance, Research & Development Service.

2. The Chief of Ordnance is requested to take the following additional action immediately:

a. Take over the Army Air Forces' agreement with Division 8, NDRC (under project AC-75) for a fixed amount of the pilot line production capacity at Monsanto Chemical Company, Dayton, Ohio, of rocket propellent powder, composite type 218-B, for the JB-2 ATO units. This agreement specifies 40 launchings per month.

b. The motors for the ATO units suitable for use with the 218-B composite propellent powder will be supplied by the Air Technical Service Command in accordance with designs prepared by them and by NDRC.

c. Production planning is to be initiated immediately for facilities required to product propellent powder (composite type 218-B) at the rate of 1,000,000-lbs. per month for a total initial quantity of 5,000,000-lbs. of propellent. Propellent characteristics are to be as stated in paragraph 1a. 3rd Indorsement.

d. This planning is to be based on a delivery schedule of the propellent to start within six (6) months from 4 October 1944.

3. The Army Air Forces' requirements for propellent powder other than the required 40 launchings per month will be stated after completion of tests on the robot bomb to be conducted at the Army Air Forces Proving Ground Command, Eglin Field, Florida. No action is to be taken with the Chief of Ordnance to obtain facilities for increased quantities of propellent powder until authorized by this Headquarters.

Ref ltr 4 Dec

Basic dtd 13 Sept 44
1st Ind - 14 Sept
2nd Ind - 30 Sept
3d Ind - 2 Oct
4th Ind - 4 Oct
5th Ind - 16 Oct
6th Ind - 21 Oct
7th Ind - 21 Oct
8th Ind - 17 Nov
9th Ind - 6 Nov
10th Ind - 6 Nov
Ref ltr dtd 8 Oct w/4 Inds.

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Y-108583

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SPUPR Subject: Robot Bomb, JB-2

5th Ind. 16 Oct 44

Headquarters, Army Service Forces

To: Commanding General, Army Air Forces (Attention: Asst. Chief of Air Staff, Materiel and Services, Major General O. P. Echols)

1. This Headquarters has no objection to authorizing the Chief of Ordnance to assume Army Air Forces' agreement with Division 8, NDRC (under project AC-75) for a fixed amount of pilot line production capacity at Monsanto Chemical Company, Dayton, Ohio, of rocket propellant powder, composite type 218-B, provided assurance can be furnished that this type of powder will be acceptable for use with motors for ATO units as finally designed by the Air Technical Service Command in coordination with NDRC.

2. With respect to the request, appearing in sub-paragraph 2c of the preceding indorsement, that production planning be immediately initiated for facilities to produce propellant powder (composite type 218-B) at the rate of 1,000,000 libs. monthly, the Chief of Ordnance reports that substantially every action has been taken that is possible in advance of definite authorization to contract for production of this powder.

3. It is noted that planning is to be based upon the assumption that delivery of propellant powder is to start within six (6) months from 4 October 1944, but that no action is to be taken to obtain facilities for increased quantities of propellant powder until authorized by Headquarters, Army Air Forces. In this connection, attention is invited to the fact that delay in authorizing this procurement will correspondingly retard the date of availability of propellant powder.

4. In view of the fact that quantity production of propellant powder is not expected to be delivered prior to April, 1945, inquiry is made as to the effect of a German collapse on indicated propellant powder requirements of 1,000,000 libs. monthly.

For the Commanding General:

LUCIUS D. CLAY,
Major General, General Staff Corps,
Director of Materiel

Basic ltd 13 Sept 44
1st Ind - 19 Sept
2nd Ind - 30 Sept
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6th Ind - 21 Oct
7th Ind - 27 Oct
8th Ind - 1 Nov
9th Ind - 6 Nov
10th Ind - 6 Nov
Ref ltr dtd 9 Oct w/4 Inds
[illegible] 4 Dec

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[redacted]

Major A.C. Erickson/med
72343
Wrtn: 21 Oct/44

SUBJECT: Robot Bomb, JB-2

AAF 471.6 (13 Sep 44) 6th Ind AFDAO-4

HEADQUARTERS, ARMY AIR FORCES, WASHINGTON 25, D.C.

TO: Chief of Ordnance, Research & Development Service, Wash. 25, D.C.

THRU: Commanding General, Army Service Forces, Washington 25, D.C.

1. With reference to paragraph 1, preceding indorsement, it is desired that the Chief of Ordnance take over immediately the Army Air Forces agreement with Division 8, N.D.R.C. (under project AC-75) as requested in paragraph 2a, 4th Indorsement. Originally, it was decided to use N.D.R.C. moulded composite propellant type 218-B, but later tests revealed the N.D.R.C. moulded composite type 492 more suitable. The rocket propellant powder, composite type 492, will be acceptable by the Army Air Forces for use with motors for ATO units as accepted by the Air Technical Service Command in coordination with N.D.R.C. This change in moulded composite type of propellant will not change existing requirements for pressing equipment as the change affects only percentages of existing ingredients which comprise the propellant.

2. With reference to paragraph 3, 4th Indorsement, it is requested that the Chief of Ordnance procure and make available a total of 5,000,000 pounds of propellant (composite type 492, or, if changed in the future by the Army Air Forces, a similar type which would not require an extensive alteration of quantities of ingredients and/or contemplated facilities) at the rate of 1,000,000 pounds per month. This rate of production to be reached by 1 April 1945. This quantity assures sufficient propellant for 1,000 launchings per month.

3. Pending further study by the Army Air Forces, it is contemplated that the Ordnance Department will be requested to fill the rocket motors. Before the final decision of loading responsibility is made, the comments of the Ordnance Department are requested as to the feasibility of shipping and storage of motors loaded with composite type 492 propellant.

4. It is further requested that this Headquarters be informed of the estimated production schedule of this propellant as soon as possible. This information is desired in order that manufacture of the other component parts by the Army Air Forces for this project can be coordinated with the production of propellant.

5. With reference to paragraph 4, preceding indorsement, it is further requested that this project be given a high priority and placed in Group III. This project is considered to be of value against Germany, against Japan, and for peace time development.

6. It will be noted that authorization has not been granted to proceed with procurement and necessary expansion of facilities on other Ordnance items

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SUBJECT: Robot Bomb, JB-2
6th Ind. (Cont'd)

for use with JB-2 aircraft, other than the 1,000 units with an estimated maximum rate of 200 per month specified in letter, this Headquarters, file AAF 471.6 (9 Aug 44) subject, "Flying Bomb", dated 10 August 1944.

For the Commanding General, Army Air Forces:

Ref ltr 4 Dec 44

Basic dtd 13 Sept
1st Ind - 14 Sept
2nd Ind - 20 Sept
3rd Ind - 2 Oct
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5th Ind - 16 Oct
6th Ind - 21 Oct
7th Ind - 27 Oct
8th Ind - 1 Nov
9th Ind - 6 Nov
10th Ind - 6 Nov

Ref ltr dtd 9 Oct w/4 Inds.

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Y-108583

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SPUPR Subject: Robot Bomb JB-2

7th Ind. 27 Oct 44

Headquarters, Army Service Forces

TO: Chief of Ordnance(Attn: Ammunition Division, Industrial Service, Brigadier General R.E. Hardy)
THRU: Requirements Division, Colonel B.R. Olmsted

1. Pursuant to the requests appearing in the preceding indorsement, the Chief of Ordnance is authorized to take immediate action to:

a. Assume Army Air Forces' agreement with Division 8 N.D.R.C. (under project AC-75) for a fixed amount of pilot line production capacity at Monsanto Chemical Company, Dayton, Ohio, of rocket propellant powder, composite type 492, for JB-2 ATO units.

b. Initiate procurement of a total quantity of 5,000,000 pounds of propellant (composite type 492 or such similar type as may be required by Army Air Forces) to be produced at the rate of 1,000,000 pounds per month.

2. It will be noted from paragraph 2 of the preceding indorsement that Army Air Forces desires that the rate of propellant powder of 1,000,000 pounds per month be attained by 1 April 1945. It is desired that an estimated production schedule of this propellant, as requested in paragraph 4 of the preceding indorsement, be furnished through this Headquarters as promptly as feasible.

3. Attention is invited to the requests appearing in the third and fifth paragraphs of the preceding indorsement. It is desired that appropriate action be taken with respect thereto.

For the Commanding General:

LUCUIS D. CLAY
Major General, General Staff Corps,
Director of Materiel

/s/ Howard Bruce

HOWARD BRUCE
Acting Director of Materiel

Basic dtd - 13 Sept 44
1st Ind - 14 Sept
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5th Ind - 16 Oct
6th Ind - 21 Oct
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9th Ind - 6 Nov
10th Ind - 6 Nov

Ref Ltr dtd 9 Oct 44 Inds.
to 4 Dec 44

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 Y-108583

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O.O. 471.6/1279 (s) [redacted]
AAF 471.6 (13 Sep 44)
SPROP (13 Sep 44)
SPUPR

8th Ind.

Army Service Forces, Ordnance Office, Washington, D.C., 1 November 1944.

TO: Headquarters, Army Service Forces, Attn: Director of Materiel
Thru: Requirements Division, Colonel B.R. Olmsted.

1. In accordance with authorization indicated in paragraph 1b of 7th Indorsement, this office has initiated procurement of a total quantity of 5,000,000 pounds of propellant (composite type 492 or such similar type as may be required by Army Air Forces) to be produced at the rate of 1,000,000 pounds per month.

2. Estimated production schedule of this Composite Propellant Type 492 is now under study and will be furnished as requested at the earliest possible moment.

3. With reference to the requested comments of this office on the feasibility of shipping and storage of motors loaded with composite propellant type 492, it is requested that the submittal of these comments be deferred until the Ordnance Department can investigate the only information available which was developed by the Monsanto Chemical Company who are operators of the pilot plant producing this propellant under contract with the N.D.R.C.

4. Attention is invited to paragraph 1a of 7th Indorsement in which the Chief of Ordnance is authorized to assume Army Air Forces' agreement with Division 8 N.D.R.C (under project AC-75) for a fixed amount of pilot line production capacity. It is believed that such arrangement would not be conducive to the best prosecution of the composite propellant program as it would place this office in a secondary position with reference to supervision of the operation and production capacity of the pilot plant. It is understood that the Director of the Office of Scientific Research and Development (higher echelon of NDRC) has approved a plan to transfer, upon request, contracts, funds and facilities which are being utilized by the N.D.R.C. in the development of this propellant. Inasmuch as the Ordnance Department will construct facilities for the commercial production of this propellant, it would be most advantageous and, in fact, a necessity for this office to have under its direct supervision, this pilot plant for the purpose of further research and development and training of operators as well as for the available production capacity.

5. An exactly analagous situation existed in the case of the R.D.X. program. The Ordnance Department was authorized to take over the pilot plant from the N.D.R.C. and this action proved most advantageous.

6. It is therefore requested that the action authorized in paragraph

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To: Headquarters, ASF
Subject: Robot Bomb, JB-2
8th Ind. (cont'd)

1a of 7th Indorsement be reconsidered and it is recommended that the authorization for this action be rescinded and submitted by an authorization for this office to proceed with the necessary arrangements for the transfer of the Composite Propellant Pilot Plant from the O.S.R.D., at the earliest possible moment, to the Ordnance Department.

For the Chief of Ordnance:

/s/ R.E. HARDY

R.E. HARDY
Brig. Gen., USA,
Assistant

Basic Ltr. 12 Sept 44

1st Ind - 14 Sept
2nd Ind - 30 Sept
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7th Ind - 27 Oct
8th Ind - 1 Nov
9th Ind - 6 Nov
10th Ind - 6 Nov

Ret. Ltr. dtd 8 Oct w/ Inds.
fr. 4 Dec 44

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AC-75

SPUPR-1057 Subject: Robot Bomb, JB-2
ABH/mdl
Ext. 3210 9th Ind.

Headquarters, Army Service Forces, Production Division Nov 6, 1944

To: Commanding General, Army Air Forces (Attention: Air Ordnance Officer)

Comment is invited with respect to the recommendation appearing in paragraph 6 of the 8th Indorsement.

For the Commanding General:

/s/ F. R. Denton

F. R. DENTON
Colonel, G.S.C.,
Acting Director, Production Division

AAF 471.6 10th Ind

Hq Army Air Forces, AC/AS, Materiel and Services, The Pentagon, Washington 25, D.C.

TO: Commanding General, Army Service Forces, Production Division
The Pentagon, Washington 25, D.C.

1. Three inclosures have been added to this file:

a. Copies of ltr from Air Technical Service Command to Commanding General, Army Air Forces, and four indorsements thereto in which file it is recommended that the Army Air Forces take over the operations of the NDRC Pilot Plant operated by the Monsanto Chemical Company at Dayton, Ohio.

b. Ltr from the Office, Chief of Ordnance to the Commanding General, Army Air Forces, dated 10 November 1944, in which it is requested that the Ordnance Department be charged with the responsibility of loading rocket motors with type 492 propellant powder.

c. Copy of letter outlining the scope of NDRC Project AC-75, under which several projects are now being carried out by NDRC at the Monsanto Pilot Plant, Dayton, Ohio. ded-5 Feb 44

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Basic - 13 Sept 44

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Subj: Robot Bomb, JB-2

10th Ind (cont'd)

All three inclosures deal with various aspects of the same subject and therefore have been added to this file to eliminate duplication of correspondence and to present a complete story.

2. With regard to paragraph 1 of the 9th Ind, the Army Air Forces believe that the best interests of the Army will be served if the Ordnance Department has complete responsibility and authority for the development and production of all types of propellant powder and the loading of this powder. The Army Air Forces do not desire to continue in the development of propellant powder for such projects as are listed in the enclosed copy of letter outlining AC-75.

3. In paragraph 4 of the 8th Ind to this file, it was stated, "It is understood that the Director of the Office of Scientific Research and Development (higher echelon of NDRC) has approved a plan to transfer, upon request, contracts, funds and facilities which are being utilized by the NDRC in the development of this propellant". Also in paragraph 1 of the attached basic communication from the Air Technical Service Command it was stated, "Information has been received that the Director of the Office of Scientific Research and Development has approved a plan to transfer to a particular service, upon request, contracts, funds and facilities which are being utilized by the NDRC on a particular project for that service." Both of these statements refer to the demobilization plan of OSRD under which the contracts and facilities of NDRC would be transferred to the various services some months after the defeat of Germany. It appears that either one or both of these statements have been interpreted to mean that NDRC desires to transfer the Monsanto Pilot Plant immediately. According to Dr. Max Roy, NDRC, this is not precisely the case. Reference to the 4th Ind to the basic letter from Air Technical Service Command (copies inclosed) will indicate that the War Department Liaison Officer for NDRC believes that the arguments and requests of the Ordnance Department in the 8th Ind to this file, require further study and that the NDRC should indicate what it considers to be the best action with regard to the Monsanto Pilot Plant at Dayton Ohio. It will be noted that the request of the Ordnance Department in paragraph 6 of the 8th Ind is that the Monsanto Pilot Plant be transferred as quickly as possible to the Ordnance Department. In contrast to this, the inclosed copy of basic ltr from Air Technical Service Command, requests that the Pilot Plant be transferred to the Army Air Forces. This Headquarters has no objection to the transfer of contracts and facilities of NDRC to the Ordnance Department and recommends that this be done. Since the Ordnance Department is now to assume full responsibility for the development of all propellant powder, any arrangements for the transfer of NDRC facilities should be made between the Ordnance Department and OSRD.

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Subj: Robot Bomb, JB-2

10th Ind (Cont'd)

4. Whether the Monsanto Pilot Plant is transferred as soon as possible to the Ordnance jurisdiction or is transferred sometime after the defeat of Germany, there will be an unavoidable lapse of at least two months from this date required for the transfer. Since the need for propellant powder for launching JB-2's is immediate, and since the Ordnance Department desires to continue research and development and the training of operators for large production, it appears that the most practical plan at this time is to have NDRC continue the operation of the Pilot Plant, having Ordnance Department technicians and operators in the plant in anticipation of eventual Ordnance Department operation. This plan will require excellent cooperation on the part of both agencies.

5. In common with all other Ordnance Department items used by the Army Air Forces, the Army Air Forces will furnish military requirements and specifications for all types of propellant powder needed by the Air Force for their own uses. Typical of these uses are listed in the enclosed letter discussing NDRC project, AC-75. It is anticipated that new uses for propellant powder will appear from time to time in the Air Forces and that the powder will be procured from the Ordnance Department. The utmost cooperation between the Army Air Forces and the Ordnance Department will be required to obtain the best results.

6. Since the Ordnance Department is already engaged in the development and production in vast quantities of powder, it is believed that the policy outlined above will result in the avoidance of needless duplication of effort and facilities in the future and will result in obtaining powder with the least delay and confusion.

see ltr dtd 9 Oct w/4 Ind
1st Ind - 19 Oct
2nd Ind - 27 Oct
3rd Ind - 7 Nov
4th Ind - 16 Nov
Ref ltr dtd 5 Feb 44
10 Nov 44
Ref R&R dtd 7 Dec 44
+ 29 Jan 45

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AIR TECHNICAL SERVICE COMMAND

Lt. Colonel E. W. Dichman
hr:TSEPR3R 2-0239

Project MX-544
JB-2 Flying Bombs

27 September 1944

Commanding General
Army Air Forces
Washington 25, D. C.

Attn: AC/AS, M&S

Reference a. Teletype WAR 27991; dated 9 September 1944
b. Teletype WAR 32885, dated 19 September 1944

1. In compliance with directions contained in References a and b above, a study has been made of the JB-2 production program to determine the possibility of meeting the schedule as presently authorized, as well as the anticipated expanded program. As the result of this investigation, it is estimated that the production of JB-2 Aircraft, exclusive of launching propellent, can reach and continue at a maximum monthly rate as indicated below:

200 Articles per month during December 1944

1,000 Articles per month during April 1945

5,000 Articles per month during September 1945.

2. In this connection, reference is made to Appendices A, B, and C attached hereto, setting forth proposed production schedules for JB-2 Aircraft necessary to establish a maximum rate of 200, 1,000, and 5,000 articles per month, respectively. During the first few months the number of JB-2 Aircraft actually completed per month will probably fall short of the schedule. The design and construction of production tools, the procurement of GFE items, and the usual problems connected with getting production started contribute to this delay. In spite of this fact, no reduction of the proposed schedule is recommended since it is confidently expected that, barring major engineering changes, the total number of JB-2 Aircraft available will equal the cumulative number on schedule by 1 January 1945.

3. Attention is invited to the fact that the expanded production schedules, as set forth in Appendices B and C, can only be realized if immediate action is taken to authorize the additional procurement required.

Classification cancelled
or changed to [redacted]
Auth: CD 356
By 11-1-

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Project MX-544

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549 [redacted]

Commanding General, Army Air Forces
SUBJECT: JB-2 Flying Bombs
27 September 1944

A delay of ten days or more in placing contracts for this expanded program may require a revision of the schedules as submitted. It is strongly recommended that the total number of JB-2 Aircraft authorized on any expanded program be at least ten times the maximum production required in any one month.

4. For the purpose of this analysis the major phases of Project MX-544 are set forth below:

a. Production of JB-2 Aircraft completely equipped ready for Service use.

b. Production of Launching Carts

c. Availability of 3-Stage Air Compressors

d. Availability of Launching Propellent

e. Establishment of Launching Sites.

5. The production of JB-2 Aircraft is contingent upon the manufacture and assembly of many essential elements described in detail in Appendix D and noted below:

a. The airframe

b. The power unit

c. High pressure air shutoff valves (two)

d. High pressure air bottles (two)

e. Air pressure regulator

f. Control system

g. Warhead, including detonators

h. Radio equipment.

6. The production of JB-2 airframe and the installation of GFE therein is being accomplished by Republic Aviation Corporation as a prime contractor to the Government. On the present procurement of 1,000 articles contractor is building seventy-five (75) articles in his Farmingdale plant and subcontracting the remaining 925 articles to Willys-Overland in Toledo.

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Commanding General, Army Air Forces
JB-2 Flying Bombs
27 September 1944

Contractor is endeavoring to meet the schedule as set forth in Appendix A. The lack of a few GFE items is occasioning some delay at the start but this situation is being cleaned up. The contractor's plans for the expanded program propose still further use of the Willys-Overland facilities augmented when and if necessary by the Republic plant facilities at Evansville, Indiana. The remaining items noted in paragraph 5, other than the airframe, are procured from a number of sources as indicated in Appendices A, B and C, and are supplied to Republic and other places as GFE. Reference is made to Appendix E attached hereto for information concerning expansion of facilities and the cost thereof for the various manufacturers concerned.

7. Procurement of launching carts is presently limited to an order for one hundred (100) of these articles from Northrop Aircraft, Inc. This design embodies a large magnesium casting to reduce the weight of the cart so that it can be accelerated without the expenditure of too much power. The Federal Aircraft Works, Minneapolis, Minnesota, proposes a design employing structural steel members. The launching cart is still in the development stage and until such time as sufficient tests have been made and the design frozen, it seems wise to withhold the procurement of any large quantity.

8. The availability of 3-stage air compressors for charging the air bottles at the launching site presents no serious problem since there are a large number of these compressors in stock and every Cle-trac has one mounted as standard equipment.

9. Propellant fuel for launching purposes is now in production at Monsanto's Dayton facility. Capacity of this plant is 48,000 net pounds per month. At an estimated consumption of 600 pounds per launching the above production will permit 80 launchings per month. Ordnance Department has been given a requirement by the Army Air Forces to provide facilities and production for 600,000 net pounds of fuel per month. This will provide for launchings at the rate of 1,000 per month. Because of the experimental nature of the propellant fuel, it is anticipated that Ordnance Department study covering additional facilities and actual production of 600,000 net pounds per month will not be completed until 15 October 1944. The study contemplates production of the above quantity no later than 1 April 1945. In addition to the propellant fuel, Ordnance Department will supply rocket motors. A requirement for 10,000 of these items has likewise been placed with the Ordnance Department. A preliminary estimate made by the Monsanto Chemical Company on the cost of additional facilities to meet the 600,000 net pounds per month requirement is $5,000,000.

10. The development of equipment for the establishment of launching sites is primarily a design problem and should await the results of launching tests

if used exclusively for this purpose.

[redacted]

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[redacted]

at Eglin Field in the near future. Since the Corps of Engineers is directly concerned with this problem, it is recommended that representatives of that Service be invited to witness the launching tests.

For the Director:

5 Incls: (in trip)
Incl. 1 - Appen."A"
Incl. 2 - Appen."B"
Incl. 3 - Appen."C"
Incl. 4 - Appen."D"
Incl. 5 - Appen."E"

CC:
Chief, Aircraft Sub-Section
Deputy Director, ATSC
Chief, Eng. and Procurement

[redacted]

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ATSC Form No. 43 (16 SEP 44)

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[redacted]

XXXXXXXXXXXXXXXXXXX
AIR TECHNICAL SERVICE COMMAND

[redacted]

HFM:cjt:[illegible]
Wright Field, Dayton, Ohio
17 October 1944

[illegible], ADDENDUM NO. 1

Procurement of Rocket Motors for JB-2 Guided Missiles

Procurement Division

1. Problem Presented:

a. To procure 25,000 Monsanto type rocket motors which are to be delivered at a rate of approximately [illegible] per month.

2. Factual Data:

a. Air Force requirements have now been established at 5,000 rockets per month, up to a total of 25,000. The Ordnance Department will conduct any necessary expansions of assisted take off powder facilities and has completed expansion studies. The Army Air Forces will develop and procure their own assisted take off rocket motors. Ordnance will furnish necessary powder and will consider filling the motors if the Army Air Force considers this desirable.

b. The procurement of 25,000 Monsanto type rocket motors is necessary in order to provide for the launching of 1,000 JB-2 guided missiles now on order, and productive capacity for the necessary rockets to launch these and other guided missiles now under consideration.

3. Authority:

a. Commanding General, Army Air Forces, by teletype [illegible]-47484, dated 14 October 1944, from the Assistant Chief of Air Staff, Material and Services; and by teletype [illegible]-46[illegible], dated [illegible] October 1944, from, Chief, Material Division, Office, Assistant Chief of Air Staff, Material and Services.

[redacted]

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

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TSC Form No. 43 (16 SEP 44)

444

~~XXXXXXXXXXXXXXXXX~~
AIR TECHNICAL SERVICE COMMAND

[redacted]

HQ [illegible]
Wright Field, Dayton, Ohio
17 October 1944

CTI-1502, [illegible] NO. 1

Procurement of Rocket Motors for JB-2 Guided Missiles

Procurement Division

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
ADJUST DIV.
OTHER

4. **Action Desired:**

a. That the Procurement Division take necessary action to procure 25,000 Monsanto type rocket motors to be delivered at a rate of approximately 5,000 per month.

By Command of Lt. General KNUDSEN:

T. [illegible]. SIMS
Colonel, Air Corps
Chief of Administration

cc: Engineering Division
Supply Division
Maintenance Division

[redacted]

HDAAA 22 SEP 44 300M

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TSC Form No. 43 (16 SEP 44)

AIR TECHNICAL SERVICE COMMAND

COORDINATION | DIRECTOR OR DEP. | AIR INSPECTOR | MGT. CONTROL | CHIEF OF ADMN. | SPECIAL STAFF | CHIEF, ENG. & PROC. | CHIEF, SUPPLY & MAINT. | FRS. & BASE SERV. DIV. | MAINT. DIV. | SUPPLY DIV. | ENGINEERING DIV. | PROCUREMENT DIV. | READJUST DIV. | OTHER

HFM:ear:TSTEX
[redacted] Wright Field, Ohio
6 November 1944

CTI-1802, ADDENDUM NO. 2

Procurement of Rocket Motors for JB-2 Guided Missiles

Procurement Division

MX-544

1. Problem Presented:

a. To procure the quantity of ten thousand (10,000) Monsanto type Assisted Take-Off Rocket Motors to be delivered at the rate of approximately five thousand (5000) per month instead of the quantity of twenty-five thousand (25,000) previously directed in CTI-1802, Addendum No. 1.

2. Factual Data:

a. The degree of recoverability and reuse of the Assisted Take-Off Rocket Motors is believed to be such that a quantity of ten thousand (10,000) rocket motors will be sufficient to provide for a total of five thousand (5000) launchings on the basis of five (5) rocket motors being used for each launching. This degree of recoverability assumes launching of JB-2 guided missiles over reasonably favorable terrain and no launchings from ships.

3. Authority:

a. Director, Air Technical Service Command.

4. Action Desired:

a. That the Procurement Division take the necessary action to procure a quantity of ten thousand (10,000) Monsanto type Assisted Take-Off Rocket Motors instead of the twenty-five thousand previously directed in CTI-1802, Addendum No. 1.

b. These Technical Instructions amend CTI-1802, Addendum No. 1.

By the Command of Lt. General KNUDSEN:

[redacted] A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Engineering Div.
Maintenance Div.
Supply Div.

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CENTRAL FILE COPY

Form No. 43 (16 SEP 44)

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[redacted]

AIR TECHNICAL SERVICE COMMAND

MX-544

HFM:ear:TSPEX

6 November 1944

COORDINATION
DIRECTOR OR DEP.
INSPECTOR
CONTROL
H. Mullins
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST. DIV.
OTHER

Procurement of Assisted Take-Off Rocket Motors for JB-2 Guided Missiles.

[redacted]
C. G., AAF
Control Centre
11-6-44
HFM

Commanding General, Army Air Forces
Assistant Chief of Air Staff
Materiel and Services
Washington, 25, D. C.

1. Reference is made to teletypes WAR-46874, dated 14 October 1944 and WAR-46484, dated 1? October 1944, which directed the Air Technical Service Command to procure Assisted Take-Off Rocket Motors similar to those developed by NDRC and Monsanto. Referenced teletypes stated that Air Force requirements have now been established at five thousand (5000) rockets per month up to a total of twenty-five thousand (25,000). Reference is also made to ATSC teletype TSEPR3B-10-6, dated 17 October by which the Assistant Chief of Air Staff, Materiel and Services was notified that action had been taken to procure the Assisted Take-Off Rocket Motors.

2. It has been determined that the Assisted Take-Off Rocket Motors can be salvaged and reused under certain conditions, the most important of which is the terrain over which the JB-2 Guided Missiles are launched and on which the rocket motors and launching cars will land. The launching car is projected approximately nine hundred (900) feet beyond the end of the launching rail. If the missiles are launched from ships or over extremely rocky and rugged terrain, the number of rocket motors which can be salvaged will be zero or practically nil, as the case may be.

3. Experience to date has consisted of five (5) launchings which resulted in firing twenty-six (26) rocket motors, five (5) rocket motors being used per launching. The extra motor fired was the result of a mis-fire. All of these Assisted Take-Off Rocket Motors landed under ideal conditions, namely, in soft sand or in very shallow water, and so far only one has not been recoverable after some degree of rework.

4. It is expected that the percentage that can be salvaged if the launching cars land in reasonably favorable terrain will be sufficient to provide for an approximate average of two and one-half firings per rocket motor, assuming no launchings from ships. This would indicate that under the above circumstances, a quantity of ten thousand (10,000) Assisted Take-Off Rocket Motors would be sufficient, with the twenty-five thousand (25,000) propellant charges, to provide for five thousand (5000) launchings.

BELIEVED
Auth: ___
By ___
Signature and Grade
Date ___

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m No. 43 (16 SEP 44)

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[redacted]

Subj: Procurement of Assisted Take-Off Rocket Motors for JB-2 Guided Missiles.

HFM:ear:TSTEX
6 November 1944

To: ACAS/MAS, Wash.25,D.C.

5. In view of the above experience and the estimated recoverability on reasonably favorable terrain, the Air Technical Service Command is taking action to procure a quantity of ten thousand (10,000) Assisted Take-Off Rocket Motors which this Command believes will be sufficient to provide for five thousand (5000) launchings.

6. It is requested that a requirement be made on Ordnance Department, through the Army Service Forces, for a quantity of twenty-five thousand propellant charges for utilization on the following basis. The ten thousand (10,000) Assisted Take-Off Rocket Motors will be initially loaded by the Ordnance Department prior to shipment for use. The Ordnance Department will pack, ship and handle the fifteen thousand (15,000) additional propellant charges. The rocket motors after use will be furnished to a point designated by the Ordnance Department for re-loading by Ordnance Personnel. The foregoing procedure is recommended with the knowledge that the Ordnance Department has recommended that the initial procurement of Assisted Take-Off Rocket Motors not be re-loaded.

7. Your concurrence in the action outlined above is requested.

For the Director:

T. A. SIMS
Colonel, Air Corps
Chief of Administration

COORDINATION
DIRECTOR OF DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMIN.
SPECIAL STAFF
CHIEF, ENG.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

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K & HEINTZ, INC.

ember 16, 1944

REPORT OF PROJECT ENGINEER, LYSLE D. CAHILL

(SUBSTANTIATED BY PROJECT ENGINEER, WALTER BUHL)

PROJECT MX-544

Project MX-544 was originated for the purpose of designing and building an aerial torpedo similar to the flying bomb being used by Germany. Original conception for the project as laid out by the Army in the first of a series of meetings held at Wright Field, was that the flying bomb, designated as the JB-2, was to be an exact replica of the German Bomb. The general concensus of opinion of manufacturers present was that such a plan was not feasible and that much time and effort could be saved if the bomb were duplicated as closely as possible with the present equipment and construction methods accepted as common practice in the U.S.A.

Manufacturers represented at these original meetings were Alloy Products on air bottles, Ford Motor on jet engine, Republic and Bell Aircraft on airframe, Northrup on launching and new type airframe designated as JB-1, Hammond and Jack & Heintz on control equipment, Hammond to work on JB-1 control and Jack & Heintz on JB-2.

The manufacturers made their first drafts on drawings at Wright Field where a collection of parts from dud bombs that had landed in England was kept in the mock-up building.

Bell Aircraft withdrew from the project and left the airframe in the hands of Republic. After the first drawings were completed the manufacturers went back to their plants and pushed their assigned part of the project with all possible speed. A series of three meetings of manufacturers was held for the three following weeks to coordinate the assemblies of the various manufacturers. The Army presided at these meetings which were held at Wright Field and did a thorough job of co-ordination. Major Kotcher was Project Engineer and was assisted by Captain Wright of the Control Branch, Captain Pierce of the Special Weapons Branch and numerous other officers whom we did not contact on our particular part of the project.

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& HEINTZ, INC.

ber 16, 1944

The control unit, which we were to build was a new type as far as our manufacturing experience was concerned. It was entirely pneumatic, its displacement control on both the pitch and yaw axes was by a single gyro tilted for giving roll stability. In addition, two rate gyros were used, one in pitch and one in yaw, their signals being mixed with the displacement signal to give control proportional to displacement from course and rate of displacement from course.

The main control unit also carried an altitude control which was operated by an aneroid through an air servo. The servo moved the pitch displacement pickoff changing the attitude of the ship in climb or dive depending on setting. A pair of coils to precess the displacement gyro in azimuth from magnetic compass signals is used for course control and was also a feature not found in previous control equipment manufactured by us.

It was decided that the main gyro control unit could use only a few of our production parts. These include our horizon rotor and housing which was changed to erect to 20° rather than vertically, our horizon bar indicator was reworked and adapted to actuate the yaw pickoff shield which was a new type not used in the German system and as far as the writer knows it is unique in this country in that it is sensitive only to yaw displacement even though it has motion in pitch. Our horizon gymbal was used without any major change.

Rate gyros were made by reworking our bank and climb gyro, all other parts used in the unit were new. An improved method of actuating the pitch pickoff was also adopted which permitted our using the JH 6516 gymbal mentioned above.

The pneumatic servos, air logs, magnetic compass and junction box were designed and produced from scratch. This also applies to main control frame, cradle, manifolds and a hundred other parts used. The net result was a control unit which duplicated the German control equipment, and which was more economical in so far as air consumption was concerned.

In order to study the control effect and to obtain the accuracy of the system, it was decided that the installation of the system in an aircraft would give us considerable help, especially in so far as study of the operation of the altitude control and magnetic slaving was concerned. Follow up ratios could not be checked to advantage because the characteristics of the C-45 which we were given permission to use by the Army, and

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674

ACK & HEINTZ, INC.

[redacted]

vember 16, 1944

those of the JB-2 are vastly different.

The installation in the C-45 served very well in instructing personnel both at Republic and in the Army as to the control characteristics and method of control. A further series of checks with photographic recording is being contemplated to give a very accurate summary of the performance of the control system.

After tests were run and the first six pilot models completed, they were taken to Republic and installed in the JB-2 units nearing completion. Republic is to be congratulated on their courteous treatment and cooperation which we received while working with them in their plant at Bethpage, Long Island.

The first two completed JB-2 units minus engine were shipped by Air Express from Bethpage, Long Island to Range 64, Eglin Field, where the tests were to be run under Army supervision.

Range 64 was set up for the specific purpose of testing the JB-2 and JB-1 units. A launching ramp 400 ft. long of concrete and steel construction inclined at an angle of six degrees was built facing the Gulf of Mexico, Hutments, mess hall, assembly shop, engine shop, rocket shop, ordinance explosive storage building, and two bomb-proofs complete the range equipment.

First assembly of the various parts of the JB-2 units, launching devices, firing control equipment and check equipment for flight controls, were all made by the officers and civilians present. This work was carried on under the direction of Major Kotcher and a full hard weeks work for everyone concerned was needed to get everything ready for launching. The Jack & Heintz personnel worked closely with Mr. Robert Jones of N.A.C.A. in setting up crude test equipment to check out the first JB-2 units in order that control follow-up ratios were within the range calculated by Mr. Jones and also known from test data of German origin. After equipment was assembled, preparation for the first launching was made. Photographic equipment for checking acceleration on the ramp was set up, aircraft for following the JB-2 unit were briefed and tried on practice runs. Radar and radio equipment for timing of takeoff and checking of flight were given last minute checks and all camp personnel was checked to see that they were in safe places before the launching.

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.CK & HEINTZ, INC.

vember 16, 1944

The take-off was very good and the attitude of the JB-2 unit did not change during the flight which was about two mile. The JB-2 slowly settled until it hit the gulf. At the time it was believed that the take-off speed was too low and maximum engine thrust was not developed. Since that time, it has been found that the engine thrust varies from engine to engine, and also it was found later that the launching rockets on the front of the carriage were burning away the control surfaces. Everything considered, it was regarded as essentially a successful flight since the engine was running and the plane was under control for the entire flight.

The second unit was ready for flight one week later. By this time, it was definitely ascertained from photographs and rocket car trajectory calculations that the take off speed was 385 ft. per second which was on the lowest calculated safe launching speed. It was therefore decided to launch with six rockets instead of five on the #2 unit. This was done and the take-off speed was sufficient to propel the JB-2 unit almost as far as #1, without the engine running. It is believed that the high acceler tion blew the motor out.

The #2 launching was into a 35 M.P.H. crosswind and the flight attitude was set for $8\frac{1}{2}^{o}$ instead of $6\frac{1}{2}^{o}$ as in the previous test. This pitch angle was quite a bone of contention between the Army and Jack & Heintz, it being our desire to have the speed lifted and the angle maintained rather than introduce a new variable. We were overruled, however and the $8\frac{1}{2}^{o}$ attitude used. The new attitude caused a very rapid climb from the launching thrust but as it slowed down below stall speed, the unit nosed over and dived at a sharp angle into the ocean.

The launching of #3 and #4 units was witnessed by Mr. Heintz as well as by General Wolfe, General Carroll, General Gardener and other Army officials of high rank. #3 was again tried with the $8\frac{1}{2}^{o}$ attitude, but with 5 rockets instead of six, also the attitude of the JB-2 on the launching dolly was changed so that it had one 8^{o} pitch angle instead of six as in previous tests. This change dropped the empenage of the JB-2 about four inches lower on the launching ramp.

The #3 launching was unique in that it was the shortest flight made up to that time. As soon as the launching car moved away, the JB-2 turned into a slow roll and dove into the ocean. Of course responsibility was placed on the control equipment although it was noticed that the control unit was "kicking" top rudder as the roll took place.

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K & HEINTZ, INC.

mber 16, 1944

#4 was launched in the afternoon of the same day before the same group of spectators and succeeded in hitting the ocean even closer to shore than #1. This time the JB-2 did a 90° roll before hitting the ocean. After these two launchings much debate took place concerning various things that could have gone wrong. Most opinions blamed control equipment. Late in the afternoon, one of the Republic men (Tom Leonard) found a section of elevator laying off the side of the ramp. Further investigation showed many small pieces of control surfaces scattered around the ramp. By this time, the Army had started to dredge up the wrecks and a quick preliminary investigation by means of a swimming expedition ascertained that the elevator control surfaces had completely burned off the first unit and that the right elevator of the second was completely gone and the left partially gone which caused the 90° roll. This finding cleared the control equipment as contributing to the faulty flights. What had actually happend was that dropping the rear section of the JB-2 four inches to change to the 8° attitude had moved the control surfaces into the blast of the front rockets on the carriage.

The next launching #5 was set up with a cart having all rockets in the rear. Upon trying to start the engine for the launching it started torching and the gasoline shut-off did not function. Consequently, fresh gasoline kept flowing out onto the ground and burning, finally two of the rockets exploded and the other three ignited and launched the whole wreck into the ocean.

#6 Launching used the new rocket arrangement of five rockets in the rear. This time CO_2 equipment was set up to blast the fire out if the motor should start torching. This launching was witnessed by Mr. Jack. The take-off was very good into a slight cross wind. The JB-2 flew out of sight and appeared to be flying with right wing slightly low. Later, the tracking plane said the wing picked up. The JB-2 hit the water about nine miles out. The estimated speed was about 400 M.P.H., faster than the tracking plane was able to travel. Radar showed the unit to go to about 800 ft. altitude and then take a fast flat dive into the ocean. This is believed to have been caused by the aneroid static tube location on the JB-2. As the speed increased the pressure decreased causing the altitude control to set in a dive. The altitude control was set for 1500 ft. This unit was also equipped with flares to indicate when the gyro uncaged and if low pressure developed. The uncaging flare operated

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vember 16, 1944

about 300 feet. from the end of the ramp and the low pressure flare did not operate.

#7 unit was launched the following day. The altitude control was set for 6000 ft. The JB-2 climbed to 6500 ft. and was shot down because it was past the 50 mile allotted distance. It is still not quite certain whether the failure to level off is due to static tube location or to temperature effect on the aneroid unit. However, both are being corrected.

#8 unit was set for 3500 ft. and launched O. K. It climbed to 3500 ft. and leveled off. The JB-2 flew at better than 400 M.P.H. and the tracking planes and fighters which were to shoot it down lost it completely. It is not known where this unit landed. To date these are all that have been launched. The most conservative estimates heard at the time the program was started was that at least 25 units would be needed to get them flying. Apparently, the most conservative estimates have been surpassed as the JB-2 appears to be definitely in the flying class. Some work remains to be done on actual course accuracy and range accuracy checks. This will be a matter of tracking and flights and determining whether or not the control equipment is delivering the expected accuracy. From our own tests, we believe the inherent accuracy of the system is as good as can be obtained with this type equipment. Further refinements are in the offing in the way of auxiliary equipment which will serve to increase the destructive effect of the JB-2 as a weapon.

The cooperation and good will between manufacturers and the army has been excellent throughout the project. It was difficult to keep a group of persons with such diverse interests working all of the time on the project, but it was noticed that civilians and Army officers alike pitched in and helped where the help was needed whether it was on the particular part the persons involved were interested in or not.

LDC:MG

L. D. Cahill

[redacted]

AAF MC-265-WF-9-2-42-500M

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INTER-OFFICE MEMORANDUM
ARMY AIR FORCES
[redacted]
AIR TECHNICAL SERVICE COMMAND

Captain C. A. Kernerthle
Ext. 2-5220
Wright Field, Dayton, Ohio
Date 2 December 1944

TO: TSEPL-5G.
Attention: Weldon Worth.

SUBJECT: JB-2 Installation on B-17 Airplane.

mx-544

1. The Chief of the Engineering Division has directed that action be initiated immediately for the installation of the JB-2 missile on the B-17 airplane for the purpose of launching this bomb in flight. The Aircraft Laboratory is proceeding on the detailed design of this arrangement on a high priority basis.

2. It is requested that your Office render all possible assistance in evolving the method of starting and operating the intermittent jet engine while the bomb is attached to the carrying airplane in flight.

3. Expenditure Order No. 673-48 has been assigned to cover the development and testing of this project.

Jack Lut, Maj. A.C.
for G. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

[redacted]

Signature

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Engineering Division

NAVY DEPARTMENT
BUREAU OF AERONAUTICS
WASHINGTON 25, D. C.

Aer-E-18-GW

C35903

26 Dec. 1944

CONFIDENTIAL

MX-544

From: Chief, BuAer.
To: CO, NAMC, Philadelphia, Pa.

Subj: Project for Investigating the Use of JB-2 Type Flying Bombs From Naval Ships - Establishment of.

Encl: (A) PAD Study No. D-70 dated 4 Dec. 1944.

1. The purpose of this letter is to take the first step in the establishment of a program to prove the feasibility of using JB-2 Flying Bombs from a CVE type aircraft carrier. It is visualized that such a weapon is adaptable to two basic tactical uses:

(a) Attacks by night or day against enemy area targets at distances of 100 miles. In this usage, remote control will be exercised through an APS type radar mounted on a carrier type aircraft which remains in the vicinity of the launching ship.

(b) Attacks by night or day against enemy shipping targets within 100 miles. Control for this usage will be the same as above or through the medium of fire control radar on the launching ship.

2. It is contemplated that the NAMU will accomplish the development phase of this program as defined in previous policy correspondence. It is further contemplated that the test and evaluation phases shall be conducted by SWTEU at a later date. The objective of the entire program shall be to demonstrate the feasibility of the use of JB-2 Flying Bombs from CVE carriers.

3. The following items of information are given as a background:

(a) One catapult is under development by the Bureau of Aeronautics which will be suitable for installation on a CVE and also for launching of the subject type bombs. This item will not be available for some months, but will be assigned to NAMU and subsequently to SWTEU.

(b) One JB-2 Flying Bomb has been requested direct from the Army to be shipped to NAMU for mockup and instructional purposes.

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CONFIDENTIAL

C35903

Subj: Project for Investigating the Use of JB-2 Type Flying Bombs From Naval Ships - Establishment of

- -

(b) Fifty JB-2 Flying Bombs are to be procured from the Army.

(c) A project to the Naval Research Laboratory is being established for the development of the electronic units of the control system.

(d) The practicability of mounting a JB-2 pick-a-back on a PB4Y-1 airplane has been established by enclosure (a). It will be noted that certain operational restrictions will be required and the airplane must be placarded accordingly.

4. It is requested that the NAMC undertake the following items of work in order to further this program:

(a) Modify one PB4Y-1 airplane to carry a JB-2 Flying Bomb pick-a-back in such a manner as to permit launchings at medium altitudes. The operational use of JB-2's from PB4Y type aircraft is not contemplated. Thus, the installation may be such as to permit the obtaining of a maximum of engineering information. (One PB4Y-1 will be assigned to NAMU at an early date. The actual delivery will be made to the [illegible] Project [illegible] at the NAS Squantum, Mass.)

(b) Upon notification of readiness from the Naval Research Laboratory, furnish flight test facilities for the working out of the control system. It is visualized that one [illegible]-1 airplane (equipped with ASC type radar and now in transit from Sta. OEZ to NAMU), plus one SNB-1 type drone (also to be assigned NAMU) will be required. It is further visualized that these airplanes will operate from the Naval Air Station, Anacostia, with personnel furnished by NAMU as a detachment. The NAS Anacostia will be requested to furnish the necessary operational and maintenance assistance.

5. In the interests of economy of aircraft, it is suggested that the PB4Y-1 airplane be assigned to the DCVE flight test group for execution of this program. It is further suggested that the DCVE flight test group utilize the airplane as a DCVE carrier, making such modifications as may be necessary. It is understood that this course of action will release two TBM type aircraft for transfer. Buaer should be notified as to the Bureau numbers of the airplanes and their dates of availability.

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Subj: Program for the Use of JB-2 Type Flying Bombs From
Naval Ships - Establishment of.

- -

6. Project TED NAM 1237 is assigned with Priority B.

7. Expenses incurred in connection with this project are to be charged to project order 420-45 which is being issued in the amount of $85,000.00.

(No Enclosures)

/s/ Robert [illegible] Fletcher
Capt., [illegible]
By direction Chief of Bureau

CC: NAMC, Johnsville, Pa.
NRL
[illegible], NAS, Traverse City, Mich.
BUORD
BUSHIPS
DCNO(Air) Attn: Op-31-7
NAS Anacostia
CinC Project [illegible], NAS Squantum, Mass.
BAGR-CD, Wright Field, Dayton, Ohio.

0576

AAF Form No. 45
(16 Sep 44)

[redacted]

"[illegible] for Investigating the Use of JB-2 Type Flying Bombs from Naval Ships - Establishment of."

COORDINATION	
DIRECTOR OR DEP.	
AIR INSPECTOR	
MGT. CONTROL	
CHIEF OF ADMN.	
SPECIAL STAFF	
CHIEF, ENG. & PROC.	
CHIEF, SUPPLY & MAINT.	
PERS. & BASE SERV. DIV.	
INT. DIV.	
SUPPLY DIV.	
ENGINEERING DIV.	
PROCUREMENT DIV.	
READJ. ST DIV.	
OTHER	

1st Ind. [illegible]

[illegible], [illegible] January 1945.

[illegible]. Attention: [illegible].

1. [illegible] initiated an investigation under the supervision of the Special [illegible] for the launching of the JB-2 [illegible] in flight from bombardment type aircraft in November [illegible]. [illegible] attention was given to the B-17, B-24, [illegible] and [illegible]. [illegible] were eliminated almost [illegible] clearance limitations. [illegible] (JB-2-1) was outlined in drawing No. [illegible] aerodynamic investigations proved that this configuration would be exceedingly dangerous to personnel of the launching aircraft during the launching operation. For this reason it was considered advisable to design an installation for carrying the JB-2 underneath the launching aircraft.

2. In the case of the B-17, the installation under the wing appeared entirely feasible. Because of insufficient ground clearance, it was necessary to place the JB-2 out board of the outboard engine and because it would require full aileron deflection at a speed of 132 mph to hold the airplane level, it was decided to carry one under each wing.

3. Preliminary performance estimates with this arrangement indicated that the take-off distance over a 50 foot obstacle would be increased 500 feet to [illegible] feet. The reduction in high speed at 10,000 feet altitude at a target weight of 57,000 pounds (just before releasing the two JB-2's) would be about 20 mph to a high speed of 242 mph. Based on a starting gross weight of 65,000 pounds with 211 gallons of fuel aboard and flying at 10,000 feet, the B-17 would have a radius of action of approximately 1,[illegible]0 miles.

4. The installation and detail drawings for carrying two JB-2 bombs on the B-17 airplane are at present approximately 75% complete and fabrication of the carrying structure has been initiated. It is anticipated that flight tests will begin at Eglin Field, Florida, during the first week of February 1945.

5. The study on carrying one or two JB-2's underneath the B-24 showed that because of the landing gear configuration and questionable wing strength, the installation would be more complicated than on the B-17. In addition, the CG of the B-24 would move aft approximately 5 per cent when carrying two under the wing.

Col P F Helmick

[redacted]

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[redacted]

1st Ind. to [illegible]GR. 15 January 1945
"Project for Investigating the Use of JB-2 Type Flying Bombs From Naval Ships - Establishment of."

6. Confirming telephone conversation between Lt. J. [illegible] Harrigan and Captain [illegible] A. Werner on [illegible] January 1945, it is requested that this Office be furnished additional information on the catapult under development by the Bureau of Aeronautics which will be suitable for launching the JB-2 as outlined in paragraph 5a, Bureau of Aeronautics letter Aer-[illegible] 65903 dated 26 December 1944.

[illegible],
Colonel, Air Corps,
Chief, Equipment [illegible],
Propulsion and Accessories Section,
Engineering Division.

1 Incl.
No change

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Capt. Jon H. Ober
ees/TSTEX (5-6147)

[redacted]IAL

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

T E C H N I C A L   I N S T R U C T I O N S

MX-544

Wright Field, Dayton, Ohio
16 December 1944

SERIAL NO: TI-2003, Addendum No. 9.

SUBJECT: Guided Missiles - Mechanical Methods of Launching Jet Bombs.

TO: Engineering Division.

1. Problem Presented:

a. To develop a mechanical launching system for jet bombs.

2. Factual Data:

a. The present assisted take-off method for the JB-2 and JB-1 has resulted in successful flights for the JB-2. The use of rockets, however, has several disadvantages:

(1) The shortage of rocket powder, and the major difficulties involved in diverting and building new facilities, and in securing sufficient raw materials.
(2) The danger involved in handling this explosive material.
(3) The large flash and resultant volume of smoke from the rocket burning.
(4) The high cost of the facilities and powder.

b. It is also evident that serious problems will be encountered in securing and transporting fuel for the imitation of the German ramp.

3. Authority:

a. CG, AAF. By letter dated 11 November 1944, subject as above, received from Chief, Engineering Division, Materiel Division, AC/AS, M&S.

4. Action Desired:

a. Development is to be undertaken for a mechanical launching system requiring no (or a minimum amount of) explosive powder or fuel. The following methods are among those that have been suggested. Comments are requested on each type, as well as other types which may be contemplated:

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SERIAL NO: TI-2003, Addendum No. 9 (continued).

SUBJECT: Guided Missiles - Mechanical Methods of Launching Jet Bombs.

TO: Engineering Division.

(1) An air turbine type (suggested by Capt. Young of Air Engineers Office).

(2) A large flywheel, motor operated, connected by a friction clutch to a tapered cable sheave. The cable would pull the bomb cart along a horizontal or inclined track of a short length (app. 200 ft.).

(3) A cart with either tricycle wheels, or operating on a rail, pulled by a cable, winding around a motor operated windlass. This would be used on either an airplane runway or a long track (possibly 3000 to 4000 ft. long).

(4) A launching cart operating on a long rail (2000 to 5000 ft.), powered by sufficient airplane motors to reach the equired launching speed and then be braked to a stop.

(5) A flash-boiler system to generate the steam for the German type ramp-instead of using explosive fuels to generate the pressure.

b. This project has a 1-A priority.

By command of Lt. General KNUDSEN:

Jon H. Olen Capt AC

T. A. SIMS,
Colonel, Air Corps,
Chief of Administration.

cc: Procurement Division
Supply Division
Maintenance Division.

[redacted]

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

11 November 1944

SUBJECT: [illegible] Methods of Launch[illegible] Jet Bombs

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

[illegible], Chief of A[illegible] (TSEPX)

1. The [illegible] assisted take-off method for the JB-2 and JB-1 has resulted in successful flights for the JB-2. The use of rockets, however, has several disadvantages:

a. The shortage of rocket powder, and the major difficulties involved in [illegible] and [illegible] new facilities, and in [illegible] sufficient raw materials.

b. The danger [illegible] the [illegible] material.

c. [illegible]

d. [illegible]

2. [illegible] the Launching rail.

3. [illegible] the [illegible] rail, it is [illegible] be started [illegible] to develop [illegible] for [illegible].

4. [illegible] have been [illegible]. [illegible] AMSC:

a. [illegible] of Air Engineers Office).

b. A [illegible] flywheel, motor [illegible], connected by [illegible] to a tapered [illegible] sleeve. The [illegible] would [illegible] the bomb cart along a horizontal or inclined track [illegible] a short length (app. 2[illegible] ft.).

c. A cart with either tricycle wheels, or [illegible] on a rail,

[redacted]

Y-116307

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[redacted]

Subj: Mechanical Methods of Launching Jet Bombs (Cont'd)

pulled by a cable, winding around a motor operated windlass. This would be used on either an airplane runway or a long track (possibly 3000 to 4000 ft. long).

. A launching cart operating on a long rail (2000 to 5000 ft.), powered by sufficient airplane motors to reach the required launching speed and then be braked to a stop.

e. A flash-boiler system to generate the steam for the German type ram instead of using explosive fuels to generate the pressure.

By command of General ARNOLD:

for M.C. Demler, Col. A.C.
D. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engr. Br., Mat. Div.,
Office, Asst. Chief of Air Staff,
Materiel and Services

[redacted]

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HEADQUARTERS ARMY AIR FORCES

Washington 25, D.C.

a. Present availability and cost of materials.

b. Time required and cost of expanding existing facilities or of building new units to produce these materials.

c. Special precautions or considerations required for the safe production, handling and storage of the materials.

d. Shipping containers required, their availability, cost, and time required to produce them if not available.

e. Availability and practicability of manufacturing [illegible] and containers in the European Theater.

f. The effect on other [illegible] [illegible] military and civilian, if [illegible] [illegible] selected are allocated to the Army Air Forces in sufficient quantity to provide for this effort of great magnitude.

[illegible] It is suggested that this study cover, [illegible]

a. [illegible] [illegible] and [illegible] [illegible].

b. [illegible] [illegible] and [illegible].

c. [illegible] and [illegible] agent.

d. Liquid [illegible] and alcohol or gasoline.

[illegible] All developments [illegible] [illegible] [illegible] concerned with successful [illegible] of [illegible] are [illegible] under the [illegible] priority, it is requested that the [illegible] outlined above be given the same [illegible].

For the Commanding General, Army Air Forces:

[illegible]
Brig General, [illegible]
Air Chemical Officer

[redacted]

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTION

Captain Jon H. Ober
ces/TSTEX (5-6147)

[redacted]

AUTH: Director, ATSC
DATE: 1-11-45
INITIALS: [illegible]

MX-544

Wright Field, Dayton, Ohio
11 January 1945

SERIAL NO: TI-2003, Addendum No. 12.

SUBJECT: Guided Missiles - Radar Control for JB-2.

TO: Engineering Division.

1. Problem Presented:

a. To make available for test during the month of March 1945, fifty (50) AN/APN-19 radar control equipments.

2. Factual Data:

a. At a recent conference it was agreed that the requirement for 50 AN/APN-19's for the JB-2 program [illegible] the overall requirement for this equipment [illegible] use. This decision was based on two factors:

(1) The use of AN/APN-19 is [illegible] material [illegible]. The AN/APN-1 program will [illegible] of the necessary testing and is scheduled to proceed [illegible] as the AN/APN-19 program could proceed.

b. A limited procurement for [illegible] radio sets AN/APN-1 is being processed through the Signal Corps. The required delivery schedule is at the rate of 500 per month, starting in April 1945, with the stipulation that inasmuch as future use of the JB-2 may require a production rate of 100 equipments per day, a contractor be chosen with facility to expand production sufficiently to provide for at least the major portion of the possible 100 per day requirement.

c. The agreement on a requirement of 50 AN/APN-19's for the JB-2 program was based on the premise that the development would take a high priority and this quantity and the quantity for the P-51 Fighters in the Eighth Air Force would be crashed. Since the conference it has developed that there is a possibility that the proposed requirement for the AN/APN-19 for Fighter use may be withdrawn, in which case no action will be taken to procure the AN/APN-19.

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[illegible] (continued).

[illegible] Missiles - [illegible] Control for JB-2.

[illegible]

[illegible]

[illegible]

copy of [illegible] for [illegible] per 6/7

[redacted]

[illegible] for JB-2.

[illegible] Division, Engineering Branch 14 MAR 1945

1

[illegible] Requirements Division Maj Short/ojj/72435

1. The operational use of the JB-2 [illegible] bomb against Japan will probably [illegible] upon the availability of suitable launching sites.

2. The development of the "zero" length type of launching indicates that [illegible] vessels might provide suitable bases for launching the JB-2 against land targets in the absence of ground bases within the range of the missile.

3. It is requested that a study be made to determine the feasibility of using [illegible] types of vessels as JB-2 launching bases. The TA-1 target boat is suggested as possibly being suitable for this use if equipped with suitable [illegible] and auxiliary equipment.

4. [illegible] assigned this project.

Prior [illegible]

[illegible]
Colonel, Air Corps
Acting Chief

[illegible] RETURN TO H.Q. [illegible]

[redacted]

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Water Borne Launching Sites for JB-2. [redacted]

Asst C/A[illegible], MAS, Engineering Branch   6 [illegible]

5

Asst C/A[illegible], [illegible], Requirements Division   Lt Col Younger/ojj/2656

1. Reference is made to Comment 2 above.

2. If the JB-2 is to be used extensively in the conduct of the war against the Jap home islands, it would appear that a large number of small vessels, having great mobility, would permit effective use of the JB-2 in covering amphibious operations.

3. Practical experience with the smaller types of vessels such as the [illegible] indicate that such vessels would not provide the stable platform, speed or working space necessary for such operations.

4. The T.A.-1 target boat, (photos attached) is absolutely stable in a fairly rough sea and would provide a large flat surface from which the JB-2 could be launched in large numbers.

5. It is suggested that reconsideration be given to the plan set forth in Comment 2 with a view to constructing one hundred (100) or more TA-1 type boats for this purpose. These vessels should be of steel, approximately 120 feet long and 40 or 50 feet wide. A fleet of 100 or more could be serviced by a Liberty or Victory ship, aboard which all assembling, preparation and stowage could be done.

6. An informal investigation through Mr. Henry Kaiser shows that man power, steel and building facilities are available and that 100 boats could be fabricated in about three (3) months. Obsolete types of Navy Allison aircraft engines, (2000 H.P.) are available and can be converted for Marine use by the time the hulls are built.

7. These inexpensive, fast and stable, twin-hulled type boats could be moved about to provide mobile launching facilities for the JB-2 in a more practical manner than from any small vessel having less stability.

1 Incls
Photos

LESLIE O. PETERSON
Colonel, Air Corps
Acting Chief

Bomb. Branch ______________

R&M Section ______________

A F D R Q/N [illegible] ______________

RETURN TO [illegible] [redacted] [illegible]

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MEMORANDUM TO ASSISTANT CHIEF OF AIR STAFF, OPERATIONS, COMMITMENTS AND REQUIREMENTS.

Subject: Joint AAF-Navy Project for Development of [illegible] as a Launching Base for JB-2's.

1. Conversations were held between Colonel Travis and Major [illegible] and Mr. Robert Lovett, Assistant Secretary of War for Air, regarding the use of [illegible] as launching bases for JB-2's. During the course of the conversation, Mr. Lovett outlined the history of the JB-2 [illegible] particular emphasis on launching methods. [illegible]

2. Colonel Travis, Major [illegible] [illegible] a brief report of the meeting follows:

a. A letter [illegible] [illegible] for ship-board launching [illegible]

b. AAF [illegible]

c. Navy representatives [illegible] [illegible]

d. [illegible] of the proposed Joint AAF-Navy Project led to the following recommendations by the Navy:

(1) That the Navy [illegible] [illegible]

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[illegible] Bureau of Ships recommend the time and place [illegible] is to be made available after conference with [illegible] Ground Command and Air Technical Service Command.

[illegible] detail project be carried out under a confidential [illegible].

S/ L.C. Petersen

LESLIE C. PATERSON
[illegible], Air Corps
Acting Chief, Requirements Division
Office of Asst Chief of Air Staff
Operations, Commitments and Requirements

[redacted]

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Auth: C.G. AMC
Initials: CWT
Date: 14 JUNE 1946

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V-35349-5
App. B, Vol. II

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Auth: C. G. AMC
Initials: cwt
Date: 14 JUNE 1946

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App. B, Vol. II

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Auth: C.G. AMC
Initials: CMT
Date: 14 JUNE 1946

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V-35349-5
App. B, VOL. II

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THE DEVELOPMENT OF GUIDED MISSILES

APPENDIX B

AAF Missiles Documents

VOL. III

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FILE NO. 201-96 V.5

[redacted]

Auth: C. G. AMC
Initials: cwt
Date: 14 JUNE 1946

Downgraded to Unclassified in accordance with letter from AMC - dated 17 Nov 59, Sub: "Declassification of Histories (U)"

(AFR 11-30)
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App. B, VOL. III

AFCGM-H-S-44/56

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Auth: C. G. AMC
Initials: cut
14 JUNE 1946

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Auth: C.G. AMC
Initials: cmt
14 JUNE 1946

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Maj Short/[illegible]/5617
Room 4E 1086
Wash 1[illegible] April 1945

1[illegible] APR 1945

AFRDB

[illegible] Launching of [illegible]

President
Army Air Forces Board
[illegible] Field, [illegible]

1. S[illegible] relative to the use of LST's as launching [illegible] for [illegible] has led to the conclusion that roughly ninety (90) percent of the work to [illegible] operational. Therefore, the Assistant Chief of Air Staff, Operations, Commitments and Requirements will be the office of primary responsibility in this Headquarters.

2. It is requested that the AAF Board initiate a project for the [illegible] and testing of the LST as a launching base for the JB-2 by the AAF Proving Ground Command. In order that this program may be expedited, you are authorized to request technical aid as needed from Air Technical Service Command directly. Authority is also granted for direct contact with interested Naval agencies. In this connection, it is suggested that you contact Captain Colvin Baxter of the Bureau of Aeronautics, Commander F. W. Snyder and Commander Robert Kleinschmidt of the Bureau of Ships who have made some preliminary studies of this same problem.

3. Preliminary studies of the problem of the adaptation of the LST and any necessary ground tests should be conducted as rapidly as possible in order that actual shipboard tests may be made at an early date if such tests are believed desirable as a result of the preliminary studies.

4. The TA-1 experimental target boat has also been suggested as a type of vessel for use as a mobile launching platform for the JB-2. The operational use of this type of vessel would differ considerably from that with the LST because of the lack of cargo space. This proposal contemplates the use of a number of the boats, each with several ramps, serviced by cargo ships in a sheltered anchorage, aboard which all assembling, preparation and stowage could be accomplished. The buzz bombs would be loaded on a launching boat ready to fire and the boat with a small crew would then proceed to a suitable position, launch the missiles and return to the anchorage. An informal investigation indicates that a large number of

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twin-hulled boats similar to the [illegible] built of steel and [illegible] converted Navy [illegible] aircraft [illegible] could be produced in a short time.

5. It is directed that the AAF Board initiate a project to investigate the proposal made in paragraph 4 and make recommendations to this Headquarters as to advisability of [illegible] the study [illegible] toward making actual launching tests at an early date.

6. The present status of the [illegible] program and the [illegible] agencies concerned make it necessary to maintain close liaison between all the interested agencies and this Headquarters on the above project.

a [illegible] priority is assigned the above [illegible]

BY COMMAND OF GENERAL ARNOLD:

[redacted]

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SUBJECT: Report on Trip to Hqs., AAF, Washington, D. C., 22 April 1945.

TO: TSESE-PG
Attention: Major Kotcher.

1. The undersigned arrived in Washington, D.C. on 22 April and reported to Hqs., AAF at 0830, 23 April for the purpose of conferences with personnel of the United States Navy, Bureau of Ships, personnel of the Office of AC/AS, M&S, and personnel of Sub-Committee No. 3 of the Guided Missiles Committee of the Committee of New Weapons and Equipment of the Joint Chiefs of Staff.

2. During the morning of 23 April, a meeting was held at the Offices of the Bureau of Ships, USN. The following personnel were present:

a. Air Technical Service Command, Engin. Div.	-	Capt. G.B. Pierce, Jr.
Office of Air Engineers, Hqs., AAF	-	Capt. T.F. Young
Bureau of Ships, USN	-	Commander Snyder Commander Kleinschmidt Lt. Wyatt Mr. French
OC&R, Hqs., AAF	-	Major Short

b. The problem of installing 50 foot rocket type JB-2 pilotless aircraft launching ramps on an LST was thoroughly discussed with the representatives of the Bureau of Ships. Drawings of the JB-2, drawings of the ramp and launching sled, drawings and pictures of JB-2 handling slings, photographs of JB-2 starting equipment and an assembly and erection manual for the JB-2 aircraft were examined by all present and left with Mr. French. Blue prints of an LST were studied to determine the best location of ramps, the method of storing JB-2 aircraft, launching sleds, and rockets, and the method of handling JB-2 aircraft from storage deck to launching ramp. It was decided that the Bureau of Ships would design an LST installation embodying the following features:

(1) The preliminary design will provide one 6° inclined 3-rail ramp placed athwartships. Length of ramp is to be 50 feet long (to be reduced to 40 ft. overall length later if possible or necessary). Room will be left available for one or two additional ramps if tests prove that more than one ramp can be operated without interference due to rocket blast.

(2) Storage for 75 assembled aircraft (less wings but with warhead, engine, and nose section) will be provided on the tank

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storage deck if possible. (Probably a quantity of 45 will be more conveniently stored.)

(3) Bombs will be hoisted from the tank deck to the firing ramp by means of a 5,000-lb. capacity crane.

c. The possibility of using steam or multiple cartridge launchers from an LST was discussed but the representatives of the Bureau of Ships stated that they were only interested in the 50 foot rocket-type launcher as the Navy Bureau of Air was conducting studies of installation of other methods of launching from an LST as a straight Navy project. (This fact was later verified by Lt. Colonel Stace of AC/AS, MMS. Capt. Young, Office of Air Engineer, is conducting liaison work on that project and has all necessary information on the ramp installations.)

3. On the afternoon of 23 April, an attempt was made by Captain Pierce to have a directive issued to procure a quantity of JB-2 aircraft handling, testing, and starting equipment to be placed in storage for future use. Conversations were held with Lt. Colonel Stace (MMS), Lt. Colonel Cannon (M[illegible]), and Major Short ([illegible]). No decisions were reached.

4. At [illegible] 24 April, a conference was held at the Munitions Building to discuss quantities of material and dates for a program to launch JB-2 aircraft from LST's. The following personnel were present:

a. AC/AS, MMS, Hqs., AAF. - Lt. Colonel Stace
Captain Bickham

Air Technical Service Command - Capt. [illegible] Pierce, Jr.
(Eng. Div., Airc. Proj. Sec.)
Capt. J.K. Duncan, Jr.
(Proc. Div., Proj. Sec.)
Capt. Evans
(Proc. Div., Communications Sub-Section)
Lt. [illegible]lfenbein
(Proc. Div., Communications Sub-Section)

Joint Chiefs of Staff Committee on New Weapons and Equipment, Guided Missiles Committee, Sub-Committee No. 3 - Major Taylor
Mr. Flood

X-115530-/

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Report on Trip to Hq., AAF, Washington, D. C., 2[illegible] April 1945.
[illegible] TB-20. Attention: Major [illegible]her.

b. Dr. Flood directed the conference and presented a plan he had worked out based on figures presented to him by OC&R. Dr. Flood had been given the job of working out the earliest date when it would be possible to make 5[illegible] effective launchings of JB-2 pilotless aircraft per day from LST's at sea for a period of [illegible] days. (An effective launching is defined as one which delivers a bomb to an area target 10 miles square and the bomb does damage to the target.) According to Dr. Flood, 5[illegible] [illegible]'s will be required. Bombs will be completely assembled, and loaded aboard an LST at an [illegible] base, moved to the firing area by LST and launched. The figure of [illegible] LST's is established by assuming that 50% of all bombs launched will hit the target and that 20% of the LST's will [illegible] casualties. (It was pointed out that these assumptions are optimistic.)

c. Representatives of the Procurement Division, Air Technical Service Command, estimated that with double A-1 and Group 2 priority the necessary JB-2 aircraft and equipment could be made available by 1 February 1946. It was also estimated that radar control equipment and launching sleds could be available by 1 February 1946. The conference was closed at 12[illegible] without discussion of any other methods of launching the JB-2 aircraft so that Dr. Flood could communicate the plan for 1 February 1946, to Guided Missiles Committee.

[illegible]. At 15[illegible] on 2[illegible] April, another conference was held to discuss possible quantities of JB-2 aircraft that could be launched by 1 September 1945 from LST's. This conference was held in the Offices of M&S, AC/AS, and in addition to personnel listed in Paragraph [illegible].a. the following personnel were present:

a. Air Technical Service Command - Capt. Fetter, Maintenance Division.

Ordnance Department - Capt. Shaeffer, Frankfort Arsenal.

b. The possible production program of JB-2 aircraft, miscellaneous equipment, launching sleds, and radar control equipment was thoroughly discussed and it was decided that the earliest possible date for launching any JB-2 aircraft was 1 February 1946. The conference closed with no decision but the inference was given that unless a launching date of approximately 1 September 1945 could be established, there would be no requirement for an LST launching program.

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"Report on Trip to Hq., AAF, Washington, D. C., 22 April 1945."
To: TSESo-E2, Attention: Major Kotcher.

6. At 0900, 25 April, a conversation was held with Captain T.P. Young with reference to the Navy Bureau of Air development of CVE and LST ramp installations. The Navy has designed a ramp similiar to the German launching ramp but made from aluminum castings instead of welded steel. Delivery date of the first ramp to the Navy will be approximately 20 May 1945. The ramp will be powered by steam or powder cartridges. The Navy program is still in the design stage and original plans are to lay the ramp horizontally on the deck of the ship and incline the bomb at the required 3° attitude by means of a light launching dolly. According to Capt. Young, the CVE installation will more readily adapt itself to JB-2 aircraft launching rapidly and in large quantity than will the LST proposition.

7. During the morning of 25 April, the general JB-2 program was discussed with Lt. Colonel Stace. Generalities only were discussed in an endeavor to think of a way to start use of JB-2 aircraft. No decisions were reached.

8. From 1130 to 1730 on 25 April, a conference was held to further discuss action necessary to initiate procurement of a quantity of JB-2 handling, testing, and starting equipment. The following personnel were present:

a. AC/AS, M&S - Lt. Colonel Stace

- Major Short

Air Technical Service Command - Capt. [illegible]

b. It was decided that OC&R would initiate action, based on a table of equipment now being studied, to procure approximately 36 sets of equipment. The necessary directive will be forwarded to Maintenance Division, Air Technical Service Command, and upon receipt of the directive, the Maintenance Division will initiate procurement based on information to be obtained from the Engineering Division, Air Technical Service Command. At that time, the Engineering Division, Air Technical Service Command, should make known to the Maintenance Division the additional sets of equipment to be required for testing purposes, AAF test ramp installations, Navy test ramp installations, or other possible uses. All required equipment would then be procured under one contract to allow placing as

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"Report on Trip to Hq., AAF, Washington, D. C., 22 April 1945."
To: [illegible]-2G, Attention: Major Kother.

large an order as possible to establish a source for future procurement.

8. Also discussed at this meeting, was the problem of handling JB-2 aircraft from landing vessels to beachheads. It was decided that a study would be initiated and that Hq., AAF personnel having adequate knowledge of landing equipment and operations will contact personnel of the Engineering Division, Air Technical Service Command, to consider the problem.

9. The undersigned returned to Wright Field by train, arriving 28 April 1945.

CHARLES B. [illegible], JR.,
Captain, Air Corps.

Copies to:
CG, AAFPGC Eglin Field, Fla.
TSMAL-4A Att'n: Capt. E. L. Vetter
TSEPR Att'n: Capt. J. R. Dungan
TSESM-2 (Attached to Temporary Duty Travel Rpt)

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COPY NO. 48

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1 [illegible]

[illegible] AND EQUIPMENT

[illegible] COMMITTEE

[illegible] 3

[illegible] AGAINST JAPAN

References: a. [illegible] 3/D
b. [illegible], to Chairman, [illegible], subj: as above, dated 7 Apr 45.
c. J.[illegible] 331

[illegible] Secretary

The enclosed report of [illegible] circulated to the members [illegible] Committee for their consideration and disposition at the [illegible] of the committee to be held [illegible].

[illegible]

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b. [illegible].

(1) Plan. Heavy bombers [illegible] target area round-the-clock in all weather, operating from airfields some 750 miles distant from the target, with take-offs and landings by instrument when necessary, and bombing by radar (S[illegible], H2X, or other) when necessary.

(2) Quantities. It is assumed that 30 successful sorties by B-24 airplanes each day would deliver 50 tons of explosive at the target. Replacements at the rate of 5%, due to enemy action and flying conditions, would require one and one-half replacement airplanes per day. Allowing for 100 per cent reserve, the total requirement is approximately 60 airplanes and 35 sorties per day. [illegible] allowance is made for aborting and other ineffective sorties due to causes other than enemy action. [illegible] required for air operations of this type [illegible] the total tons of bombs required would be approximately [illegible] tons.

c. [illegible].

(1) Plan. [illegible]-17 airplanes operating from airfields within radar control range of the target area. [illegible] would take the airplane off the ground, bail out, and the airplane would then be under radar control from the ground, which would be used to guide the airplane to the target and cause it to crash.

(2) Quantities. Since each Willie would carry ten tons of explosive, it would be necessary to have only five crash in the target area to deliver an explosive load equivalent to 50 JB-2. It is estimated that two of each seven Willies would fail to reach the target either through enemy action or other cause, so that seven Willies would be used each day. There would then be required for the sixty-day period: 420 Willies, 4200 tons of explosives, 420 electronic control equipments, and two SCR-584.

d. Controlled JB-2 from ship.

(1) Plan. It is assumed that the JB-2 equipment and personnel will be procured and trained before shipment to the staging area at Manila, and similarly for the ships (LST or CVE) and ship crews. The ships

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(2) Quantities. The following quantities apply:

Total JB-2 delivered [illegible]	6,000
JB-2 specialist personnel	1,800
Rocket propellants	1,500 tons
SCR-5[illegible] (if used)	[illegible]
Liberty ships required at [illegible]	12
JB-2 freighter space	1[illegible],5[illegible]0 tons
T[illegible] space	1,[illegible],00[illegible] mls. [illegible]
Engineer troops	1 battalion
[illegible] troops	1 company
[illegible]	[illegible]
JB-2 loss from [illegible] launching attempts	30[illegible]
Launching attempts [illegible] for 5[illegible] effective [illegible]	[illegible]

[illegible]. Schedules. The dates and [illegible] for all schedules are based on the assumption that priorit[illegible] [illegible] with bomb and munition procurement would be assigned by higher authority by [illegible] 19[illegible]. The estimates are based on the best information available to the subcommittee, but often depend upon the results of future [illegible] and development work, and are subject in many instances to [illegible] errors. Wherever possible, [illegible] dates are given for each item, representing optimistic, realistic, and pessimistic estimates of future progress. In several instances, notably for launching from L[illegible] or [illegible] and for [illegible] control of JB-[illegible], all three types of estimates are based on the [illegible] assumption that the development in process can be completed successfully.

a. Conventional [illegible]. [illegible] fuzes [illegible] special equipment for this purpose. It is estimated that the requirement for [illegible] 50,000 fuzes could [illegible] at Manila by 15 November 19[illegible].

b. Blind [illegible] operation. The [illegible]th Bombardment Group ([illegible]), [illegible] MTO, are already experienced in the use of SHORAN and could [illegible] in the Pacific Theater by [illegible] October 1945. As an alternative, [illegible] Heavy Bombardment Group of B-2[illegible] aircraft, [illegible] with SHORAN and [illegible] equipment, would be required. It is [illegible] that a Heavy Bombardment Group could be

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[illegible] equipped and trained [illegible] able in the Pacific Theater ready for [illegible] by [illegible] Navy has been successful in blind landings [illegible] Aleutians, and it is [illegible] blind landings at Iwo Jima. [illegible]

c. [illegible]. The [illegible] to that required for [illegible], [illegible] highly skilled crews. It is [illegible] completed [illegible] in the operational area [illegible] has been unable to [illegible] and availability of [illegible] Orders in the [illegible] theater [illegible]

d. [illegible]. [illegible] the LST [illegible] Navy beyond the [illegible] carrier JB-2 will [illegible].

(1) JB-[illegible]. [illegible] critical items [illegible] therefor.

[illegible]

JB-[illegible]

Item	[illegible]	[illegible]	[illegible]
Airframe	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Starting and [illegible] (100 units)	[illegible]	[illegible]	[illegible]
Propellant	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

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The airframe and pilot estimates are based on the specific assumption that this portion of the project will be given an AA1 Group II rating, and that no engineering changes will be made. Since present production makes no provision for electronic control it will be necessary to establish a modification center to equip the JB-2 with the APW-1, and it is estimated that this will require from one to two months at the rate of 15 man-hours per JB-2 by one two-man team. The Ordnance Department [illegible] difficulty in procurement of metal components for [illegible], of explosives (if "E-Day occurs), of metal [illegible], or of rocket-firing equipment. Army Air Forces does not expect [illegible] JB-2 will require [illegible] critical items listed in Schedule 1. Any [illegible] production of JB-2, beyond [illegible] Schedule 1, would require [illegible]. [illegible] the first JB-2 is about ten months after the [illegible] program, and then [illegible] per month thereafter.

(2) JB-2 [illegible]. It [illegible] would be [illegible] in the operational area by the dates shown in Schedule 2, following.

SCHEDULE 2

Procurement and Training of Personnel

Item	Optimistic	Realistic	Pessimistic
Successful test of JB-2 from LST	1 Jun [illegible]	15 Jun [illegible]	1 Jul [illegible]
JB-2 crews trained and at POE	15 Oct 45	15 Nov [illegible]	[illegible]
LST with JB-2 crew arrive at Manila	15 Nov 45	15 Dec [illegible]	[illegible] 46
LST leave Manila for operational area	1 Dec 45	15 Jan [illegible]	[illegible] Apr [illegible]
LST arrive operational area	15 Dec 45	1 Feb [illegible]	[illegible] May [illegible]

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(3) [illegible]. Schedule [illegible], following, [illegible] the principal dates of a modified program [illegible] and personnel.

SCHEDULE 3

Ship JB-2 Program Schedule

	Optimistic	Realistic	Pessimistic
Procurement completed	1 [illegible] 46	1 [illegible] 46	1 Apr 46
Modification completed	1 [illegible]	15 Mar [illegible]	1 Jun [illegible]
Arrive Manila	15 Apr [illegible]	15 Jun [illegible]	1 Oct [illegible]
Leave Manila (after assembly, tests and adjustments)	1 [illegible]	1 Aug [illegible]	1 Dec [illegible]
First launching	[illegible] 6	15 Aug 46	15 Dec [illegible]

(4) LST modification. It is [illegible] that the [illegible] of launching JB-2 from LST will be completed during June 19[illegible]. No estimates are available concerning the time it will require for the modification of the LST's, to be used in the operation, but it is likely that they could be completed prior to 1 February 19[illegible]6, the earliest [illegible] they would [illegible] delivered at the PE in order to keep pace with the other [illegible] of the JB-2 program.

c. JB-2 launched from beach. The personnel and material schedules for JB-2 launched from beach are the same as for JB-2 launched from LST, up to the time of delivery at Manila (see Schedule 3). The estimated schedule after delivery at Manila is shown in Schedule 4, following.

SCHEDULE 4

Beach JB-2 Program Schedule

	Optimistic	Realistic	Pessimistic
Arrive Manila	15 Apr 46	15 Jun [illegible]	1 Oct 46
Leave Manila	1 May 46	1 Jul 46	1 Nov 46
Arrive operational area	15 May 46	20 Jul [illegible]	1 Dec 46
First launching	1 Jun 46	1 Sep [illegible]	1 Feb 47

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9. Weather Factors.

a. Conventional bombing. It would be desirable to have estimates of the fraction of the time that it will not be possible to conduct conventional bombing missions, from airfields within range of the target area, because of minimum weather conditions existing between the airfield and target. Available weather data show that it is likely that missions can be flown from at least one of the several airfields within range at nearly any time with visual take-off and landing. Additional weather information would be required to indicate the need for all-weather weapons and to determine the delay intervals required for bomb fuzes.

b. Blind aerial operation. It would be desirable to have information concerning the fraction of the time that it will not be possible to conduct radar missions, from at least one of the several airfields within range of the target, because of weather which makes flying the mission impossible even with suitable blind flying and landing equipment. Such weather information would indicate the extent to which blind aerial operation would or would not serve as an all-weather weapon.

c. Willie-Orphan. Weather plays essentially the same role for Willie-Orphan as for blind aerial operation, except that the use of Willie-Orphan is limited to airfields within radar-control range of the target area with the consequent added limitation on times when weather would permit operations.

d. Controlled JB-2 from ships. Rough seas would make it impossible to handle and launch JB-2 from ships, and it is estimated that [illegible] winds of more than 10-15 mph would prevent launching. It is also estimated that a sea of more than 6' would prevent launching JB-2 from LST or CVE, and available weather data indicate that 6' seas are found off Central Honshu about under 10% of the time in winter, and less frequently in summer. It would be desirable to have more accurate information concerning the fraction of time that rough weather would prevent successful launchings from LST or CVE, but this information will be available only after such launchings have been attempted.

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9. JB-2 launched [illegible]. [illegible] more than 10-[illegible] mph would prevent [illegible]. [illegible] possible to change the heading of JB-2 by more than [illegible], there will [illegible] some fraction of the time, probably [illegible] 5[illegible] Central [illegible], when high tail winds will prevent launching JB-2 [illegible] from [illegible].

10. Reduced JB-2 program. It would be possible to [illegible] somewhat if fewer than [illegible] over a [illegible] requirement. It is estimated that JB-2 could be made [illegible] for [illegible] from the [illegible], following.

[illegible]

[illegible] Program

Date	[illegible]	[illegible]	[illegible]	[illegible]
1 September 1945	[illegible]	[illegible]	[illegible]	[illegible]
1 October 1945	[illegible]	[illegible]	[illegible]	"
1 November 1945	500	400	[illegible]	"
1 December 1945	1,[illegible]	1,[illegible]	[illegible]	[illegible]
1 January 1946	[illegible]	[illegible]	1,[illegible]	[illegible]
1 February 1946	[illegible]	3,[illegible]	[illegible]	[illegible]
1 March 1946	[illegible]	[illegible]	[illegible]	[illegible]

It would not be possible, [illegible] on the basis of optimistic [illegible], [illegible] any quantity of JB-[illegible] ready for shipment from the [illegible] before 1 September 1945 because rocket propellants [illegible] production [illegible] date, and also because starting and firing equipment cannot be made available by that date. It is very doubtful that starting and firing equipment can be made available in any quantity before 15 November 1945 so that, taking account of the time needed for procurement of the [illegible], it would appear that JB-2 would be available in quantities sufficient only for experimental and training purposes prior to 1 November 1945. If it is [illegible]

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that sleds will be schedules to keep pace with other items after 1 November 1945 then JB-2 could be made ready for shipment from the PCE according to Schedule 6, following.

SCHEDULE 6

Reduced JB-2 Program
Sleds Assumed Not Critical

	Quantity of JB-2 ready at PCE			
	Optimistic	Realistic	Pessimistic	Critical Item
1 December 1945	2,500	2,000	1,500	Airframe and APW-1 modification
1 January 1946	3,631	3,000	2,500	"
1 February 1946	4,631	4,000	3,500	"
1 March 1946	5,631	5,000	4,500	"

It is estimated that four to eight months after shipment from the PCE the JB-2 would be first launched in the operational area, so operational dates for the reduced JB-2 program can be estimated from Schedules 5 and 6 by moving the optimistic dates back four months, the realistic dates back five months, and the pessimistic dates back eight months.

11. Interferences. The subcommittee did not make a careful study of interferences with other programs for any of the five weapons under consideration in this report. It is expected that explosives will not be a critical item after VE-Day unless the present bomb program is increased, in which case each weapon would cut off an equivalent tonnage in explosives for general purpose bombs. There appear to be no major interferences with other programs except as requirements for shipping space, personnel, standard equipment, and production facilities represent effort which might be devoted to alternate programs.

DISCUSSION

12. Operational features.

a. Conventional bombing. It is expected that there may be a shortage of airfields for operations against the Japanese mainland and that heavy

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demands will be made on conventional bombing forces.

b. Blind aerial operation. It is probable that special crews could be trained in the use of GCA equipment so as to make blind landings with 0/0 visibility entirely feasible. Blind operation is not popular and may lead to heavier losses due to enemy action because of the difficulty met in flying formations under such conditions.

c. Willie-Orphan. It seems doubtful that five or six crashes per day with ten tons of explosive each [illegible] would give a [illegible] effect as great as [illegible] larger number of [illegible] each with smaller [illegible] load. [illegible] [illegible] from a [illegible]. [illegible] Willie [illegible] airplanes, [illegible] to [illegible] action.

d. [illegible]. It [illegible] expected that preset control will be satisfactory for JB-2 launched from shipboard because the magnetic compass would probably [illegible] in advance of loading [illegible] on shipboard [illegible]. It is also unlikely that radar control of JB-2 will be accomplished [illegible] from shipboard and it appears necessary, therefore, that [illegible] JB-2 launched from shipboard [illegible] controlled by a radar station on the ground. The need for ground station radar control of JB-2 launched from LST or LCE implies that JB-2 cannot be used for beach bombardment in preparation for an amphibious operation. It is possible that JB-2 may be launched more successfully in rough weather from beached LST, but in this case a stretch of beach in front of the LST would need to be kept clear because of danger from the falling sleds.

e. JB-2 launched from land. It appears certain that JB-2 can eventually be launched successfully from ground ramps round-the-clock in all weather, except for some very small fraction of the time when excessive tail winds would make launching impossible. Preset control should provide adequate accuracy for area bombardment for JB-2 so that electronic control equipment may not be necessary for this application.

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CONCLUSIONS

13. It is concluded that:

a. Five weapons could possibly be made available for operational use against Japan during 1946 to provide round-the-clock area bombardment of a target, at a distance of from thirty to sixty-five miles inland from a beach, at a rate of fifty tons of explosive per day for sixty days.

b. The five weapons could probably be placed in operation according to the following estimated schedules:

	Optimistic	Realistic	Pessimistic
Blind aerial operations	1 Oct 45	15 Oct 45	1 Dec 45
Conventional bombing, delay fuzes	15 Nov 45	15 Dec 45	1 Feb 46
Willie-Orphan	1 Feb 46	1 Mar 46	1 Jun 46
JB-2 from LST or CVE	25 May 46	15 Aug 46	15 Dec 46
JB-2 from beach	1 Jun 46	1 Sep 46	1 Feb 47

c. There will be no assurance that JB-2 can be launched successfully from LST or CVE until tests have demonstrated this to be possible.

d. Weather will not seriously limit conventional aerial bombing of area targets in Central Honshu provided radar aids are available for flying and bombing.

e. The JB-2 could probably be placed in operation two months sooner if 1,500 rather than 3,000 effective hits over a sixty-day period were required.

f. It is expected that the problem could be best met by combining conventional bombing using delay fuzes and a reduced beach preset JB-2 program according to the following optimistic schedule (assumes airframe and rockets are only critical items) for theater operations:

First launching	JB-2 hits
1 February 1946	1,300
1 March 1946	1,600
1 April 1946	2,100
1 May 1946	2,600

g. Willie-Orphan is operationally unsuited to the problem unless airfields within radar control range of the beach are available for the Willie take-offs, or unless the Willie could be flown from more distant airfields to to the operational area before the Willie is turned over to ground radar control.

h. JB-2 and Willies would eventually provide weapons which could be useful to supplement bombardment by more conventional methods. See Appendix "B" for a discussion of importance of supplementary bombardment.

Enclosure

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RECOMMENDATIONS

1[illegible]. It is recommended that:

a. The JB-2 be given immediate high priority only if its value as a round-the-clock weapon to be used after [illegible], or [illegible] weapon to be used after [illegible] 194[illegible], is sufficient [illegible] estimated as necessary to make it available [illegible] those times.

b. The JB-2 [illegible] handling tests on LST [illegible].

c. The development [illegible] controlled JB-2 launched from LST, [illegible] rocket-assisted take-off, [illegible]

d. The development [illegible] launched from [illegible], [illegible] launching, be continued [illegible] priority [illegible].

e. A careful [illegible] JB-2 which are used in the [illegible] perience thus [illegible] desirable characteristics [illegible]

Approved and concurred in by [illegible]:

[illegible]

[illegible]

Colonel [illegible]

Captain [illegible]

[illegible] FLOOD
Secretary

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HEADQUARTERS, ARMY AIR FORCES
WASHINGTON
25

IN REPLY REFER TO:

AFDMA-3
3 December 1945

Subject: Liaison with Navy Program for Shipboard Launchings of Guided Missiles

To: Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attn: TSENG

452.— Pilotless

1. Attached is a letter from the AAF Board dated 29 October 1945, subject: "Recommendation for Cancellation of JB-2 Launching from LST". Also attached is the first indorsement directing that the project be cancelled.

2. Although these launchings are being cancelled, it is probable that the AAF will need technical information on shipboard launchings of guided missiles and the problems related thereto. As the Navy at present is contemplating considerable work along these lines, it is directed that close liaison be maintained with their program so that this information will be readily available to the Army Air Forces.

By command of General ARNOLD:

Vincent A. Stace Lt Col A.C.
for ALDEN R. CRAWFORD
Brig General, U. S. A.
Chief, Research & Engineering Div
Office, Asst Chief of Air Staff-4

1 Incl:
Cy ltr dtd 29 Oct 45
w/cy 1st Ind thereto
dtd 30 Nov 1945

Incl. not available for Records Section/lt

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CENTRAL FILES
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ADDRESS REPLY TO: COMMANDING GENERAL, ARMY AIR FORCES, WASHINGTON 25, D. C.

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R E S[redacted]

4 ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TSTEX
Major H. F. Mullins

FM

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T E C H N I C A L   I N S T R U C T I O N S

Wright Field, Dayton, Ohio
7 December 1944

Serial No.: TI-2003, ADDENDUM NO. 8

Subject: Guided Missiles - Procurement of JB-2 Jet Bombs

To: Procurement Division

MX-544

1. Problem Presented:

a. To procure an additional 1000 JB-2 jet bombs with adequate spare components.

2. Factual Data:

a. Reference is made to CTI-1802, dated 7 August 1944, which directed the Materiel Command to procure 1000 JB-2 jet bombs, a suitable number of launching devices and other applicable items of equipment for the testing and use of the 1000 JB-2 bombs.

b. Reference is also made to CTI-1802, Addendum No.2 dated 6 November 1944, which directed the procurement of 10,000 Monsanto type assisted take-off rocket motors to provide for a total of 5,000 launching.

3. Authority:

a. Commanding General, Army Air Forces, by teletype WAF-73224, dated 6 December 1944, from, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take the necessary action to procure an additional 1000 JB-2 jet bombs, with adequate spare components, to be delivered at the rate of 200 per month, deliveries starting immediately after completion of the 1000 JB-2 jet bombs now on order.

By Command of Lt. General KNUDSEN:

Classification cancelled
or changed to
AUTH:
By
Signature and Grade
Date

T. A. Sims
T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Engineering Division
Supply Division
Maintenance Division

[redacted]

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Incl. Orig. of tele listed in Auth. above

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON, D. C.

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WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON, D. C.

[redacted]
By Authority of
The Commanding General
Army Air Forces
JAN 14 1945
Date Initials

ORIG FILE COPIES TO: INITIALS

VALUE OF PAPER CHECK ONE
PERMANENT TRANSITORY

2003

SUBJECT: Launching and Procurement Program on the JB-2 Bomb.

TO: Director,
AAF - Air Technical Service Command,
Wright Field, Dayton, Ohio.

Attention: Office, Chief of Administration (TSTEX)

1. This confirms the conversation of 12 January 1945 between Major General B. E. Meyers and Brigadier General E. M. Powers. In a meeting of 12 January 1945, General Arnold directed that immediate action be taken to establish a program to launch the JB-2 Jet Bombs at a rate of 100 per day not later than 1 September 1945, 200 per day by 1 October 1945, 300 per day by 1 November 1945, 400 per day by 1 December 1945, and 500 per day by January 1946. General Arnold also stated that these launching schedules are to be secured at earlier dates if possible.

2. The following action is therefore directed:

a. The procurement of seventy-five thousand (75,000) of the JB-2 Jet Bomb with the delivery schedule to provide sufficient quantities for the launching program as specified in paragraph one above. In order to comply with General Arnold's requirement in this case, it will be necessary for the initial quantities to be ready at the Port of Embarkation at least thirty days prior to the launching date.

b. Procure one hundred (100) launching ramps according to the following schedule:

(1) Twenty (20) ramps for immediate delivery for testing and training.

(2) Eighty (80) ramps at the rate of sixteen (16) in July 1945 and sixteen (16) per month thereafter.

Classification cancelled
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AUTH: CD 356
By
Signature and Grade
Date [redacted]

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

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c. Procure sufficient launching equipment of rocket-assisted type to permit seventy-five thousand (75,000) launchings at the rate indicated above. Equipment to be usable on launching slopes ranging from 0° to 6° to the horizontal.

d. Prepare an immediate request to the Air Ordnance Officer for the Ordnance components and services required for both the JB-2 Jet Bomb and the launching of the JB-2 Jet Bomb. This request will contain a schedule of required deliveries.

e. Secure any spare components or parts considered necessary for the JB-2 Jet Bomb or launching equipment.

f. Insure that necessary steps be taken to have jet fuels available in sufficient quantities.

3. General Arnold further directed that remote control of the JB-2 be added as soon as practicable, but that this addition is not to delay the delivery or launching programs. It is therefore directed that necessary action be taken to insure that sufficient components are available with each JB-2 to permit use with or without the AN/APW-1 radar control equipment. The Signal Corps will procure seventy-seven (77,000) of the AN/APW-1 radar control equipments, and one hundred (100) ground control equipments.

4. A further directive will follow on Table of Equipment items.

5. The two thousand (2,000) JB-2 Jet Bombs now on order are in addition to the seventy-five thousand (75,000). It is requested that this delivery schedule be expedited as necessary to furnish sufficient JB-2 Jet Bombs and launching equipment for the test and training program.

6. It is further directed that a report be submitted by 25 January 1945 on the proposed overall plan for the accomplishment of this program.

For the Commanding General, Army Air Forces:

E. M. Powers
Brigadier General, U. S. A.
Deputy Asst. Chief of Air Staff,
Materiel and Services

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c. Procure sufficient launching equipment of rocket-assisted type to permit seventy-five thousand (75,000) launchings at the rate indicated above. Equipment to be usable on launching slopes ranging from 0° to 6° to the horizontal.

d. Prepare an immediate request to the Air Ordnance Officer for the Ordnance components and services required for both the JB-2 Jet Bomb and the launching of the JB-2 Jet Bomb. This request will contain a schedule of required deliveries.

e. Secure any spare components or parts considered necessary for the JB-2 Jet Bomb or launching equipment.

f. Insure that necessary steps be taken to have jet fuels available in sufficient quantities.

3. General Arnold further directed that remote control of the JB-2 be added as soon as practicable, but that this addition is not to delay the delivery or launching programs. It is therefore directed that necessary action be taken to insure that sufficient components are available with each JB-2 to permit use with or without the AN/APW-1 radar control equipment. The Signal Corps will procure seventy-seven thousand (77,000) of the AN/APW-1 radar control equipments, and one hundred (100) ground control equipments.

4. A further directive will follow on Table of Equipment items.

5. The two thousand (2,000) JB-2 Jet Bombs now on order are in addition to the seventy-five thousand (75,000). It is requested that this delivery schedule be expedited as necessary to furnish sufficient JB-2 Jet Bombs and launching equipment for the test and training program.

6. It is further directed that a report be submitted by 25 January 1945 on the proposed overall plan for the accomplishment of this program.

For the Commanding General, Army Air Forces:

E. M. Powers

E. M. Powers
Brigadier General, U. S. A.
Deputy Asst. Chief of Air Staff,
Materiel and Services

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

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INITIALS

H.F.M.

TECHNICAL INSTRUCTIONS

Maj. H. F. Mullins
cjt/TSTFX (5-7126)
Wright Field, Dayton, Ohio
18 January 1945

Serial No.: TI-2003, ADDENDUM NO. 14 MX-544

Subject: Guided Missiles - Procurement Program for JB-2 Bombs

To: Procurement Division
Engineering Division

1. Problem Presented:

a. To procure 75,000 of the JB-2 Jet Bombs and related equipment.

2. Factual Data:

a. Reference is made to CTI-1802, dated 7 August 1944, which directed the procurement of 1000 JB-2 Jet Bombs, a suitable number of launching device and other applicable items of equipment for the testing and use of the 1000 JB-2 Jet Bombs. Reference is also made to CTI-1802, Addendum No. 2, dated 6 November 1944 which directed the procurement of 10,000 Monsanto type assisted take-off rocket motors to provide for total of 5000 launchings.

b. Reference is made to TI-2003, Addendum No. 8, dated 7 December 1944, which directed the procurement of an additional 1000 JB-2 Jet Bombs with adequate spare components.

c. General Arnold has directed that immediate action be taken to establish a program for launching the JB-2 Jet Bombs at a rate of 100 per day not later than 1 September 1945, 200 per day by 1 October 1945, 300 per day by 1 November 1945, 400 per day by 1 December 1945 and 500 per day by January 1946. General Arnold had also stated that these launching schedules are to be secured at an earlier date if possible. In order to comply with General Arnolds requirement in this case, it will be necessary for the initial quantities to be ready at the port of embarkation at least 30 days prior to the launching date.

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HFM:cjt:TSTEX
Wright Field, Dayton, Ohio
18 January 1945

Serial No.: TI-2003, ADDENDUM NO. 14

Subject: Guided Missiles - Procurement Program for JB-2 Bombs

To: Procurement Division
Engineering Division

d. General Arnold has further directed that remote control of the JB-2 be added as soon as practicable, but that this condition is not to delay delivery on launching program. The Signal Corps will procure 77,000 of the AN/APW-1 radar control equipments and 100 ground control equipments.

e. A further directive will follow from the Office, Assistant Chief of Air Staff, Materiel and Services on Table of Equipment items.

f. The procurement of the 75,000 JB-2 Jet Bombs directed herein is in addition to the 2000 now on order. It will be necessary to expedite the delivery schedule of the 2000 JB-2 Jet Bombs previously procured in order to furnish sufficient JB-2 Jet Bombs and launching equipment for the test and training program.

g. The procurement of the JB-2 Jet Bomb and related equipment directed herein will be handled under the appropriate security classification for the item concerned.

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 14 January, subject, "Launching and Procurement Program on the JB-2 Bomb", from, Deputy Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Engineering Division furnish to the Procurement Division all drawings and engineering information necessary for the procurement directed herein.

b. That the Procurement Division take the following action:

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HFM:cjt:TSTEX
Wright Field, Dayton, Ohio
18 January 1945

Serial No.: TI-2003, ADDENDUM NO. 14

Subject: Guided Missiles - Procurement Program for JB-2 Bombs

To: Procurement Division
Engineering Division

(1) Initiate procurement of 75,000 of the JB-2 Jet Bombs with the delivery schedule to provide sufficient quantities for the launching program as specified in paragraph 2. above.

(2) Procure 100 launching ramps according to the following schedule:

(a) 20 ramps for immediate delivery for testing and training.

(b) 80 ramps at the rate of 16 in July 1945 and 16 per month thereafter.

In the event subsequent decision is reached that launching ramps will be procured and furnished by the Corps of Engineers, the Procurement Division will take the necessary action to make such request on the Corps of Engineers and will follow up and coordinate the delivery of this equipment as required.

(3) Procure sufficient launching equipment of the rocket-assisted type to permit 75,000 launchings at the rate indicated above. Equipment to be usable on launching slopes ranging from 0° to 6° to the horizontal.

(4) Prepare an immediate request to the Air Ordnance Officer for the Ordnance components and services required for both the JB-2 Jet Bomb and the launching of the JB 2 Jet Bomb. This request will contain a schedule of required deliveries.

(5) Secure any spare components or parts considered necessary for the JB-2 Jet Bomb or launching equipment.

(6) Insure that necessary steps will be taken to have jet fuels available in sufficient quantities.

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HFM:cjt:TSTEX
Wright Field, Dayton, Ohio
18 January 1945

Serial No. TI-2003, ADDENDUM NO. 14

Subject: Guided Missiles - Procurement Program for JB-2 Bombs

To: Procurement Division
Engineering Division

(7) Insure that sufficient components are available with each JB-2 to permit use with or without the AN/APW-1 radar control equipment.

(8) Expedite the delivery schedule of the 2000 JB-2 Jet Bombs now on order in order to furnish sufficient JB-2 Jet Bombs and launching equipment for the test and training program.

(9) Prepare and submit a report to the Office, Assistant Chief of Air Staff, Materiel and Services through this Office by 25 January 1945 on the proposed over-all plan for the accomplishment of this program.

c. This procurement program is assigned a 1A priority.

By Command of Lt. General KNUDSEN:

HF Mart... Maj AC
for T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Supply Division
Maintenance Division
Budget & Fiscal (Col Kohlreiser)

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AAF 471.6

JB-2 Robot Bomb.

AC/AS, OC&R.

13 Jan 45

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AC/AS, MAS, Air Ordnance Officer.

Major Erickson/em/72343

1. Pursuant to General Arnold's request 12 January 1945 and subsequent prearranged delivery schedule of subject item in the quantities listed,

	Per Month	Per Day
September 45	3,000	100
October 45	6,000	200
November 45	9,000	300
December 45	12,000	400
January 46	15,000	500
February 46	15,000	500

etc., a meeting was held between members of this office and representatives of the Chief of Ordnance.

2. The above schedule can be met if full overriding priorities are issued to this program for obtaining machines, presses, tools, facilities, labor, etc., regardless of cost to any program whatsoever now present in the Ammunition Division, Office of the Chief of Ordnance and can be met only under these conditions. The program would therefore interfere with Medium and Heavy Artillery increases now in progress and with the bomb expansion and full rocket propellant program. In the case of the Medium and Heavy Artillery Program the above schedule would cut into the current expended program approximately 25% initially, and would level off at about 17½% reduction in the overall artillery program. It would also make impossible, expansion of the present production schedules now being planned by the Ammunition Division, Office of the Chief of Ordnance.

3. The statement given in paragraph 2 is made in view of the following which would be the case if no interference is injected into the Ordnance Department programs:

a. New Toluene plants will be required to meet the above schedule and these plants will take 15 months for construction.

b. New Ammonia facilities must be built which will require a minimum of 12 months.

c. New TNT facilities must be built which will require a minimum of 9 to 12 months.

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d. New load lines for the war-head will have to be built which will require 9 months.

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JB-2 Robot Bomb.

AAF 471.6

AC/AS, OCAR

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AC/AS, M&S, Air Ordnance Officer

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(Cont'd)

e. Powdered Aluminum facilities will have to be built. However, these can probably be built in from 4 to 6 months provided there is sufficient aluminum capacity in the country. This includes both cast and sheet aluminum facilities.

f. Potassium Nitrate facilities will have to be built for quantities over and above 6,000 per month (200 per day).

g. While facilities are available for production of Ammonium Picrate, the raw material needed for this explosive is Benzol. Any increase in consumption of Benzol will interfere with aviation gasoline and synthetic rubber programs.

4. No estimate can be made at the present time of the effect of the number of presses that will be required in subject program. These presses are required to grain the propellant used in the rocket take-off motor of this bomb. The Office of the Chief of Ordnance states that the press industry of the United States is now being fully utilized in the present urgent artillery, bomb, and rocket programs and a thorough study will have to be made with W.P.B. to determine the probable dates of additional presses over and above existing programs.

5. In order to furnish proper training equipment and to equip operating and supporting organizations, it will be necessary to obtain overriding or high priority covering the procurement and issue of certain critical handling equipment which is vitally important to proper operation. This equipment will consist of such things as Cargo Trucks, Tractor Cranes, Wrecking Trucks, Prime Movers for Fuel Service Units, and Bomb Service Trucks. Since it is anticipated that additional procurement of some of these items will be required, early assignment of priorities is necessary in order to meet assigned schedule.

R. C. COUPLAND
Brig. Gen., U.S.A.

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By Authority of
The Commanding General
Army Air Forces
20 Jan 1945 ...
Date Initials

[redacted]

HEADQUARTERS ARMY AIR FORCES
OFFICE OF THE AIR ORDNANCE OFFICER
WASHINGTON 25, D. C.

AAF 471.6 (20 Jan 45)

20 JAN 1945

SUBJECT: JB-2 Jet Bomb.

TO: Ordnance Officer, Engineering Division, Hq. Air Technical Service Command, Wright Field, Dayton, Ohio.
ATTN: TSORD-1.

1. No doubt your ~~headquarters~~ office has been informed of the new Army Air Forces requirement of JB-2 Jet Bombs which resulted in action taken within this headquarters. For your information, a copy of the directive going to Wright Field is attached as Inclosure No. 1.

2. In view of the 500 per day requirement, a conference was held with the Chief of Ordnance on 13 January 1945 and the programs with which this requirement will interfere were sent to the Assistant Chief of Air Staff, Operations, Commitments and Requirements, a copy of which is attached as Inclosure No. 2. In addition this program will interfere to the extent of 17% on the peak bomb production.

3. Also attached hereto as Inclosure No. 3 is a copy of the letter forwarded to the Chief of Ordnance from this Headquarters stating the Army Air Forces JB-2 requirement.

4. The inclosures are forwarded for your information only so that your office will be acquainted with the present situation. As additional information becomes available, it will be forwarded to your office.

For the Air Ordnance Officer:

J. M. Gruitch
J. M. GRUITCH
Lt. Col., Ord. Dept.
Assistant

3 Incls:
Incl. 1 - Cy. ltr. to ATSC, dtd. 14 Jan 1945.
Incl. 2 - Cy. R&R to AC/AS, OC&R, dtd 13 Jan 45.
Incl. 3 - Cy. ltr. to Ch/Ord, dtd. 17 Jan 1945.

CLASSIFICATION CANCELLED OR ~~CHANGED TO~~
AUTHORITY: CAD 356 11-1-45
BY
NAME AND GRADE
DATE 11-21-45

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JB-2 Large Scale Procurement Program

TSDEP TSHPR3H 15 Jan 45 1
Attn: Maj. Gen. B. E. Meyers

1. The essential features of the plan for producing JB-2 Jet Bombs on an extensive scale are submitted herein for consideration.

2. It is understood that the requirements as presently established specify that delivery of JB-2 Jet Bombs set up ready for use in the ETO shall be supplied in accordance with the schedule as set forth below:

100 per day beginning 1 September 1945
200 per day beginning 1 October 1945
300 per day beginning 1 November 1945
400 per day beginning 1 December 1945
500 per day beginning 1 January 1946

3. Transforming the above daily requirements into monthly production rates on the basis of a thirty day (30) month and allowing a lead time of one (1) month for shipment from contractors' plants to the ETO indicates that production of JB-2 Jet Bombs must reach the rates noted below:

3,000 during August 1945
6,000 during September 1945
9,000 during October 1945
12,000 during November 1945
15,000 during December 1945

4. The attainment of the production goals set forth in Paragraph 3 above cannot even be approached unless conditions as noted below obtain:

a. All contractual arrangements shall be completed and the various prime and GFE contractors participating in the program shall have some written instrument in hand not later than 1 February 1945, which enables them to place subcontracts, order material, and start work. It is obvious that this initial step in the program cannot be taken until the authority for procurement is received from the AC/AS, M&S.

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b. The total procurement authorized shall be approximately ten (10) times the scheduled maximum monthly production, in this case 150,000 articles. This will provide a sufficient backlog to permit the several contractors to operate at peak production for six (6) months or more.

c. The articles produced shall be exactly the same as the seventy-fifth (75th) JB-2 Jet Bomb produced by Republic and no engineering changes shall be introduced which might delay production. This seventy-fifth (75th) article incorporates all the refinements and improvements resulting from launching experience to date and has been designated the model JB-2 Jet Bomb.

d. The project as a whole shall carry a priority at least equal to that presently enjoyed by the B-29 Project, namely, AA-1, Group II, and for some items an AAA priority shall be granted. This will insure the availability of necessary material, equipment, facilities, and labor.

e. Prompt action shall be taken to provide the necessary facilities. It is estimated that these facilities, more fully discussed later, will involve a total expenditure of approximately $130,000,000.00, apportioned among the various important phases of the project substantially as follows:

(1) For airframe prime contractors	$ 43,000,000.00
(2) For GFE contractors	9,000,000.00
(3) For Warheads by Ordnance Department	4,000,000.00
(4) For Propellant Fuel	72,000,000.00
(5) For Rocket Motor Cases	2,000,000.00
(6) For Launching Carts	1,000,000.00
TOTAL	$130,000,000.00

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5. Immediately upon receipt of appriate authority for procurement of JB-2 Jet Bombs on a large scale, it is proposed to proceed along the following lines:

a. Designate Republic, or some equally competent organization, the engineering design contractor for the project. A contract will be entered into between the Government and Republic or whoever is selected to supply the several production prime contractors with drawings, technical data, tooling information and engineering assistance. It is anticipated that Republic will have complete and up to date production drawings available by 1 February 1945. It would be helpful if Republic could participate in the production program even to a limited extent but it is believed that present circumstances preclude such an arrangement.

b. Select several airframe prime contractors, probably five, more fully discussed in Paragraphs 6 and 7 below, and enter into contracts with these firms to produce JB-2 Jet Bombs in accordance with engineering data and drawings prepared by Republic and supplied by the Government. This will be in addition to the articles produced by Willys-Overland who are presently endeavoring to build JB-2 Airframes complete with GFE installed as subcontractors to Republic.

c. Place orders for GFE with the present manufacturers of that equipment as listed below:

(1) Control Units from Jack & Heintz

(2) Jet Engines and Metering Units from Ford

(3) Air Containers from Alloy Products

(4) Pressure Regulators from Air Reduction Sales

(5) Shutoff Valves from GFE Suppliers

(6) Radio Equipment from GFE Suppliers

(7) Rocket Motor Cases from GFE Suppliers

d. Formally advise the Ordnance Corps of the requirements for items the procurement of which comes under its cognisance specifically as follows:

(1) Warheads loaded

(2) Propellant Fuel

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e. Place orders for launching carts. Launching tests to date have employed a magnesium type of launching cart built by Northrup. Serious consideration is being given to the development of launching carts made of steel or of aluminum alloy, but no realistic plans for production of these carts can be made until such time as they have been built, tested and approved. However, the production of launching carts of any type whether of magnesium, steel or aluminum alloy, should not be a critical item in the JB-2 program.

f. In cooperation with the Corps of Engineers formulate plans for the production, shipment, and erection of launching ramps as required by the ETO. The tests to date on the experimental equipment at Eglin Field indicate that a level ramp approximately 400 feet long consisting of steel rails mounted on concrete is satisfactory for launching the JB-2 by the use of five rocket motors. This analysis of production possibilities for JB-2 Jet Bombs does not include the launching ramps nor sites except by way of comment since the requirements for these items have not as yet been definitely established.

g. IMPORTANT: It should be noted that earnest consideration is being given to the possibilities of launching the JB-2 jet bombs by the use of hydrogen peroxide or supercharged steam which if successful will eliminate the necessity for launching ramps, launching carts, propellent fuel and rockets. There assuredly will be items of equipment to be procured in connection with this new method of launching, on which the production problems connected therewith can be considered only at such time as it has been determined just what is required.

6. The plans for the production of JB-2 jet bombs involves the employment of five prime contractors in addition to Willys-Overland presently manufacturing this item. Below is the production required from each contractor to meet the schedule as set forth in Paragraph 3 above. It should be noted that each prime contractor with the exception of Willys will be called upon to reach a monthly production rate of 600 articles in August 1945 and increase this rate by 600 articles a month until the maximum rate of 3000 articles is reached in December 1945. Some contractors may be able to exceed the estimates set up and thus take up the slack occasioned by other contractors who fall behind or are eliminated from participation. In view of their poor showing to date, Willys' contribution has been estimated at a maximum of 200 articles per month which can be considered as a small cushion against unforeseen contingencies. If they can improve this rate so much the better.

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ESTIMATED PRODUCTION SCHEDULE JB-2 AIRFRAMES

Contractor	A Nash Kelvinator	B Firestone	C Budd	D Murray	E Higgins	F Willys	Monthly Total	Cumulative Total
January 46						50	50	50
February						25	75	125
March						100	100	225
April						125	125	350
May	10	10	10	10	10	150	200	550
June	50	50	50	50	50	175	425	975
July	200	200	200	200	200	200	1200	2175
August	600	600	600	600	600	200	3200	5375
September	1200	1200	1200	1200	1200	200	6200	11575
October	1800	1800	1800	1800	1800	200	9200	20775
November	2400	2400	2400	2400	2400	200	12200	32975
December	3000	3000	3000	3000	3000	200	15200	48175
January 46	3000	3000	3000	3000	3000	200	15200	63375
February	3000	3000	3000	3000	3000	200	15200	78575
March	3000	3000	3000	3000	3000	200	15200	93775
April	3000	3000	3000	3000	3000	200	15200	108975
May	3000	3000	3000	3000	3000	200	15200	124175
June	3000	3000	3000	3000	3000	200	15200	139375
July	3000	3000	3000	3000	3000	200	15200	154575
	30260	30260	30260	30260	30260	3275	154575	

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7. In view of the ever changing conditions affecting the production of war material, it is deemed expedient to provide a high degree of flexibility in the selection of prime contractors. The contractors tentatively selected do not represent the final choice but serve as examples of the type of organizations required to do this work. A number of manufacturers, as noted below, have been supplied engineering information and drawings of the JB-2 Jet Bomb and are under consideration for participation in the production program.

a. Nash-Kelvinator has sent a number of their key production personnel to Republic where they made a thorough investigation of the JB-2 and the problems connected with its production. They express themselves satisfied that they can undertake to produce fifty (50) units per day after tooling is complete which should be accomplished within three (3) months from date of contract. For this project Nash proposes to use their Milwaukee and Grand Rapids plants. The cutback in the propeller program fits in with this program.

b. Firestone has sent production personnel to Republic to examine the JB-2 Jet Bomb and to discuss problems of production. It is believed that Firestone will be a good producer. However, the recent resumption of C-46 wing production by Firestone may necessitate their elimination from the JB-2 program. If Firestone does not participate, it will be necessary to speed up the others or select another prime contractor.

c. Budd has a set of drawings and has expressed a willingness to participate but has not visited Republic nor examined the JB-2.

d. Murray has a set of drawings and has expressed a desire to participate. They have not visited Republic nor have they examined the JB-2.

e. Higgins has a set of drawings and is interested to the extent that they are building five (5) articles on their own in order to gain experience. They have visited the Air Technical Service Command where they examined the JB-2 but they have not as yet visited Republic. There is an imminent possibility of Higgins being required to produce shells for the Ordnance Corps in which case they may be eliminated from the JB-2 program. This will necessitate the selection of another contractor or the speed up of contractors remaining in the program.

f. Willys is currently producing 925 JB-2 airframes complete as subcontractor to Republic. As directed by the Commanding General, Air Technical Service Command, an additional procurement of 1,050 is being placed with Republic who will subcontract this work 100% to Willys. This makes a total of 1,975 which should keep Willys busy until 1 January 1946. Willys will remain in the program but based upon experience to date it is not believed that their production will exceed 200 articles per month.

8. The procurement of GFE in sufficient quantity to meet requirements of the production schedule as set forth in Paragraph 3 above involves the employment of an additional 7500 people as direct labor and expenditure of approximately nine million dollars for facilities. Jack and Heintz, manufacturing the control units, and Ford, manufacturing the jet engines, are the largest users of the above two items. Information secured from various sources affecting the procurement of GFE items is summarized below:

a. Ford estimate that they can reach a production of 15,000 jet engines per month within ten months of the date of contract. To do this they will require two million dollars for facilities and will require 2500 additional people as direct labor.

b. Jack and Heintz estimate that they can reach a production of fifteen thousand control units per month within eight months from the date of contract. To do this they will require six million dollars in facilities and an additional four thousand people direct labor.

c. The other requirements total one million dollars in facilities and one thousand additional people in direct labor for the manufacture of air containers, pressure regulators and shut-off valves.

d. It should be noted that both Ford and Jack and Heintz are located in critical labor areas and it may be necessary to bring in additional sources of supply such as Sperry and Airon of Kansas City, in order to relieve this situation.

9. The expendable launching equipment consists of the launching carts, rockets, and propellant fuel. The development of launching carts has not progressed to the point where they can be released for large scale production. No serious difficulty is anticipated in the procurement of sufficient carts to meet the requirements of the program. The same comment applies to the rocket motor cases but not to the propellant fuel. The Ordnance Department has contracted to provide facilities sufficient to produce 1,000,000 pounds of propellant fuel per month. Allowing twenty-five percent (25%) for testing and spoilage, this should be sufficient for 1,500 launchings at 500 pounds of fuel per launching. The cost of this facility is approximately $8,000,000.00. It was scheduled to start production in April 1945 but will probably be a few months late in getting started. To provide for 15,000 launchings per month, or 500 per day, will require a facility ten (10) times as large for the production of propellant fuel. This means an expenditure of $80,000,000.00 or $72,000,000.00 additional. The problem of obtaining sufficient chemicals to produce the propellant fuel is not considered in this analysis.

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10. It is estimated that the cost of the JB-2 project will involve a total expenditure of approximately one and one-half billion dollars ($1,500,000,000.00) summarized below:

JB-2 Jet Bombs Complete with Warheads

a. 150,000 JB-2 Airframes at an average unit cost of $2,600.00 each $390,000,000.00

b. 150,000 Control Units at an average unit cost of $2,000.00 each $300,000,000.00

c. 150,000 Jet Engines and Metering Units at an average unit cost of $1,000.00 each $150,000,000.00

d. 150,000 Pressure Regulators at an average unit cost of $100.00 each . . . . $ 15,000,000.00

e. 150,000 Sets of Air Containers (2 per set) at an average unit cost of $170.00 per set . . . . $ 25,500,000.00

f. 150,000 Sets Shut-off Valves (2 per set) at an average cost of $50.00 per set . . . . $ 7,500,000.00

$888,000,000.00

g. 15,000 Sets Radio, 1 for each 10 airframes, at an average unit cost of $150.00 each . . . . $ 2,250,000.00

h. 150,000 Warheads loaded from Ordnance at an average unit cost of $600.00 each . . . . $ 90,000,000.00

i. Total for 150,000 JB-2 Jet Bombs complete with Warheads $980,250,000.00

Launching Requirements

j. 75,000,000 pounds of propellent fuel sufficient for 150,000 launchings using 500 pounds of fuel per launching at a cost of $48.00 per 100 pounds or $240.00 per launching . . $ 36,000,000.00

k. 750,000 rocket motor cases sufficient for 150,000 launchings using 5 rockets per launching at a cost of $250.00 per rocket case, or $1,250.00 per launching . . . $187,500,000.00

l. 150,000 Launching Carts at an estimated cost of $500.00 per cart . . . . $ 75,000,000.00

m. Facilities required from Paragraph 4a $130,000,000.00

o. Total cost of the JB-2 Project excluding the cost of establishing launching sites in ETO, sums of i, m, and n, above $1,408,750,000.00

Project MX-544

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11. It is a foregone conclusion that production of JB-2 Jet Bombs on a large scale will interfere with procurement of other items in the War Program. An estimate of the amount of this interference can be obtained by examining the requirements for manpower, facilities, and material. The manpower requirements for the JB-2 Airframes with GFE installed, but not including loaded warheads nor launching equipment, is shown below:

Monthly Production	Number Contractors	Total Production	Direct Labor Required
600 Articles	5	3,000	5,000
3,000 "	5	15,000	22,000
GFE Labor Requirements from Paragraph 8			7,500
Total Labor Requirements to produce 15,000 Articles per month complete with GFE installed			29,500

Of this number, about one-fourth or 7,000 need be skilled workers, another one-fourth or 7,500 semi-skilled, and the remaining 15,000 unskilled.

12. The facilities required for large scale production of JB-2 Airframes consist principally of machine tools, handling equipment, welding equipment, sheet forming equipment, jigs and fixtures. Many of these items may be available and hence will not have to be purchased. The estimated value of all of these facilities necessary to reach the production of 15,000 airframe units per month is approximately $43,000.00. When this amount is added to the $9,000,000.00 facilities for GFE, it makes a total outlay for facilities of approximately $52,000,000.00. This estimate does not include facilities for warheads, manufacture of propellant fuel, rocket motor cases, nor launching ramps.

13. The monthly material requirements to reach a peak production of 15,000 airframes per month, complete with GFE, are summarized below:

Aluminum - Sheet, Forgings, Castings	918 Tons
Steel - 1020, Sheet, Tube, Bar	12,600 "
Steel - X4130, Sheet, Tube	5,256 "
Brass - Forgings, Bar, Sheet	30 "
Bronze - Bar	36 "
Magnesium - Casting	6 "
Copper - Tube, Wire	2 2/5 Tons
Dural - Bar and Sheet	2 2/5 "
Zinc - Castings	1 1/2 "
Duronze - Bar	1 1/2 "

The total material requirements are ten (10) times the quantities noted above. This estimate does not include material necessary for warheads, rocket motor cases, propellant fuel, nor launching ramps.

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14. The data on boxing and shipment of the JB-2 Jet Bomb complete is summarized below:

JB-2 Airframe			
18 ft. x 7 ft. 4 in. x 5 ft. 2 in.	= 800 cu. ft.		3,700 lbs.
Jet Engine			
12 ft. 7 in. x 31 in. x 31 in.	= 100 cu. ft.		735 lbs.
Warhead			
4 ft. 6 in. x 3 ft. 6 in. x 3 ft. 6 in.	= 50 cu. ft.		2,500 lbs.
TOTAL	950 cu. ft.		6,935 lbs.
For shipping space use	1,000 cu. ft.	and	7,000 lbs.
Launching Carts			
14 inc. x 14 in. x 15 ft.	= 150 cu. ft.		
18 in. x 18 in. x 5 ft.	= 12 cu. ft.		
	162 cu. ft.		1, 200 lbs.
Rocket Motors each			
15 in. x 15 in. x 5 ft.	= 10 cu. ft.		430 lbs.
Propellant Fuel Charge			
1 ft. x 1 ft. x 5 ft.	= 5 cu. ft.		170 lbs.

TOTAL SHIPPING REQUIREMENTS

JB-2 Airframe Complete with Engine and Warhead	1,000 cu. ft.		7,000 lbs.
Launching Carts	162 " "		1,200 "
Rocket Motors (5)	50 " "		2,150 "
Propellant Fuel (5 charges)	25 " "		850 "
Total for one Launching	1,237 " "		11,200 "
Use for Shipping Date	1,500 " "	and	12,000 "

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15. Examination of the boxing and shipping data reveals that the largest single item requiring transporation in the ETO is the JB-2 airframe which weighs approximately two tons and whose largest dimension is 18 feet. This point should be noted in order that any special arrangements for transporting this material in ETO can be made if necessary. Provision should also be made for the assembly and handling of the JB-2 Jet Bombs. It is obvious that if cover can be provided for the assembly operations it will be desireable but they can be assembled without cover. Certain equipment in addition to launching ramps should be provided at the site. This equipment consists of air compressors for charging the air bottles, cranes and dollies for handling the various parts of the JB-2. Occasion is taken to emphasize the importance of employing trained crews to assemble and launch the JB-2 Jet Bombs. The experimental tests conducted to date indicate that if the crew are not properly trained the launching of the bombs may not only be inaccurate but premature explosion of the warhead may occur with fatal results to personnel engaged in this work.

16. In spite of its rugged exterior the JB-2 Jet Bomb is an intricate type of mechanism. It is not a collection of scrap iron and stove pipe which can be slapped together by any blacksmith but is an aircraft traveling at over 400 miles per hour and should be built as such. While it carries no pilot, it contains a great deal of delicate and expensive equipment the malfunction of any part of which might throw it off its course and result in a fruitless mission. There is no mystery to the production of the JB-2. Its construction is simple but the same degree of care and attention must be paid to the maintaining proper contours, holding required tolerances, and keeping weight and balance between specified limits as devoted to the building of any high performance aircraft. The JB-2 might be considered as a large calibre shell with wings or a flying torpedo. It is hoped that every occasion will be taken to disabuse the mind of the uninitiated of the impression that the JB-2 is a rough and ready job which can be thrown together with no regard for accuracy. This condition accounts to some extent for the poor production showing of Willys to date. Unless adequate standards are set up and maintained all the effort given to development, the expense of production, the use of material, the space required for shipment, the risk of the work of launching will produce results which can only be described as abortive.

K. B. WOLFE
Major General, U.S.A.
Chief of Engineering and Procurement

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Col Dickman

7-Ops 2/2

COPY

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

16 January 1945

—answered—

Major General B. E. Meyers, Deputy Director
Air Technical Service Command
Wright Field
Dayton, Ohio

Dear General Meyers:

General Hopkins has requested that I write you with repsect to the proposed JB-2 program along the lines discussed in your recent telephone conversation with him.

The only information I have on the proposed plan is a copy of General Power's letter to you requesting that plans be submitted for the accomplishment of the program. I assume, that because of the limited range of the JB-2, the proposed use is for the Western Front, and not for the Pacific Theater. If such premise is correct, it has been estimated by the Traffic Division that 25% of the present shipping space to U.K. would be required to transport the required numberof JB-2's to meet the number of daily launchings proposed. It is probable the the JCS would never consent to such a major diversion of shipping.

From the facilities angle, the accomplishment of this program would require an estimated 60,000 aircraft workers and 5,000,00 sq. ft. of floor space based on 1,000 man hours per JB- 2. Idle facilites of this size are not currently available in the aircraft industry and the procurement of additional workers in the above number would be very difficult. The only method of obtaining the facilities in the time required would be to curtail the production of other types of aircraft in order that existing facilities could be used. The Higgins plant at New Orleans, La. is probably the only one that could be used without serious dislocation of aircraft production and this plant would only satisfy part of the floor space and labor requirements. New facilities could not be constructed and put into operation in time to meet the launching dates set.

One method of attempting to meet the program would be to manufacture the propulsion units, gyros, and other components in the country and fabricate the airframe and accomplish final assembly in France. Labor is plentifully available in the Paris area and some floor space is available or could be converted. No single units of the size required are available however, and assembly would have to be accomplished in serveral places. It

Classification cancelled
or changed to Col Gillespie has arr
AUTH: 1/27 — meeting between Gen Cook, Col Dickman
By & Col Gillespie
Signature and Grade
1-1-45 Informed Gen Meyers Secy of this.
[redacted]
2/2/45 — Informed Mrs. Kissinger Col. Cook's rel. All

is deemed inadvisable to consider any areas south of Paris for this work in view of the inadequate rail service and the possiblity of civil disorders. It should also be pointed out that French workers are undoubtedly less efficient than Americans, and production lines would take longer to set up. The possiblity of sabotage on the part of French collaborationists must also be borne in mind.

The Germans had several V-1 assembly and manufacturing plants in France. They were located underground in converted limestone quarries and iron mines. They used forced labor and war prisoners to man these facilities. Several of these places were wrecked by Allied bombing and German demolitions, however, at Thil, France, near the Luxembourg border, an entire plant was found intact, complete with machine tools. Many of the tools have been removed since the discovery of this plant and it is not in condition to operate at present. Also, sufficient labor is not available in the vicinity. The Germans utilized about 5,000 prisoners to man this plant which had an estimated production capacity of 50 V-1 bombs per day. The prisoners were quartered in nearby barracks.

The fact the Germans had their V-1 plants underground raises the question as to whether any important production facilites should be above ground in a Theater of Operation. Even with aerial superiority, plants above ground in France would be subject to night attack by bombers or robot bombing. This would not be as much of a threat if plants were located in the Paris area as if they were located in the advanced communication zone in France, Luxembourg or Belgium. In the latter zone are located heavy industries with large amounts of floor space available for conversion to final assembly. Labor and housing however are scare due to military operations.

To sum up, the proposed program is a tough one when our long lines of communications and the shipping space problems are considered. An extremely costly rocket production program may also be required for assisted takeoff of theJB-2. The tactical advantage of such a weapon in the quantities proposed for daily launching is, in my humble opinion, certainly open to question, inasmuch as it would be equivalent to about 800 tons of bombs that could be delivered much more accurately by our air forces. This holds as long as we maintain aerial supremacy over the Germans. If an attempt is to be made to meet the proposed program it would seem that French facilities and labor might be used for airframe fabrication and assembly.

Lt. Colonel Walter Clark, attached to General Wolfe's office, went through the underground V-1 plants with me, and can probably answer any questions that you may have on the subject.

With best regards, I am

Sincerely,

/s/ John C. Vaughan, Jr.
JOHN C. VAUGHAN, JR.
Colonel, Air Corps

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

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VALUE OF

TECHNICAL INSTRUCTIONS

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31

Serial No.: TI-2003, ADDENDUM NO. 16

Subject: Program on Procurement of JB-2

To: Procurement Division

MX-544

1. Problem Presented:

a. To suspend all procurement action directed in TI-2003, Addendum No. 14 and forward to the Office, Assistant Chief of Air Staff, Materiel and Services recommendations as to how a rate of 1000 JB-2 jet bombs per month by January 1946 can be met without interference with any aircraft or component program.

2. Factual Data:

a. Total procurement authorized now reverts to 2000 JB-2 jet bombs directed in CTI-1802, dated 7 August 1944 and TI-2003, Addendum No. 8 dated 7 December 1944.

b. It is probable that eventual requirements will settle down to 1000 JB-2 jet bombs per month by January 1946 and that this will not be permitted to interfere materially or appreciably with other programs.

3. Authority:

a. Commanding General, Army Air Forces, by teletype WAR-27072, dated 26 January 1945, from, Deputy Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take the necessary action to suspend all procurement action directed in TI-2003 Addendum No. 14 and prepare and forward to the Office, Assistant Chief of Air Staff, Materiel and Services, recommendations as to how a production rate of 1000 JB-2 jet bombs per month to be reached by January 1946 can be met without interference with any aircraft or component program.

Classification cancelled
~~or changed~~ to
AUTH:
By
Name and Grade
Date

Central File

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J12

[redacted]

HFM:cjt:TSTEX
Wright Field, Dayton, Ohio
31 January 1945

Serial No.: TI-2003, ADDENDUM NO. 16

Subject: Program on Procurement of JB-2

To: Procurement Division

b. These Technical Instructions cancel and supersede TI-2003, Addendum No. 14.

By Command of Lt. General KNUDSEN:

for T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Engineering Division
Supply Division
Maintenance Division

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ATSC Form No. 10-508 (3 Jan 45)
(Old ATSC Form No. 43)

582 [redacted]

COORDINATION
DIRECTOR OR DEP.
TSEPS5B
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.

B

Colonel [illegible]
ejt [illegible]

6 February 1945

7 FEB 1945

Procurement of 1000 JB-2 Jet Bombs Per Month

Commanding General
Army Air Forces
Washington 25, D. C.

MX-544

Attention: AC/AS, M&S
(General Powers)

Reference: Teletype WAR-27072 from AC/AS, M&S, dated 26 January 1945.

1. The plan herein submitted for producing JB-2 jet bombs at a rate of 1000 per month in accordance with instructions contained in reference teletype closely follows the pattern suggested previously for production of these articles at a much higher rate. One engineering contractor and three production contractors will participate in the program. Republic will be the engineering contractor. Willys-Overland, Nash-Kelvinator and Firestone are tentatively selected as production contractors.

2. Representatives of the four contractors mentioned above together with a representative of the Air Technical Service Command shall constitute the JB-2 committee. Questions of interchangeability, tooling, material, subcontracting, and the efficient use of the combined facilities available will be considered and if possible decided by the committee. On appropriate occasions, GFE or important subcontractors may be represented at the meetings.

3. By way of stating the problem as understood from reference teletype, supplemented by information from other sources, the following action is desired.

a. Formulate plans for the procurement of 1000 JB-2 jet bombs per month beginning in November 1945 which allows a lead time of two months from date required in ETO.

b. The procurement noted in subparagraph a above shall include the present order of 2050 articles from Republic, 1975 of which are being built by Willys.

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AUTH: CD 3-6
By [illegible]

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Area B-1-1-45-600M

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ATSC Form No. 10-806 (3 Jan 45)
(Old ATSC Form No. 45)

Commanding General, Army Air Forces
SUBJECT: Procurement of 1000 JB-2 Jet Bombs Per Month

c. The JB-2 jet bombs shall be complete articles ready for assembly prior to launching, with GFE, except the engine, installed. Jet engines, warheads, launching carts, and loaded rocket motors shall be shipped separately from the plants of the contractors producing these items.

4. The production schedule set forth below shows when JB-2 airframes with items of GFE installed shall be complete, accepted, boxed, and ready for shipment from airframe contractors' plants. The production alloted to various contractors may be subject to some adjustment. GFE to be installed in the airframes should be shipped to airframe contractors' plants one month in advance of the airframe-schedule. Other items such as the jet engines, warheads, launching carts, and loaded rocket motors shall be ready for shipment from respective contractors' plants, to coincide with the shipment of airframes.

JB-2 AIRFRAME PRODUCTION SCHEDULE

Month	Present Production Republic (Willys)	Proposed Monthly Production Quantities Alloted May Be Revised: Willys	Nash Kelvinator	Firestone	Total Production During Month	Cumulative Production At End of Month
January 1945	25				25	25
February	100				100	125
March	100				100	225
April	125				125	350
May	150				150	500
June	175				175	675
July	200				200	875
August	200		15	10	225	1100
September	200		50	50	300	1400
October	200		200	200	600	2000
November	200		400	400	1000	3000
December	200		400	400	1000	4000
January 1946	100	100	400	400	1000	5000
February		200	400	400	1000	6000
March		200	400	400	1000	7000
April		200	400	400	1000	8000
May		200	400	400	1000	9000
June		200	400	400	1000	10000
TOTAL	1975	1100	3465	3460	10000	

[redacted]

584 [redacted]

Commanding General, Army Air Forces
SUBJECT: Procurement of 1000 JB-2 Jet Bombs Per Month

5. To realize the schedule as set forth in Paragraph 4 above it is suggested that procurement of 8000 units be authorized in the immediate future so that the contractors for airframes, GFE and other items will have at least a letter contract in hand not later than 1 March 1945. Such action is necessary if subcontracts are to be placed and material secured without recourse to special priorities which might interfere with other phases of the war production program. The articles procured should be identical with the 75th JB-2 airframe produced by Republic which incorporates all the refinements and improvements resulting from launching experience to date and no engineering changes, which might delay production, can be introduced if the schedule is to be maintained.

6. Based upon the procurement of 8000 articles as noted in Paragraph 5 above, it is estimated that the total cost of the project exclusive of launching site equipment such as ramps, cranes and dollies will involve an expenditure of approximately seventy two million dollars ($72,000,000.00) as summarized below:

SUMMARY OF ESTIMATED COST

8000 JB-2 airframes - $3000.00 each	$24,000,000.00
8000 Jet Engines - $1500.00 each	12,000,000.00
8000 Control Units - $2000.00 each	16,000,000.00
8000 Sets Air Containers (2 per set) - $170.00 per set	1,360,000.00
8000 Pressure Regulators - $20.00 each	160,000.00
8000 Sets Shut Off Valves (2 per set) - $20.00 per set	160,000.00
	$53,680,000.00
8000 Launching Carts at $600.00 each	4,800,000.00
8000 Sets Rocket Motor Cases at $800.00 per set 4 rocket motor cases per set at $200.00 each	6,400,000.00
Total Procurement from Air Corps Funds	64,880,000.00
800 Sets Radio Equipment procured by Signal Corps at $250.00 per set	200,000.00
8000 Live Warheads procured by Ordnance Department at $600.00 each	4,800,000.00

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ATSC Form No. 10-000 (5 Jan 45)
(Old ATSC Form No. 45)

Commanding General, Army Air Forces
SUBJECT: Procurement of 1000 JB-2 Jet Bombs Per Month

8000 Sets of Charges of rocket motor propellant fuel procured by Ordnance Dept. at $240.00 per set. Each rocket contains one charge of 125 pounds and four charges or 500 pounds constitute one set. At an estimated price for propellant fuel of $48.00 per 100 pounds the cost of 500 pounds will be $240.00. $ 1,920,000.00

Procurement from other than Air Corps Funds 6,920,000.00

Total Estimated Cost not including facilities: $71,800,000.00

7. It is the opinion of the Air Technical Service Command that a program as outlined in Paragraphs 3, 4, 5 and 6 above, if initiated promptly, can be accomplished with little or no additional facilities. Special dies, assembly tools, jigs, fixtures, and possible some rearrangement of equipment in contractors' plants will be required, the expense of which is believed to be a fair charge against the supply contract and should not require a separate facility contract.

8. A study of the direct labor man power required to produce items under Army Air Forces cognizance, such as the JB-2 airframes, the GFE and the launching carts, indicates that a total of 4000 people will be required to produce 1000 articles per month. Of this total 2600 will be employed in airframe production, 1100 in GFE production, and 300 in launching cart production.

9. The material for production of JB-2 jet bombs should be received in contractors' plants at least 30 days prior to the date when completed articles are scheduled for acceptance and shipment. The basic material required to build 1000 articles for items under Air Corps cognizance is summarized below:

COMPLETE BILL OF MATERIAL
WEIGHTS IN TONS FOR 1000 JB-2 UNITS

COMPONENT	STEEL	ALUM.	MAG.	COPPER	BRASS	BRONZE	ZINC	TOTAL
Airframe	797.85	13.83						[illegible]
GFE	340.30	52.12	.52	.24	4.82	2.16	.09	400.25
Launching Cart	22.27	105.93	161.40					289.60
Rocket Motor Cases	520.00							[illegible]
TOTALS	1680.42	171.88	161.92	.24	4.82	2.16	.09	2021.53

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ATSC Form No. 10-508 (3 Jan 46)
(Old ATSC Form No. 43)

Commanding General, Army Air Forces
SUBJECT: Procurement of 1000 JB-2 Jet Bombs Per Month

10. While the radio equipment is presently shown as a Signal Corps
item the procurement of this material will soon become an Air Corps
responsibility. The availability of one AN/ART-19 radio set for each
ten JB-2 jet bombs should not be critical. The use of this equipment is
confined to sending out signals for the purpose of plotting the path of
each tenth bomb. The production of AN/APS-1 radar equipment for controlling
the flight of the JB-2 after launching as noted in Paragraph 4b(7) of
TI-2003, Addendum 14, will require some additional facilities and man
power. While every effort will be made to have this equipment available
with or installed in the airframes, it is obviously impossible to submit
production estimates of any value until such time as the equipment has
been developed, tested and approved.

11. The procurement of rocket motor cases should not be critical
provided orders are placed in the very near future. The rocket motor
cases shall be loaded with propellant fuel under the supervision of the
Ordnance Department and shipped by them to the ETO. It might be noted
that only four rocket motors are required per launching instead of five
as previously used. The procurement of propellant fuel is under the
cognizance of the Ordnance Department who have sponsored the construction
of a facility with capacity to manufacture one million pounds of propellant
fuel per month. This should be sufficient for approximately 1500
launchings per month which is more than the required production of JB-2
jet bombs. This factory was originally scheduled for operation in April
1945 but it may be delayed for a few months. Subject to the concurrence
of the Ordnance Department, it is believed that it should be in full
production by July 1945.

12. The procurement of live warheads is under the cognizance of
the Ordnance Department who have expressed the opinion that the procurement
of warhead casings presents no serious obstacle. It might be noted that
each JB-2 jet bomb requires 1900 pounds of explosive material for the
warhead so that 1000 of these articles per month would require 900 tons
of explosive per month. It is recommended that Ordnance be contacted
to determine if this explosive will be available without curtailment
of explosives alloted to the Army Air Forces for bombs or similar material.

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MAINT DIV
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Commanding General, Army Air Forces
SUBJECT: Procurement of 1000 JB-2 Jet Bombs Per Month

13. The base equipment for the launching sites consists of launching ramps, air compressors for charging the air bottles, cranes, dollies, sheds, buildings and other equipment for handling and assembling the JB-2 jet bombs after their receipt at the launching site. The requirement for launching site equipment is only noted herein since the launching technique is constantly being improved and simplified. This phase of the overall problem is receiving attention in an endeavor to determine just what is needed at each launching site. The procurement of this material should not be critical.

B. E. MEYERS
Major General, U.S.A.
Deputy Director

CC:
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TSEPR

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BPR DEP

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Major H.F.Mullins
ear:TSTEX:5-7126

ARMY AIR FORCES
Headquarters
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Wright Field, Ohio
17 February 1945 H.F.M.

VALUE OF PAPER-CHECK ONE
PERMANENT ☐ TRANSITORY ☐

Serial No.: TI-2003, ADDENDUM NO. 18

Subject: Guided Missiles - Procurement Program for JB-2 Jet Bombs

To: Procurement Division

1. Problem Presented:

a. To procure a quantity of 10,000 JB-2 jet bombs and necessary auxiliary equipment including radar controls in addition to the 2000 previously authorized.

2. Factual Data:

a. Reference is made to TI-2003, Addendum No. 14 which directed the procurement of 75,000 JB-2 jet bombs and TI-2003, Addendum No. 16 which directed that procurement action on 75,000 JB-2 jet bombs be terminated and that recommendations be forwarded to Office, Assistant Chief of Air Staff, Materiel and Services as to how a rate of 1000 JB-2 jet bombs per month by 1 January 1946 could be met without interference with any aircraft or component program.

b. Procurement directed herein should be made so as to insure the availability for an operational launching rate in the theater of 1000 per month by 1 January 1946.

c. A large portion of the 2000 now on order will undoubtedly be required for experimental and service tests and training purposes. The Office, Assistant Chief of Air Staff, Materiel and Services will ascertain the number required for training.

3. Authority:

a. Commanding General, Army Air Forces by teletype WAR-37805, dated 15 February 1945, from Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take the necessary action to procure a quantity of 10,000 JB-2 jet bombs and necessary auxiliary equipment including radar controls as

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~~or changed~~ to ______
AUTH:
By ______
Signature and Grade
Date ______

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Serial No.: TI-2003, ADDENDUM NO. 18

Subject: Guided Missiles - Procurement Program for JB-2 Jet Bombs

To: Procurement Division

outlined above, in addition to the 2000 previously authorized and advise the Office, Assistant Chief of Air Staff, Materiel and Services through this office, the recommended schedule for all 12,000 articles.

By Command of Lt. General KNUDSEN:

T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Engineering Division
Maintenance Division
Budget & Fiscal
Supply Division

[redacted]

X-44110-

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ROUTING AND [redacted] AIR TEC CAL SERVICE COMMAND

Use this form for inter-office correspondence within headquarters. | Use authorized office symbols to designate addressor and addressee. | Place initials of dictator and typist, telephone number and location to right of signature.

Use entire width of sheet, both sides. | Number all comments consecutively. | Separate comments by horizontal lines across page.

SUBJECT Stabilization of Requirements

TO TSBPR
Attn: Col. Hatcher

FROM TSBPR3H

DATE 21 Feb 45

COMMENT NO. 1

215

1. The procurement of JB-2 Jet Bombs and Gliders is suffering to a great extent because of lack of stabilized requirements as indicated in the following paragraphs.

2. JB-2 Jet Bombs. Teletype WAR 37805, dated 15 February 1945, directed the procurement of 10,000 JB-2 Jet Bombs, in addition to those presently on order. This teletype was to be the final culmination of a number of instructions first to buy a tremendous number of JB-2 Jet Bombs and finally merely to make plans for a number of them and then later to make plans for reaching production of only 1,000 per month. Lt. Colonel V. A. Stace, Engineering Branch, Materiel Division, AC/AS, M&S, contacted Lt. Dungan, Special Aircraft Branch on 20 February 1945 and advised that this recent procurement of JB-2 Jet Bombs authorized by Teletype WAR 37805 had been approved so far only by the Deputy Chief of Air Staff, General Timberlake. The General Staff had not approved this procurement but was expected to within the next two days. In view of this, Colonel Stace stated that General Echols had issued the following instructions for transmittal at Air Technical Service Command: "Until General Staff approval was secured for this procurement no definite commitments were to be made by the Air Technical Service Command. Air Technical Service Command should continue to expedite the production planning for this procurement making no definite commitments until further notice". This office contacted Major Mullins, TSTEX, on 20 February 1945, and advised him of the above information and requested that immediate action be taken to secure definite instructions in regard to the action to be taken on this procurement.

3. As the situation now stands, the Air Technical Service Command has a directive to procure 10,000 JB-2 Jet Bombs, followed by verbal instructions from one subordinate in the Office AC/AS to another subordinate officer in the Procurement Division saying not to buy them until further notice. The following points arise in connection with this matter:

a. Why were not the instructions sent by teletype to the Commanding General, Air Technical Service Command?

b. What is wanted?

4. CG-13A Gliders. CTI-1358, dated 9 July 1943, directed the procurement of one hundred (100) CG-13A Gliders and contracts were let with Ford and Northwestern for this quantity. The quantity was increased by five hundred (500) in accordance with CTI-1552, dated 17 January 1944.

a. Teletype AFDMA-4-7675, dated 27 April 1944 - instructions were received to purchase 1,434 additional CG-13A Gliders.

b. PES-4451, 16 May 1944, advised that CG-13A Gliders had a landing speed of seventy-nine (79) miles an hour which might prove to be a limitation on their tactical use.

c. WAR 56609, dated 27 June 1944, directed the procurement of additional CG-15A or CG-4A Gliders in lieu of CG-13A Gliders.

Classification ... or changed to ...

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TO FROM [redacted] DATE COMMENT NO.

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By ...

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TO | FROM | DATE | COMMENT NO.

d. CTI-1775, dated 10 July 1944, reduced the number of CG-13A Gliders on procurement by three hundred (300).

e. CTI-1775, Add. No. 2, 3 November 1944, reduced the number of CG-13A Gliders by one hundred sixty-three (163) leaving eighty-seven (87) to be produced by Ford and fifty (50) to be produced by Northwestern.

5. Reference is made to disposal of CG-13A tools. The Special Aircraft Branch has been advised that there is a strong possibility of ordering additional CG-13A Gliders. To order additional CG-13A Gliders after all the backing and filling that has been going on would be extremely detrimental to the Glider Procurement in general and the CG-4A Procurement in particular. The same objections to the CG-13A Glider which were brought out in PES-4451, dated 16 May 1944, still apply. It is, therefore, urged that no additional CG-13A Gliders be procured.

6. It is requested that the above confused situation be discussed with the proper authority in Office, AC/AS, M&S. It is extremely difficult to maintain the interest and morale of contractors' establishments with constant changes in the procurement, and, furthermore, such changes are always reflected in greatly increased costs and loss of production.

7. Contracts resulting from presently authorized procurement of CG-4A and CG-15A will be completed late in 1945. The maximum continuity of production and set forth in W-13 additional procurement should be authorized in the immediate future. Material situation is critical and about six months' flow time is required.

E. W. DICHMAN
Colonel, Air Corps
Chief, Special Aircraft Branch
Production Section

EWD:hr:ejt
2-4223
Bldg. 16

FROM | DATE | COMMENT NO.

(DO NOT WRITE BELOW THIS LINE)

CONFIDENTIAL

ATSC Form No. 10-508 (3 Jan 45)
(Old ATSC Form No. 43)

[redacted]

Capt. J. R. Dun[illegible]an, Jr.
ejt [illegible] Ext. 2-3225

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
[illegible] 3391
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
J R Duncan
E W Dithane
READJUST DIV.
OTHER

20 [illegible] 1945

SUBJECT: Procurement 10,000 JB-2 Jet Bombs
Willys-Overland Motors, Inc., Toledo, Ohio

TO: Commanding General
Central District
Air Technical Service Command
[illegible] Avenue
Detroit [illegible], Michigan

Attention: [illegible] Representative
(C[illegible] [illegible] [illegible])

1. [illegible] is made to telephone conver[illegible] on this date with Capt. [illegible] [illegible] Sorslad, [illegible] Representative, Central District.

2. In placing the subject procurement for 10,000 JB-2 Jet Bombs, the Air Technical Service Command, in keeping with the urgency of the program, had two possible sources to consider, namely Republic Aviation Corporation, [illegible], Long Island, New York and Willys-Overland Motors, Inc., Toledo, Ohio.

3. Republic Aviation Corporation currently holds Contract W33-038 ac-[illegible]30 for 2050 Jet Bombs. However, inasmuch as Republic's facilities are completely occupied with other high priority Army Air Forces prime contracts, they have subcontracted 1975 of this quantity of Jet Bombs to Willys-Overland and have built only 75 in their own experimental shop. If the additional procurement were placed with Republic, therefore, a costly expansion of facility would have been required with the attendant delay in the program.

4. Willys-Overland however are producing the major portion of the Jet Bombs on contract with Republic and have all the facilities that will be required to produce the additional 10,000 JB-2 Jet Bombs except a small quantity of machine tools and factory equipment. Although Toledo is a Group 1 labor area, and Willys-Overland will require additional people, they are the only known source who have both the required facilities and the experience to carry on this program without unwarranted delay. Willys-Overland personnel have verbally advised representatives of the Air Technical Service Command that the additional people required can probably be made available by diversion from Ordnance work that is being cut-back at that facility.

AUTH
[redacted]
CENTRAL FILE COPY
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WP. Area B-1-1-45-600M

0658

[redacted]

ATSC Form No. 10-508 (3 Jan 45)
(Old ATSC Form No. 43)

Commanding General, Central District
SUBJECT: Procurement 10,000 JB-2 Jet Bombs
20 April 1945

5. Headquarters, Army Air Forces, have established a deadline of 1 January 1946 upon which date a rate of 1000 JB-2 Jet Bombs per month must be available in the theater of operations, which means they must be ready to ship by November 1945 at the latest. It is therefore imperative that this program be established with a minimum of delay and that the contract be placed and production begun immediately.

6. Expeditious action is requested in securing manpower clearance for the additional people required for this project from the Area Production Urgency Committee.

By Command of Lieutenant General ARNOLD:

E. R. Dickman Lt Col
for
H. A. [illegible]
Colonel, Air Corps
Acting Chief, Production Section
Procurement Division

CC:
AAI Sub-Res.Rep., Toledo Sub-Res. Office

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B 1023 C

24 March 1945
1537Z

FROM: WASHINGTON

TO: ATSC WFO

IN REPLY CITE: WAR 58104

This is a supplemental directive to that furnished by teletype WAR 37805 dated 14 February 1945 which authorised procurement of 10,000 JB2 articles and auxillary equipment in addition to the 2,000 previously authorized to insure availability for an operational launching rate of 1,000 per month by 1 January 1946. WAR 58104 to Knudsen for Meyers TSDEP from Echols signed Arnold this also rescinds verbal instructions to delay actual placement of contracts. It is directed that you place contracts w thout delay for these 10,000 additional articles. Caution must be exercised that action be taken so as to avoid interference with critical artillery ammunition and bomb programs or programs of equal priority

IMX-544

NOTE: WAR 37805 - Action assigned to TSTEX

ACTION: ATSC

[illegible]
CM-IN- 4300-GG (24 March 1945) 1932Z trc

DISTRIBUTION: EM

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2. Cable Secy
3. Tsbuy action 7/26
4. Tscep (Tscep 2A) W

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Guided Missiles Procurement

AC/AS, M&S, Control Office, Financial Branch — 10 May 1945

AC/AS, Material and Services — 1 — Lt Col Stace/mjr/2100

1. JB-2

a. The original 1000 JB-2s were authorized on 1 August 1944 on the verbal request of General Arnold. This request was confirmed on 5 August 1944 by AC/AS, OC&R.

b. Sufficient launching powder for 5000 launchings at rate of 1000 launchings per month was authorized by R&R from AC/AS, OC&R on 13 October 1944. This was formerly procured by Ordnance.

c. An additional 1000 JB-2's were directed by Brig. General Powers on 6 December in order to maintain production facilities. 50 were later added by the ATSC for the Navy.

d. 10,000 more JB-2's were directed by teletype on 15 February 1945 as a result of the Deputy Chief of Air Staffs' Memorandum of 14 February 1945 stating "a program to assure the AAF the capability of launching 1000 JB-2 buzz bombs per month by 1 January 1946 has been approved and will be initiated immediately."

e. Actual procurement was withheld until 24 March 1945. Procurement was then authorized after receipt of R&R of 23 March 1945 from G-4 stating that procurement planning continue in program based on 1000 launchings per month but that no action be taken to interfere with any portion of critical artillery, ammunition and bomb programs.

f. The present schedule for the JB-2 follows:

JB-2 Schedule (less Ordnance items, radar and launching sleds)

	Per Month: First 2050 Republic Aviation subcontracted to Willys Overland	Per Month: Next 10,000 Willys Overland	Cumulative
To Date	518		518
April	200		718
May	225		943
June	225		1168
July	225		1393
August	225	50	1668
September	225	250	2143

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0661

Guided Missiles Procurement

AC/AS, MMS, Control Office, Financial Branch 10 May 1945

1 (cont)

AC/AS, Material and Services Lt Col Stace/mjr/2100

October	[illegible]	500	2881
November		750	3631
December		1000	4631
1946		1000/mo until completion	

These schedules were approved by JAC on 26 April 1945 and added to M-14.

a. Army Service Forces have now decided that they cannot furnish warheads on the JB-2 schedule (due to shortage of T.N.T.) without OPD's approval and have referred the question to OPD.

b. A staff study by the Joint Chiefs of Staff Guided Missiles Committee on possible use of JB-2 for a 1 January operational program has shown that the JB-2 could not be available in quantity at that time but has recommended consideration as an auxiliary weapon to other bombing means. This study is now in the hands of the Joint Chiefs of Staff Guided Missiles Committee and OPD.

c. There is a decided doubt at the present time whether the program will be continued at:

(1) 12,000 total.
(2) A reduction to 2000 plus any other requirements for development only.
(3) A reduction to a total of 9000 with a small operational use planned. This action now appears probable.

d. A decision is expected shortly. G-4, OPD and Pres. Bd. [illegible] 26/5

2. Azon VB-1

a. Approximately 14,000 VB-1's were produced on original contracts before cancellations were effected in Sept 1944. These units contained approximately 64% Emerson Radio Receivers and 36% General Instrument Receivers.

b. By R&R Comment 3 dated 19 February 1945, AC/AS, OC&R requested the [illegible] of 1000 VB-1's (will contain AN/CRW-7) delivery [illegible] July 1945.

c. By R&R Comment 1 dated 19 April 1945, AC/AS, OC&R requested [illegible] stocks of VB-1 in MTO and ETO shipped to FE Theater and that an [illegible] Receiver be procured for each VB-1 unit that does not [illegible] Receiver.

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Guided Missiles Procurement

AC/AS, M&S, Control Office, Financial Branch

10 May 1945

1 (cont)
Lt Col Stace [illegible]/2100

AC/AS, Materiel and Services

d. Best inventory of theater stocks reveals approximately 9000 VB-1's are available in MTO and ETO. Of these a minimum of approximately 6500 probably need AN/CRW-7. (Practically all units expended in these theaters contained General Instrument Radio.

e. There are approximately 2300 General Instrument Radio on hand for replacement use. Approximately 1600 have been requested shipped to [illegible].

f. 6500-2000 = 4500 is minimum no. of AN/CRW-7 that should be procured with spares. This quantity should be a 5000 minimum, and inventories may reveal as high as 5000 required.

3. Razon VB-3

a. A memorandum of 28 October 1944 from General McClelland to General Echols established a requirement for 3000 VB-3's. This was based on an FEA request from the 20th Air Force.

b. Msg. CAX 5042, 17 April 1945, stated a firm requirement for [illegible] & IB Theaters of 2500 VB-1/mo starting July. Msg. CM-IN-[illegible] dated 22 April 1945 changed the requirements to Azon or Razon as soon as tested and ready for theater use.

c. Msg AX 77992 dated 2 May 1945 from Far East AF requested information on availability of Azon and Razon equipment.

d. Delivery - 150 preproduction models delivered. 500 per month starting June 1945.

e. AC/AS, OC&R stated a 3500/mo. requirement in an R&R of 9 May 1945.

f. It is believed funds should be [illegible] for a possible 500/mo. production.

4. Felix VB-6

a. Procurement for 1000 VB-6's was established in our letter of 11 November 1944. R&R comment 1 dated 3 November 1944 from [illegible] stated this requirement.

b. Delivery is scheduled for 150 May, 350 June, 500 July 1945.

[redacted]

[redacted]

-3-

Guided Missiles Procurement

AC/AS, M&S, Control Office, Financial Branch — 10 May 1945

AC/AS, Materiel and Services — 1 Lt Col Stace/mjr/2100

5. By R/S comment 4 from AC/AS, Plans dated 5 May 1945 to AC/AS, OC&R and the AC/AS, Intelligence, Joint Target Group, it was recommended that both Razon VB-3 and Felix VB-6 be procured and used in the Japanese War area.

FRED R. DENT, Jr.
Colonel, Air Corps
Chief, Engr. Br. Mat. Div.

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474

ARMY AIR FORCES
Headquarters
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Major W.M.Barstow
ear:TSTEX:5-4141

[redacted]

Auth:.........
Date:.5-14-45.....
Init:..........
...Field, Ohio
1...1945

Serial No.: TI-2003, ADDENDUM NO. 34

Subject: Cancellation of Procurement of 5000 JB-2 Articles

To: Procurement Division

1. Problem Presented:

a. To cancel procurement of five thousand (5000) JB-2 Jet Bombs and all necessary auxiliary equipment including radar controls and AN/APW-1 equipment, leaving a total procurement of seven thousand (7000) JB-2 Bombs, two thousand (2000) of which are for experimental and training purposes with five thousand (5000) production articles to be delivered at the rate of five hundred (500) per month.

2. Factual Data:

a. Reference is made to TI-2003, Add. No. 18 which directed procurement of ten thousand (10,000) JB-2 Jet Bombs in addition to the two thousand (2000) already authorized, and TI-2003, Add. No. 25 which directed procurement of ten thousand (10,000) AN/APW-1A equipments.

3. Authority:

a. CG, AAF by teletype WAR-15761, dated 12 June 1945, from Chief, Materiel Division, AC/AS, M&S.

4. Action Desired:

a. That the Procurement Division take immediate action to cancel procurement of five thousand (5000) JB-2 Jet Bombs, together with the necessary auxiliary equipment including radar controls and AN/APW-1 equipment.

b. These Technical Instructions amend TI-2003, Add. No. 18 and Add. No. 25.

By Command of Major General MILLER:

for W.M.Barstow Major A.C.
T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Engineering Division
Maintenance Division
Supply Division
Tech. Liaison Office
Aircraft Test Control
Air Communications Office

[redacted]

L-159727-219

ATSC Form No. 10-204 (19 OCT 44)

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FOR VICTORY BUY WAR BONDS AND STAMPS

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

[redacted]

TSESE-2G/JL/MTC

WRIGHT FIELD, DAYTON, OHIO
12 March 1945

220

IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL:
TSTEX (TSESE-2G)

SUBJECT: Research Development and Procurement of Launching Devices

TO: Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: AC/AS, M&S, Development Engineering Branch

Reference: AC/AS, M&S ltr. Dated 5 February 1945 (AFDMA-2G)

1. In order to insure successful and expeditious development of all launching devices for AAF Pilotless Aircraft, it is recommended that these developments and tests be the responsibility of the Air Technical Service Command. The technical services, such as Ordnance, Chemical Warfare, and the Engineers, will be called upon for assistance in their specialized fields only when it is considered necessary, as has been the practice in the past. This is in accordance with paragraph 3 of the Memorandum for the Commanding General, Army Air Forces from the Deputy Chief of Staff, dated 2 October 1944.

2. After completion of experimental tests and development, these items will be offered to the technical services best suited to handle procurement or further development. However, as in the past, in anticipation of the particular technical service likely to become engaged in the further development or procurement of any equipment, arrangements will be made to establish early liaison with that particular service in order to acquaint them with the project.

For The Director

J. H. OBER
Captain, Air Corps
Office, Chief of Admini[redacted]

X-36528-A

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[redacted]

WT Area A & DEC 44 45000

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Lt. J. C. Jones:apv
Ext. 2-5194

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DDRESS BOTH
ION AND EN-
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OFFICE SYMBOL:
(TSE-4I)

HEADQUARTERS
Air Technical Service Command

9 January 1945

Launching Equipment for JB-2 Bombs.

Commanding General,
Army Air Forces,
Washington 25, D. C.

MX-544

Attention: AAF Liaison Officer with NDRC
Colonel J. F. Phillips
Rm. 4C 871 The Pentagon

1. The Air Technical Service Command feels that a requirement exists for a more feasible launching system other than that employed at the present time for JB-2 bombs. Under the present system the bomb is launched on a cart propelled along rails by rockets developed under the National Defense Research Committee Project AC-75. The large cloud of white smoke resulting from the burning of the rockets readily locates the launching site, rendering the system unfavorable under combat conditions. A , much time and labor is required to build the ramp for launchings.

2. At the present time, launching cart assembly is either completely destroyed or severely damaged after each launching, and requires much time and labor in the salvage of usable components. In order to expedite launching in combat areas it is highly desirable to recover and reuse the cart assembly.

3. It is therefore requested that a project be initiated to have the National Defense Research Committee investigate and develop methods of launching JB-2 Bombs. It is highly desirable to have a launching unit which could be transported on trucks, quickly assembled, and give the enemy no indication of its position when a bomb is launched. In any system of launching that is developed, consideration should be given to the salvage of the launching cart.

4. This project is considered of sufficient importance and urgency to warrant the draft deferment of civilian personnel engaged thereon.

5. The Air Technical Service Command liaison officers are as follows: Colonel S. R. Stewart, Equipment Laboratory, Engineering Division; Major J. P. AuWerter, Engineering Standards Section, Engineering Division; and Lt. J. C. Jones, Engineering Standards Section, Engineering Division.

COM. GEN.
CH. STAFF
DEP. CH. STAFF
TECH. EXEC.
ADJ. GEN.
EXEC. PROC.
AIR. INSP.
INTELL.
COMPTROLLER
C. O.
BUD. OFF.
PERS. SEC.
ENG. DIV. Jones
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS

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By CD 336

AG5-11 10 JAN 1945

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Ltr., ATSC, TSESE-4I, 9 January 1945, to CG, AAF, Washington, D. C., subj: Launching Equipment for JB-2 Bombs.

6. Classification of this project should be RESTRICTED.

For the Director:

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[redacted]

AFD[illegible]
Col Giffin/ek/[illegible]
13 Feb 45

Secret by [illegible]

2/26/45
Date

20 FEB 1945

Dr. V. Bush
Office of Scientific Research
and Development
1530 P Street, N. [illegible]
Washington, [illegible]

Dear Dr. Bush:

As you suggest in your letter of [illegible] February 194[illegible], we will [illegible] require OSRD assistance in connection with our JB-2 [illegible] program. [illegible] have in fact already requested [illegible] to act in an advisory capacity with respect to our proposed [illegible] type control to the JB-2 and also [illegible] a flywheel inertia starting [illegible], pilot models for which [illegible] early March. [illegible] requested to undertake developmental work in connection with a [illegible] system [illegible] multiple [illegible] system for the [illegible] with the [illegible] starting [illegible] assistance [illegible] propellants for use with the [illegible]

[illegible] it appears unlikely that [illegible] forced to request any major [illegible] of OSRD effort to the JB-[illegible]

In view of your [illegible] interest in the JB-[illegible] review of the Air Forces' [illegible] indicated. [illegible] that the Germans [illegible] in a position to initiate [illegible] attack [illegible] southern England at the rate of [illegible] JB-2's per day, [illegible] very well have [illegible] Allied countermeasures, [illegible] exploit fully this revolutionary [illegible] disaster was averted.

We believe the JB-2 [illegible] very long range weapons whose [illegible] will [illegible] affect future [illegible] and especially aerial warfare. [illegible] very long range missiles [illegible] serious diversion of effort [illegible] this way. [illegible] the JB-2, both for the purpose of [illegible] against the enemy and [illegible] obtaining actual experience in the use of this representative [illegible]

It was our thought that the [illegible] JB-2's [illegible] day, [illegible] accurate control system, would [illegible] destructive [illegible] of visibility [illegible]

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more of numerous suitable area targets. ~~Further, we would thus possess a valuable supplement to those air operations designed to "isolate the battlefield."~~ Even without control, area targets could be harassed when our bombers were grounded. However, a careful study of the costs involved in this program (or any larger program) indicated that the diversion in personnel, shipping and production effort would be prohibitively great at this stage of the European war.

Our present plan is to attain the capability of launching operationally 1000 JB-2's per month by 1 January 1946. The cost of this program in terms of control equipment and propellent powder, while considerable, can scarcely be regarded as prohibitive. While we are assuming that the "composite" propellant will be utilized, we are sparing no efforts to attain more effective and economical means of launching the missile. We anticipate no serious difficulty in finding suitable Japanese Empire targets for these missiles in the later stages of the Pacific war, whether or not a system insuring accuracy of control becomes available. With reasonable accuracy of control, the potential targets for the JB-2 will be multiplied many times. The possibilities of air launching must be given consideration in this connection.

Developmental and production problems in connection with the JB-2 program come within the cognizance of General Echols, and I am accordingly designating him as the one man to whom OSRD can turn for resolution of OSRD problems in this connection.

Sincerely yours,

Signed

BARNEY M. GILES,
Lieutenant General, U. S. Army,
Deputy Commander, Army Air Forces and
Chief of Air Staff

20 FEB 1945

sent by special messenger

[redacted]

OFFICE SYMBOL		2 AFOCR	3 AFACO	4 AFAMS	5 AFAEP	6
SIGNATURE OF RESPONSIBLE OFFICER						
STENOGRAPHER'S INITIALS						

SLS
AAG 471.6 Buzz Bomb (8)

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STATUS REPORT ON SCALE MODEL OF

JB-2 LAUNCHER

by

Lt. V. D. Russillo and R. B. Kershner

19 March 1945

At the request of the Ordnance Department, the Allegany Ballistics Laboratory is developing a smokeless powder powered launching system for the JB-2. The JB-2 is the American version of the German robot bomb V-1 and was developed by the Army Air Forces.

The Germans launched their V-1 from a slotted tube launcher 160 feet in length by 11½ inches in diameter. A piston in this slotted tube was propelled down the tube and the bomb was attached above the piston by a fin extending through the slot in the tube. An ingenious obturating pipe prevented too much gas leakage through the slot. The propelling system was the catalyzed decomposition of H_2O_2 (90%).

The Army Air Forces wish to use similar launchers for the JB-2 but a new propelling system must be developed since 90% H_2O_2 is not available commercially in this country. A flash steam system and several chemical propellants are being investigated.

A rocket A. T. O. unit has been developed but will not completely answer the Air Force requirements since not enough propellant can be produced to give the required number of launchings.

Dr. C. N. Hickman suggested a means for using relatively thin web (solvent extruded) rocket powder as propellant for use in the German type launcher. The details of the Hickman proposal are given in a memorandum of 12 February 1945 entitled "Calculations on the Scale Model JB-2 Launcher".

The Ordnance Department requested ABL to demonstrate the feasibility of the Hickman method by the construction of a scale model. Such a model was built and the installation at ABL was completed on 1 March 1945.

The enclosed photostat and photographs give the details of the construction of this launcher. The model is scaled only in diameter, which is three inches (I. D.)

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Status Report on Scale Model of JB-2 Launcher

- approximately 1/14 the scale in area. The length - 160 feet, velocity - 250 mi./hr., operating pressure - 850 lb. /in.^{2}, powder web - 5/16 inch, are all full scale. The powder charge - approximately 3.5 pounds and accelerated weight - 382 pounds are 1/14 the scale.

As mentioned above, the powder web (granulation) is full scale. The powder is single perforated 7/8" x 1/4" x 5" and of the T2 (M-4) composition. Its composition and burning rate are given in the memorandum mentioned above. In the full scale model grains ten inches long may be used but the 7/8" x 1/4" dimensions will remain.

No attempt is made to simulate the bomb in the scale model except in weight. The weight is obtained by using a projectile consisting of five long slugs of steel. These are shown in an attached photograph.

Two systems of firing control were developed - an electrical system and a percussion system. The first chamber is fired electrically in both systems. In both systems the firing of the subsequent chambers is based on the principle of actuation by the gas pressure in the tube. Thus the charge in a particular chamber is fired immediately after the projectile has passed the chamber orifice and exposed the firing control to the gas pressure. In the electrical system, the firing control is a Bourdon Tube which trips a microswitch when the pressure rises to 330 lb./in.^{2}. This Bourdon Tube is located at the same junctor as the powder chamber (see attached photograph). The details of the percussion systems are shown in an exploded view attached. The gas pressure forces the inner chamber and percussion element back against the firing pin fixed in the outer chamber head.

In the final full scale model electrical firing could be employed with much simpler firing controls since switches could be tripped mechanically by the passage of the bomb and piston. However, even in this case the percussion method would be simpler since no wiring is necessary. To insure against any misfire, it might be wise to use both percussion and electrical firing systems.

In tests of the scale model launcher at ABL, the pressure-time curve has been obtained by electronic strain gage equipment with the gage at the first junctor. The velocity of the projectile is measured from ribbon-frame

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Status Report on Scale Model of JB-2 Launcher

camera photographs. A second strain gage placed further along the tube was used on some rounds to give information on leakage past the shell and the time of passing later juncters.

In all, seventy rounds have been fired - of which eight rounds have been with percussion firing and the remainder with electrical. The only difficulty encountered was a very great lack of uniformity in the early rounds. This was found to be due largely to powder break-up caused by the fact that no powder trap was used on the early rounds. The powder was broken by being ejected from the chamber against the far wall of the main tube. A picture of partially burned grains showing the type of cracking that occurred is attached. The inclusion of a trap or magnesium blowout disc has eliminated most of the erratic behavior and the pressure-time curve is now reasonably reproducible.

The spacing of charges as originally designed has been found proper with one small exception - it has been found necessary to reduce the initial chamber length to nine inches. This is accomplished by using a one-inch filler block and starting the projectile from a position ten inches from the breech.

The charge in the first chamber is about .235 pounds as originally planned. The first pressure peak resulting from this charge is a little erratic even with traps due probably to unavoidable variations in starting friction but not enough rounds have been fired under identical conditions to warrant a final statement on consistency. However, the value of the first pressure is between 700 and 850 lb./in.^{2} on most records.

The pressure reached due to the firing of subsequent charges is more consistent. However, with the charge as originally planned (.47 pounds), this pressure is somewhat low - about 650 lb./in.^{2}. Increasing the subsequent charges to .505 pounds gives a level about 800 lb./in.^{2}.

Even with this increased charge the velocity attained so far is only 240 ft./sec. This is considerably lower than the required velocity. Apparently friction losses and work against the atmosphere are greater than anticipated. The addition of a seventh chamber brings the velocity to about 275 ft./

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Status Report on Scale Model of JB-2 Launcher

sec. Chambers which allow a charge of .60 pounds to be used are expected momentarily and should give the desired velocity.

Typical pressure time curves for electrically fired and percussion-fired rounds are attached. It will be noted that the ignition in the percussion-fired rounds is faster, giving a sharp rise which shows when the individual chambers are fired. The hash on the record of the electrically fired rounds is probably due to electrical disturbances picked up by the pressure gage leads caused by the current through the firing leads, since the records of percussion fired rounds show that there is no actual pressure wave.

Occasionaly misfires have occurred with the electrical system due largely to the rather makeshift character of the pressure switches involved. With mechanical switches which could be used on the full scale model there is no reason to expect misfires since squibs which function better than 99.8% are available. No misfires have occurred yet with the percussion system.

In no round has a chamber fired prematurely. No blowups have occurred and even on the preliminary exploratory rounds the pressure has never exceeded 1300 lb./in.^{2}.

In future rounds the charge will be first increased until a velocity of 250 mi./hr. (365 ft./sec.) is obtained. Then a uniformity series will be fired, the effect of initial powder temperatures will be studied and the effect of a single misfire in each position will be found.

Victor D. Russillo

VICTOR D. RUSSILLO
1st Lt., Ord. Dept.

R B Kershner

R. B. KERSHNER

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ATSC Form No. 10-806 (3 Jan 45)
(Old ATSC Form No. 43)

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COORDINATION
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AIR INSPECTOR
MGT. CONTROL
TSESE-2 (TSESE-2G)
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
M. T. DIV.
SUPPLY DIV.
ENGINEERING DIV. J. G. Dykes Capt, A.C.
PROCUREMENT DIV.
READJUST DIV.

TSESE-2G/JAD/MTC

[redacted]

26 March 1945

Launching Ramp Program

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: AC/AS, M&S, - Air Engineers

1. This is to confirm a telephone conversation on 21 March 1945 between Capt. I. P. Young of your office and a representative of this office in which the following program was concurred in:

a. The first American made German type ramp modified for use with the multiple-cartridge launching is to be erected at Range 64, Eglin Field, Florida near the Babcock and Wilcox Steam Equipment to make use of existing bomb-proof shelters. This ramp will be shipped to Eglin Field 10 April 1945. A representative from the office of Air Engineers was invited to be present at the test of this ramp. The second ramp is tentatively scheduled to be sent to Wendover Army Air Base, Wendover, Utah pending results from the multiple-cartridge ramp at Eglin Field.

b. Capt. Young is at Eglin Field now to initiate work on the 400 ft., 3 rail, level ramp. Delivery of the rails is expected about 1 April 1945. Completion of the ramp is expected by 4 April 1945.

c. Capt. Young will be present at tests on the Babcock and Wilcox steam equipment which are to be made this week.

d. Any basic modifications to the launching ramps will be coordinated through your office for comments and recommendations.

FOR THE DIRECTOR:

Leck Maj AC

M. S. ROTH,
Colonel, Air Corps,
Chief, Aircraft Projects Section,
Service Engineering Subdivision,
Engineering Division.

AG5-8 26 MAR 1945

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No. of pages - 2

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ARMY AIR FORCES
AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

TSEPL-316/WJH/hle
Date 25 May 1945

SUBJECT: Launching Device for Pilotless Aircraft

225

OFFICE TSEPL-316 Contract or Order No.

SERIAL No. TSEPL-3-673-84 Expenditure Order No. 673-84

A. PURPOSE:

1. To close out Expenditure Order No. 673-84, Project No. 45-1130-A.

B. FACTUAL DATA:

2. Expenditure Order No. 673-84 was set up to provide funds for conducting studies on the possibility of launching pilotless aircraft by means of energy stored up in a rotating flywheel, as directed by T.I. 2003, Addendum 9. The Allis-Chalmers Manufacturing Company was given contracts under Expenditure Order No. 673-84, to carry out studies and tests on a one-fifth scale model of the proposed launching device.

3. Upon completion of the original studies and tests by Allis-Chalmers Manufacturing Company on the scale model, a new Expenditure Order, 673-89, was set up to cover procurement of two full scale models of the launching device, and contracts have been let to Allis-Chalmers Manufacturing Company for the device.

C. CONCLUSIONS:

4. Results of the tests on the scale model indicate that a one-fifth scale object can be launched successfully and small changes in design would make the full scale model feasible. The analysis of the engineering data on the test model as presented by Allis-Chalmers shows that the studies and tests were entirely successful from an engineering standpoint.

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Memorandum Report No. TSEPL-3-673-64
25 May 1945

D. RECOMMENDATIONS:

5. It is recommended that the following action be taken by the organization designated below:

a. Engineering Division, Air Technical Service Command, Equipment Laboratory.

(1) That, in view of the foregoing data, Expenditure Order No. 673-84, Project No. 45-1130-A, be closed out.

[redacted]

Concurrence:

Prepared by WALTER J. HANSEN, 1st Lt., A.C.
(Name)

Approved by C. O. FRENCH, Jr., Lt. Col., A.C.
Chief Special Weapons Branch

Approved by S. R. STEWART, Colonel, A.C.
Chief, Equipment Laboratory
Propulsion & Accessories Subdivision
Engineering Division

Distribution:
Mat. Div., AC/AS, M & S (5)
HIS (5)
Tech. Data Lab. (TSEAL-6D)
Aircraft Projects Section (TSESE-2G)
TSEPL-3I6

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HqATSC Form No. 80-507 (20 Jan)
(Old AAFMC-200)

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Total number of pages - 3

ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND

MEMORANDUM REPORT ON

TSEPL-3N10/TAM/jjw
Ext. 3-5316
Date 8 October 1945

SUBJECT: Flywheel Launching Device for Launching Pilotless Aircraft, Type JB-2.

OFFICE TSEPL-3N10 Contract or Order No.

SERIAL No. TSEPL-3-673-84 Expenditure Order No. 673-89

A. PURPOSE:

1. It was desired to develop a mechanical system for launching jet bombs. A rocket assisted take-off method had previously been developed but had several disadvantages. These disadvantages were:

a. The shortage of rocket powder, and the major difficulties involved in diverting and building new facilities, and in securing sufficient raw materials.

b. The danger involved in handling this explosive material.

c. The large flash and resultant volume of smoke from the rocket burning.

d. The high cost of facilities and powder.

The catapult flywheel was one proposed method of eliminating these difficulties.

B. FACTUAL DATA:

2. Under T.I. 2003, Addendum No. 9 of the Air Technical Service Command dated 16 December 1944, the project of developing a flywheel launching device for JB-2 bombs was initiated. The expenditure order (E.O. 673-89) opening this project was dated 26 April 1945.

3. Contract No. W33-038-ac-10636 was initiated on 25 April and was awarded on 4 May 1945 to Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin. This contract called for the design and fabrication of two (2) each Launching, Device, Flywheel Type, capable of launching 5000 pounds at a speed of 360 feet per second

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within a 200 foot run. In connection with this project the following Authority for Purchase was prepared:

A.F.P. 430473, Amount $120,200.00, dated 25 April 1945.

Work on the project progressed very slowly from April to September due to the difficulty in obtaining high priority materials. On 29 August 1945 only 30% of the work was complete of which 20% was comprised of engineering research and design. The small portion of completed parts are now located at the contractors plant and are of no value to the Army Air Forces. A one fifth scale model of the flywheel launcher was fabricated under E.O. No. 673-84 (a project closed out by Memorandum Report serial No. TSEPL-3-673-64 dated 25 May 1945, subject, Launching Device for Pilotless Aircraft). This model has been given to the Aero-medical Laboratory to aid in the study of acceleration effects.

4. The following Memorandum Reports concerning this project have been written:

a. Serial No. TSESE-2G-1163, subject, Test of Model Flywheel Launching Device, dated 20 March 1945.

b. Serial No. TSEAL-6F-154, subject, Mechanical Launching Device for JB-2, dated 13 March 1945.

c. Serial No. TSEPL-3-673-64, subject, Launching Device for Pilotless Aircraft, dated 25 May 1945.

5. No tests were conducted on the full scale model. Tests results concerning the fifth scale model are contained in Memorandum Report referenced in paragraph 4-b.

6. No evaluations were made by other organizations.

7. In accordance with Routing and Record Sheet, subject, Flywheel Launching Device for JB-2 bomb, dated 27 August 1945 from TSESE-2G stating that this type of launcher is of no value at the present time, this project is being terminated. Satisfactory operation of the Catapult, Multiple Cartridge and the rocket launchers have made further development of the flywheel type ramp for JB-2's unnecessary. Simultaneous development of these various methods of launching JB-2's was undertaken because of the urgent requirement for this missile during the hostilities with Japan.

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HqATSC Form No. 90-597 (20 Jun)
(Old AAFMC-200)

Memo. Report No. TSEPL-3-673-84 [redacted]
8 October 1945

8. No further procurement of the subject item is contemplated and the original Contract No. W33-038-ac-10636 was cancelled by Teletype No. TSERE-4-9-120 dated 20 September 1945.

9. No information has been forwarded to Maintenance Division for Technical Orders.

10. No special tools, test equipment, or training aids were required for the item developed.

C. CONCLUSIONS:

11. That a fifth scale model of the proposed final product was successfully tested. No requirement exists at present for a launching device of this sort for Pilotless Aircraft.

D. RECOMMENDATIONS:

12. It is recommended that the following action be taken by the organizations designated below:

a. Engineering Division, Air Technical Service Command, Equipment Laboratory.

(1) Discontinue from further consideration the flywheel launching device for pilotless aircraft.

This Memorandum Report closes out Expenditure Order No. 673-89 and Project No. 45-1207.

Distribution:

AC/AS, M & S (5)
TSEAL-6G, Tech.Data.Lab.
TSEPL-3N10, Equip.Lab.
HIS (5)

Prepared by T. A. MAHAN, Captain, Air Corps

Approved by C. O. FRENCH, Jr., Lt.Colonel, A.C.
Control Equipment Branch

Approved by T. B. HOLLIDAY, Colonel, Air Corps
Chief, Equipment Laboratory
Propulsion and Accessories Subdivision

Concurrence: Engineering Division

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ALLEGANY BALLISTICS LABORATORY
Cumberland, Md.

18 August 1945 W 200

MEMORANDUM

TO: Files

FROM: R. B. Kershner

SUBJECT: Meeting on JB-2 Launcher Project

On August 10th, a meeting was held at the Allegany Ballistics Laboratory to discuss a number of features that have recently arisen in connection with the JB-2 launching program. Those in attendance were as follows: Captain Hudson, Captain McDonald, Lt. Winemiller and Mr. Lipnick of the Ordnance Department, Captain Burke of the Engineer Board, Lt. Donovan the Navy Liaison Officer, Dr. Hickman and Dr. Kershner of the Allegany Ballistics Laboratory, and Mr. Pope of the Budd Wheel Company.

Captain Hudson opened the meeting by remarking on the gratification of the Ordnance Department with the speed and efficiency with which the project had been handled and the excellence of the results obtained. Captain Burke then described the status of the various ramps. He explained that the Engineer Board was responsible for any further development on the ramps themselves. At present there are three ramps in existance, namely, the original German ramp modified to permit steam launching at Eglin Field, the powder ramp at Eglin Field and a third at Huntsville used with hydrogen peroxide propellant. A fourth ramp is scheduled for completion on August 20th and will go either to Wendover or Eglin Field. Captain Burke also mentioned the existance of the Navy ramp now approaching completion which will be installed at Port Mugu, California. He stated that the Engineer Board was very much interested in the Navy launcher in that the weight was in the neighborhood of 18 tons as compared with 40 tons for the German design. The Engineer Board is also interested in the flat ribbon sealing strip used by the Navy and is conducting experiments with such sealing strips. Finally, Captain Burke mentioned that a recent 18 ton design had been proposed by the Willis-Overland Company which involved a change in diameter from approximately 11½" now used on all ramps to 8¼" (roughly one-half the cross section area). Captain Burke asked our opinion of the ballistic difficulties that would arise from the use of a launcher with one-half the cross section area and thus necessarily operating at approximately double the pressure. It was decided that this much change would probably be advantageous from the ballistic standpoint in that the powder would burn more regularly at the higher pressure but that no smaller launcher than 8¼" should be contemplated since the use of the still higher pressures would require a powder so thick that solvent extrusion could not be used.

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We next informed the meeting that the Allegany Ballistics Laboratory was engaged in the design of a production type powder chamber for the JB-2 powder ramp. The drawings in their current state were examined and the progress made to date was approved by all those present.

Captain Hudson next pointed out that by rather small adjustment of the position of the last two chambers (specifically moving the next to last chamber forward approximately 5 ft. and the last chamber rearward approximately 3 ft.), it would be possible to construct a ramp in which all sections after the first would be identical and interchangeable. Each launching section after the first would be drilled and tapped to receive two powder chambers. Of course the positions where no chamber is used would simply be plugged. It was agreed by all that the proposed shift in the position of the last two chambers would not have a seriously objectionable ballistic effect.

At the close of the meeting, a comparison of the various ramp launching methods was made. Captain Burke informed us that the steam launching had been definitely abandoned so that the present choice lies between the hydrogen peroxide launcher and the powder ramp. He was unable to suggest any virtues of the hydrogen peroxide launching system which would compensate for the increased complexity of the supply problems over those with the powder ramp. Dr. Hickman then questioned whether the hydrogen peroxide might not be safer having in mind specifically the possibility of a bomb being stranded on the ramp and developing a gasoline leak. This accident occurred once with the powder ramp and the bomb immediately burned due to the ignition of the gasoline by the hot powder gases in the ramp. Dr. Hickman questioned whether a similar fire would have occurred if hydrogen peroxide propellant had been in use. It was the unanimous opinion of others present that the results of the hydrogen peroxide decomposition was at a sufficient high temperature to ignite gasoline vapors and that a similar fire would have occurred with the hydrogen peroxide (and probably even with the steam) launching system.

R. B. Kershner

RBK:omb

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DISTRIBUTION:

1. Captain H. W. Arnold, Aviation Ordnance Engineering Office, TSORE, Wright Field, Dayton 7, Ohio
2. Major J. P. AuWerter, AAF, ATSC, Engineering Division, Research Projects Branch, Wright Field, Dayton, Ohio
3 - 4 Director, Air Technical Service Command, Dayton, Ohio, Attn: Aviation Ordnance Office, Engineering Section (TSORE)
5. Lt. Col. H. C. Beaman, ATSC Liaison Officer, Applied Physics Lab., Johns Hopkins University, 8621 Georgia Ave., Silver Spring, Md.
6. Office of Air Ordnance Officer, Pentagon, Room 5C-1047, Washington 25, D. C., Attn: Major R. L. Davis
7. Lt. Robert Dickey, III, USNR, Room 2W98, Building W, Navy Dept., Washington 25, D. C.
8 - 9. Rocket Development Division, Research and Development Service, Office of the Chief of Ordnance, The Pentagon, Washington 25, D.C., Attn: Captain C. M. Hudson
10 - 11 Ordnance Officer, Army Air Force Proving Ground Command, Eglin Field, Florida, Attn: Lt. Col. Samuel P. Huff
12 - 13 Major Jack Leet, AAF, ATSC, Engineering Division, Equipment Laboratory, Special Weapons Branch, Wright Field, Dayton, Ohio
14. Lt. F. J. Perella, USNR, Research and Development Division, Bureau of Ordnance, Room 0422, Navy Department, Washington 25, D. C.
15 - 16 Research and Development Service Sub-Office (Rocket), Office of the Chief of Ordnance, P. O. Box 210, Cumberland, Maryland
17. Lt. Col. V. A. Stace, AAF, AC/AS M & S, Materiel Division, Pentagon, Room 5D-870, Washington 25, D. C.
18. Major H. A. Zahl, SC, Signal Corps Ground Signal Agency, Shark River Hills Hotel, Bradley Beach, New Jersey
19. Mr. F. L. Hovde
20 - 21. Dr. R. E. Gibson
22 - 23. Dr. C. N. Hickman
24. Dr. A. Kossiakoff
25. Dr. W. H. Avery
26. Capt. H. H. Abram
27. Lt. J. J. Donovan
28. Major A. R. T. Denues
29. Mr. S. Golden
30. Mr. O. R. Roderick
31. Mr. G. H. Hoppin
32. Mr. W. Pope
33. Dr. B. D. VanEvera
34. Mr. C. F. Curtiss
35. Major J. Miller
36. Major F. Bellinger
37. Capt. Clyde Wilson, Range 64, AAF PGC, Eglin Field, Florida
38. Major Holbrook, Range 64, AAF PGC, Eglin Field, Florida
39. Major G. S. McKee, C.E. OCE Liaison Officer, TSXCE, Post 2-275, Bldg. 125, Area B, Wright Field, Dayton, Ohio
40. Mr. W. A. D. Millson (2)
41. Major Olund (2), Technical Division III, Mechanical Equipment Section, Engineer Board, Ft. Belvoir, Virginia

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ATSC Form No. 10-508 (3 Jan 45)
(Ol, ATSC Form No. 43)

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TSESE-20/CHP/kt

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
TSESE (TSESE-20) MGT CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

12 September 1945

Development Program for JB-2.

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Asst. C/AS, M&S, (AFDMA-20).

To be sent to file shortly

1. Reference is made to Hq.AAF letter dated 28 August, subject "Development Program for JB-2". The Engineering Division of the Air Technical Service Command is not in agreement with the outlined program for continued development of the JB-2 bomb for the following reasons:

a. Sufficient flight data has already been obtained on this missile to adequately determine its flight characteristics, controllability, preset accuracy, and range limitations.

b. Studies made at Wright Field, Republic Aviation Corporation, and Willys Overland Motors Corporation indicate that while it is possible to extend the range of the missile it is not practical to do so without a design change involving extensive modification to the airframe.

c. Control equipment for any missile must be designed to suit the missile's own operating characteristics. To perfect JB-2 control equipment would not necessarily make suitable control equipment available for some other controlled aircraft.

d. Development of reliable and accurate radar control equipment may be carried out with a fast, pilot-carrying airplane and later, when desirable, fitted to whatever missile is to be controlled. For long range control from ground stations and for control from other aircraft a radio or radar control system development program is definitely indicated before attempting flight tests of the particular pilotless missile.

Central File
TSESE-20 CHP/kt
9-11-45

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Commanding General, Army Air Forces, Washington 25, D. C. Attention: Asst. C/AS, M&S, (AFDMA-2G). "Development Program for JB-2"
12 September 1945

e. Launching and handling equipment developed for the JB-2 bomb is considered adequate for all contemplated tests. Further development of such equipment could not be expected to be of value for launching and handling other types of guided missiles now in the planning stage.

2. The present program of the Air Technical Service Command contemplates completion of development of the intermittent jet engine used with the JB-2 and a number of tests to determine its performance in flight. Various flight tests will be made with the JB-2 bomb to obtain additional data on best methods of radar flight control and to study possible means of obtaining better accuracy through control of the final dive-in trajectory. Some work will be done with preset flight controls in order to ascertain what course a development of accurate, automatic, non-radio controlled robot pilots should follow. No extensive work in connection with seeker type control of the JB-2 is contemplated until development of suitable types of seekers has been accomplished and proof tested in pilot carrying aircraft.

3. It is recommended that the directive to continue the development of the JB-2 bomb be rescinded and replaced with a directive to develop other types of ground to ground missiles of higher speed and longer range which will materially aid the advancement of the guided missiles program.

FOR THE COMMANDING GENERAL:

Copy to:
TSTPR

JOHN H. OBER
Major, Air Corps
Office, Chief of Administration

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ATSC Form No. 10-505 (3 Jan 45)
(Old ATSC Form No. 43)

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Development Program for JB-2

2nd Ind. TSESE-2G/CHP/kt

HQ AAF ATSC Wright Field, Dayton, Ohio, 30 October 1945

TO: Commanding General, Army Air Forces, Washington 25, D. C. Attention: ACAS-4, Production Division.

1. The JB-2 development program now being conducted at Wendover Field Utah, will be essentially as follows:

a. Approximately 50 JB-2 aircraft will be flown by radar control to determine the best method of employing presently available beacon-selector-receiver units and actuator units and to aid in the development of better and more reliable equipment.

b. In connection with tests of radar control equipment, attempts will be made to obtain predictable controlled trajectory characteristics for the final dive phase of the flight in order to make the JB-2 consistently more accurate.

c. Miscellaneous experimental JB-2 flights will be made from time to time to test new control developments, airframe modifications, or installations of new or modified equipment. It is anticipated that some JB-2's will be equipped with new types of self-guiding navigational equipment for service test before use with new types of ground-to-ground missiles.

2. The program outlined in Paragraph 1 will require approximately 200 JB-2 aircraft during the next two year period.

FOR THE COMMANDING GENERAL:

JON H. OBER
Major, Air Corps
Office, Chief of Administration

Classification cancelled

Copy to:
TSTEX

COORDINATION
DIRECTOR OF SUP
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
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CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
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OTHER

CENTRAL FILES
TSESE-2G/CHP/kt
10-19-45
D/c sent to Records
Section 10-12-45/kt

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DDR BOTH
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ATTENTION OF
OFFICE SYMBOL:
ESE-414)

Headquarters
Air Technical Service Command

TSESE-41:MWE:apr

20 January 1945

Request for initiation of AAF-NDRC Project.

[redacted]
AUTH: D.R., ATSC
INITIALS
DATE 20 JAN 45

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Commanding General,
Army Air Forces,
Washington 25, D. C.

X-334.8 - NDRC - Conf'l

Attention: AAF Liaison Office for NDRC
Colonel Wm. G. Brown
Room 5D 876 The Pentagon

V-4-8

1. It is requested that a project be initiated with the National Defense Research Committee for the development of a remote control system using ground radar for use with JB-2 missiles.

2. The Army Air Forces have initiated the development and production of this type of jet propelled missile, but initially no form of remote control was provided; therefore, it is concluded that the development of a remote control using ground radar will materially improve their effectiveness, especially in tactical operations. Also, the Army Air Forces have initiated a program using the AN/APW-1 control equipment in conjunction with the modified SCR-584, which is similar to that developed for the remote control of war-weary aircraft and known as the Cottongrass Phase of the Abusive Project. Recently this program was discussed by the National Defense Research Committee and the Air Technical Service Command personnel, and the National Defense Research Committee has suggested a second phase, which will be considerably advanced in performance, security and non-interference.

3. It is further requested that the National Defense Research Committee act as advisors on the first phase which will be used until the second phase is ready for use. At least ten models of the airborne portion of this equipment should be furnished to the Air Technical Service Command for field testing. The monthly progress reports relative to the subject study would be furnished this Command.

4. This request will confirm verbal concurrence given to the request initiated by the Air Communication Office as discussed by General McClelland, Air Communication Officer, and Lt. Col. Haller, Engineering Division, Air Technical Service Command. It is believed that this project can be considered under the recently requested NDRC Project AC-220.03 entitled "Research and Development of new secure systems for the remote control of rocket and/or pilotless aircraft."

Classification cancelled
or changed to
AUTH: CD 335
By
Signature

COM. GEN.
CH. STAFF
DEP. CH. STAFF
TECH. EXEC.
ADJ. GEN.
EXEC. PROC.
AIR. INSP.
INTELL.
COMPTROLLER
C.O.
BUD. OFF
PERS. SEC.
ENG. DIV.
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS

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Ltr., ATSC, 20 Jan 45 (334.8), to CG, AAF, Subject: Request for Initiation of AAF-NDRC Project.

5. This project is of sufficient importance to warrant deferment from draft of personnel engaged thereon.

6. It is desired that Lt. J. L. Bowers, of Special Projects Laboratory, Radio and Radar Section be designated as project officer, and that Major J. P. Auwerter and Lt. N. W. White be designated as liaison officers.

7. It is requested that this Command be advised of action taken.

For the Director:

F. O. CARROLL
Brigadier General, U. S. A.
Chief, Engineering Division

cc: Lt. J. L. Bowers

TECHNICAL STAFF

SECRET

X-7498-A

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ADDRESS REPLY TO
HEADQUARTERS OF THE ARMY AIR FORCES
WAR DEPARTMENT
WASHINGTON, D. C.

[redacted]

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

[redacted]
By A [redacted]
The Commanding General
Army Air Forces
2-003-45
Date Initials

AFDMA-2F/2
20 March 1945

SUBJECT: Extending Range of Control on JB-2

230

TO: Director,
AAF, Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: Special Projects Laboratory, TSERR2C

1. The present standard modification kit and extended plotting board for the SCR-584 Radar Set permits tracking up to a range of approximately 96 miles. The JB-2 Bomb has an operating range of 150 miles. With the present equipment the JB-2 Bomb will be controllable only for approximately two thirds of its operating range.

2. In view of the above it is directed that your laboratory undertake the necessary research and development of equipment to permit tracking and control of the JB-2 to the limit of its range. This may involve modifications to the JB-2 and modifications or substitutions for SCR-584 Radar Set. These possibilities should be thoroughly explored before development action is taken along any particular line.

3. If a satisfactory equipment is developed to extend the tracking and control ranges for the JB-2 to 150 miles, definite requirements will be established by this headquarters.

4. A 3A priority is assigned this project.

By command of General ARNOLD:

D. C. Richardson, Lt Col AC

Classification cancelled
or changed to
AUTH
By

D. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engineering Branch
Office, Asst. Chief of Air Staff
Materiel & Services

[redacted]

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTION

Captain Jon H. Ober
ees/TSTEX (5-6147)
[redacted]
Auth: Dir, ATSC
Date: 3-30-45
Initial: HO

Wright Field, Dayton, Ohio
30 March 1945

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SERIAL NO: TI-2003, Addendum No. 24.

SUBJECT: Extending Range of Control on JB-2.

TO: Engineering Division.

1. Problem Presented:

a. To develop equipment to permit tracking and control of the JB-2 to the limit of its range.

2. Factual Data:

a. The present standard modification kit and extended plotting board for the SCR-584 Radar Set permits tracking up to a range of approximately 95 miles. The JB-2 Bomb has an operating range of 150 miles. With the present equipment the JB-2 Bomb will be controllable only for approximately two thirds of its operating range.

b. If a satisfactory equipment is developed to extend the tracking and control ranges for the JB-2 to 150 miles, definite requirements will be established by AC/AS, M&S.

3. Authority:

a. CG, AAF. By letter dated 20 March 1945, subject as above, received from Chief, Engr. Br., ~~Materiel Division~~, ACAS/M&S.

4. Action Desired:

a. That the Engineering Division develop the necessary equipment to permit tracking and control of the JB-2 to the limit of its range.

(1) The above may involve modifications to the JB-2 and modifications or substitutions for SCR-584 Radar Set. These possibilities should be thoroughly explored before development action is taken along any particular line.

b. This project carries a 3-A priority.

By command of Lt. General KNUDSEN:

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AUTH:
By
Signature and Grade
Date

Wash Ltr dtd 3/20 for C/Eeo.

for H. O[illegible]

T. A. SIMS,
Colonel, Air Corps,
Chief of Administration.

MX-544

cc: Procurement Division
Supply Division
Maintenance Division

[redacted]

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ATSC Form No. 80-5C7 (20 Jan 45)
(Old AAF No. 268)

P-1

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ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

No. of pages - 19

TSEPE-11J/DAC/hle
Date 28 February 1946

SUBJECT: Remote Control of JB-2 Pilotless Aircraft With A Modified SCR-584 Radar Set And AN/APW-1 Radio Unit

OFFICE TSEPE-11J

Contract or Order No.

SERIAL No. TSESA-7-1253

Expenditure Order No. 448-17

A. PURPOSE:

1. The purpose of the tests described below was to determine the accuracy, reliability, and limitations with which pilotless aircraft can be controlled to a stationary target by a system of remote ground control employing a modified SCR-584 Radar Set on the ground and an AN/APW-1 unit in the pilotless aircraft.

B. FACTUAL DATA:

2. The JB-2 pilotless aircrafts were employed as the vehicles with which to test the control equipment. The bombs were assembled, prepared, and launched in accordance with AAF Technical Order No. 11-75BA-3, with certain required modifications and changes in procedure. See Appendix 1, attached.

3. The AN/APW-1 units were installed in the JB-2 bombs in accordance with Service Bulletin No. JB2-3 dated 26 July 1945, Republic Aviation Corporation. Certain modifications were necessary for installation and operation.

4. A standard SCR-584 Radar Set, equipped with Close-Support Plotting Board, D-170500, was modified for control of the missile by personnel of the Aircraft Radio Laboratory. See Appendix 2, attached.

5. The accuracy and reliability of the control units was evaluated in terms of ten selected remote controlled flights in which neither launching failures nor JB-2 malfunction were contributory factors. The tests were conducted at Wendover Army Test Base, Wendover Field, Utah, from 25 September 1945 to 21 January 1946. The JB-2 bombs were launched at a target 119,000 yards from the SCR-584 Radar Unit and 113,800 yards from the 390 foot 6° inclined launching ramp.

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Memorandum Report No. TSESA-7-1253
28 February 1946

6. Twenty-seven JB-2 bombs were launched, and in conjunction with the project the T-15 wing destructors (refer to Memorandum Report Serial No. TSESA-7-1252) were used on six bombs. Also four 50 foot trailer ramp launchings were attempted with the type A-1 Northrop launching sleds. On the basis of the ten selected controlled flights, two bombs had control malfunctions which prevented them from striking the target area. The average range error of those ten bombs was plus 1.472 miles, and the deflection error was 0.705 miles left. For complete flight data and a plot of the hits, refer to Appendix 3, attached.

7. Two missions were conducted with a B-24 airplane on 2 November 1945 to determine the range of control of the SCR-584 Radar Unit. The AN/APW-1 was installed in the airplane. For results refer to Appendix 3, attached.

C. CONCLUSIONS:

8. The results of the maximum range tests with the beacon installed in a B-24 airplane indicate the SCR-584 - AN/APW-1 system of remote control is effective over an eighty-five mile range even in a mountainous locality.

9. The SCR-584 - AN/APW-1 system of controls is not reliable for operational employment in its present state of development, because of the difficulty encountered in tracking the AN/APW-1 beacon, the malfunctions experienced in delayed dumping of the JB-2, the self-stepping of the AN/APW-1 stepping relay and the tendency of the unit to go into oscillation.

10. An M-7A1 power unit should be used with the SCR-584 Radar Unit instead of the M-18 power unit now employed due to the better voltage regulation and smoother overall operation.

11. Some manner of mounting the beacon transmitting antenna should be worked out so as to give equal sensitivity in elevation and azimuth. If that is impractical, an antenna should be devised for the radar that would be sensitive in both planes.

12. The control system installed in the SCR-584 will work much better if a beacon is used that uses all sub-multiples of radar basic range frequency. This concerns only the Right, Down and Dump section, since 1137 Cps. is used here, and it is necessary to change two stages in the range unit. This gives the radar a tendency towards instability. If the frequency used for these three controls was a direct sub-multiple of the 5KC M.V., this instability would not occur.

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Memorandum Report No. TSESA-7-1253
23 February 1946

D. RECOMMENDATIONS:

14. It is recommended that the following action be taken by the organizations designated below:

a. Engineering Division, Air Technical Service Command, Equipment Laboratory.

(1) That Army Air Forces Technical Order No. 11-75BA-3 be amended to show the modifications necessary in the airframe of the JB-2 bomb for installation of the AN/APW-1 control. (Action to be initiated).

(2) That, in the event the JB-2 is used as a vehicle or missile for future testing, the remote control unit be installed because it allows for greater accuracy or ranges up to eighty-five miles. (Action to be initiated).

b. Engineering Division, Special Projects Laboratory, Electronics Subdivision.

(1) That investigations be made to determine the practicability of the following modifications to the remotely controlled units: a. Substitution of an M-7A1 power unit for the M-18 unit for better voltage regulation and smoother overall operation; b. Another method of mounting the beacon transmitting antenna to give equal sensitivity in elevation and azimuth; c. Substitution of a beacon or a modification so that only sub-multiples of the radar basic range frequency are used.

Concurrence:

Prepared by DOUGLAS A. CRAVEN, 1st Lt., A.C.
(Name)

Approved by P. H. ROBEY, Colonel, A.C.
Chief, Equipment Laboratory

Approved by GEORGE E. PRICE, Colonel, A.C.
Chief, Aircraft Projects Section

Distribution:
AC/AS-4
Att'n: Guided Missiles Branch (5)
TSEWF-6
TSESA-7
TSEPE-11J
TSEXS, Att'n: Lt. Col. Luczak
TSELT

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ARMY AIR FORCES
~~MATERIEL CENTER~~
AIR TECHNICAL SERVICE COMMAND
MEMORANDUM REPORT ON

Date 1 March 1946

SUBJECT: "JB-2 Pilotless Aircraft".

SECTION Aircraft Projects Section

SERIAL No. TSESA-1256

Contract No.
Expenditure Order No. 448-17
Purchase Order No.

A. PURPOSE:

1. To summarize the development of JB-2 Pilotless Aircraft as covered by Expenditure Order No. 448-17.

B. FACTUAL DATA:

1. The project to develop the JB-2 Pilotless Aircraft (American copy of the German V-1 "Buzz Bomb") was initiated in July 1944 at the direction of the Commanding General, Materiel Command. During the period July 1944 to February 1946, a preset version and a remotely controlled version of the JB-2 were developed and tested. Detailed reports of all phases of the development and testing of the JB-2 aircraft and its component propulsion, control, and launching systems have been prepared. These reports are listed in Appendix I attached.

C. CONCLUSIONS:

1. The JB-2 Pilotless Aircraft can carry a 2100 lb. warhead (1875 lb. explosive load) for a maximum distance of 150 miles at speeds of 400 mph ± 10%.

2. The preset version of the JB-2 is suitable for area bombing of cities or other large areas. At 150 miles range 50% of preset JB-2's reaching the target area should hit within a 5-mile radius of the center of the target.

3. The remotely controlled version of the JB-2 is limited to distances of 100 miles. Consistent hits are possible within an area 1/2 mile square at 100 miles range.

4. Development of the JB-2 Pilotless Aircraft as covered by E.O. No. 448-17 has been carried to the practical limit. Further development work will produce only slight gain in technical information and tactical usefulness.

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Memorandum Report No. TSESA-1256, "JB-2 Pilotless Aircraft", 1 March 1946.

D. RECOMMENDATIONS:

1. It is recommended that Expenditure Order No. 448-17 be closed out. (Action initiated by Pilotless Aircraft Branch, Aircraft Projects Section, Engineering Division.)

THIS MEMORANDUM REPORT CLOSES OUT EXPENDITURE ORDER NO. 448-17.

Prepared by C. H. PIERCE, Jr., Capt. A.C.
(Name)

Approved by GEORGE E. PRICE, Colonel, A.C.
Chief Aircraft Projects Section

Concurrence:

John R. Kelly

JOHN R. KELLY, COLONEL, A.C.
Ch. Pilotless Aircraft Br.

Approved by

Distribution:

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APPENDIX 1

List of Reports covering the Development and Testing of the JB-2 Pilotless Aircraft:

1. "The Compressed Air System on MX-544", ATSC MR TSENG-49-660-52-H, dated 11 September 1944.

2. "Theoretical Performance of the Intermittent Ram Jet", NDRC Preliminary Analysis for BuAero, dated 30 September 1944.

3. "Altitude and Mixture Control Pressure Surveys on Full-Scale Robot Bomb - JB-2 - Wright Field 20-Foot Wind Tunnel Test No. 35" ATSC MR No. TSEAL-2-6731-11, Add. 2, dated 11 December 1944.

4. "Republic JB-2 Jet Bomb - Vibration Study of Motor Installation and Structural Components" ATSC MR No. TSEAL-2-6732-3-4, dated 27 November 1944.

5. "Conference at Range 64, Eglin Field, Florida, on Projects MX-544 and MX-594" ATSC MR No. TSEPL-5-506-56, dated 31 March 1945.

6. "Vibration Inspection and Flutter Analysis of Republic JB-2 Jet Bomb" ATSC MR No. TSEAL-2-6732-3-6, dated 9 April 1945.

7. "Propaganda Dispensing Attachment for JB-2 Pilotless Aircraft" ATSC MR No. TSEAL-2-6732-11-4, dated 18 April 1945.

8. "Installation of JB-2 Pilotless Aircraft on B-29 Airplane" ATSC MR No. TSEAL-2-4261-4-22, dated 14 April 1945.

9. "Flight Tests of JB-2 Pilotless Aircraft" ATSC MR No. TSEPL-3-673-37-K, dated 28 April 1945.

10. "Dispersion Determination Tests of Wingless JB-2 Bombs" ATSC MR No. TSEPL-3-448-1, dated 5 May 1945.

11. "Launching of the JB-2 from B-17G Type Aircraft" ATSC MR No. TSEPL-3-673-61, dated 16 May 1945.

12. "Status Report on Multiple Cartridge Launcher for JB-2" Ordnance Rpt, dated 25 June 1945.

13. "American Copy of German Robot Bomb V-1, Army Air Forces Type JB-2 ATSC MR No. TSEPL-3-448-2-B, dated 26 June 1945.

14. "Intermittent Jet Engine Field Performance" ATSC MR No. TSEPL-3-448-2-E, dated 4 July 1945.

15. "JB-2 Remote Control Equipment" ATSC MR No. TSEPL-3-448-2-G, dated 9 July 1945.

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16. "Trailer Ramp Catapult Rocket Sleds for the JB-2 Pilotless Aircraft" ATSC MR No. TSEPL-3-448-2-H, dated 17 July 1945.

17. "Jet Propelled Bomb, Type JB-2 Project MX-544" ATSC MR No. TSEPL-3-673-37-L, dated 7 July 1945.

18. "Launching Sleds for Short Ramp or Trailer Ramp Launchings of JB-2 Pilotless Aircraft" ATSC MR No. TSEPL-3-448-2-F, dated 10 July 1945.

19. "JB-2 Control Equipment Performance" ATSC MR No. TSEPL-3-448-2-I, dated 21 July 1945.

20. "Northrop Aircraft Inc., Experimental JB-2 Launching Sleds" ATSC MR No. TSEPL-3-448-2-J, dated 21 July 1945.

21. "General Tire and Rubber Company Experimental JB-2 Launching Sleds" ATSC MR No. TSEPL-3-448-2-K, dated 21 July 1945.

22. "Vibration Test of Standard JB-2 Magnetic Compass" ATSC MR No. TSEPL-3-448-2-L, dated 25 July 1945.

23. "The System: Hydrogen Peroxide--Permanganate as Chemical Propellants" Chemical Warfare Service, Rpt No. 1 of Fred Project, dated 24 July 1945.

24. "The System: Red Fuming Nitric Acid--Aniline as Liquid Chemical Propellants" Chemical Warfare Service, Rpt No. 2 of Fred Project, dated 26 July 1945.

25. "The System: Nitromethane - Oxygen as Chemical Propellants" Chemical Warfare Service, Rpt No. 3 of Fred Project, dated 28 July 1945.

26. "Installation AN/APW-1 Radio", Republic Aviation Corp. Service Bulletin No. JB2-3, dated 26 July 1945.

27. "Contact Tests on JB-2 Control Equipment" ATSC MR No. TSEPL-3-448-2-C, dated 26 July 1945.

28. "Launching of JB-2 Bombs from 50-Foot Ramp Rocket Launching Catapults" ATSC MR No. TSEPL-3-448-2-N, dated 28 July 1945.

29. "Vibration Test of JB-2 Compass, modified for use with AN/APW-1 actuator" ATSC MR No. TSEPL-3-448-2-M, dated 2 August 1945.

30. "American Copy of German Robot Bomb V-1, Army Air Forces Type JB-2" ATSC MR No. TSEPL-3-448-2-P, dated 6 August 1945.

31. "Flight Endurance of JB-2 Type Aircraft" ATSC MR No. TSPL-3-448-2-R, dated 9 August 1945.

32. "Test of Full-Scale Robot Bomb JB-2 20-Foot Wind Tunnel Test

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No. 35" AAF Technical Report No. 5184, (Laboratory No. TSEAL-2-6731-11-2T), n/d.

33. "Starting Test of the JB-2 Intermittent Jet Engine for Aircraft Launching" ATSC MR No. TSEPL-3-448-2-Q, dated 10 August 1945.

34. "Extending the Range of the JB-2 Pilotless Aircraft" ATSC MR No. TSEAL-2-4483-1-1, dated 15 August 1945.

35. "JB-2 Control Equipment" ATSC MR No. TSEPL-3-448-2-S, dated 22 August 1945.

36. "Drag Calibration with Jet Bomb Racks, Glide Bomb Racks, and Jet Bombs Installed on the B-17G Airplane, AAF No. 43-39119, ATSC Flight Section Rpt Serial No. TSFER-1946, dated 4 September 1945.

37. Fred Project, Monthly Rpt No. VIII, Chemical Warfare Service, dated 19 September 1945.

38. Fred Project, Chemical Warfare Service, Engineering Branch Rpt, dated September 1945.

39. "Visit to Special Weapons Test Unit at Wendover, Utah - Period of 19 October 1945 to 2 November 1945, Ordnance Rpt, dated 8 November 1945.

40. "American Copy of German Robot Bomb V-1, Army Air Forces Type JB-2" ATSC MR No. TSEPP-448-2-V, dated 30 November 1945.

41. Compressed Air Equipment for JB-2 Aircraft, ATSC MR No. TSEPS-657-82.

42. "Remote control of JB-2 Pilotless Aircraft with a Modified SCR-584 Radar Set and AN/APW-1 Radio Unit", ATSC MR No. TSESA-7-1253, dated 26 February 1946.

43. "Modified Northrop Short Ramp Launching Sleds, Type A-1", ATSC MR No. TSEPE-673-82A, dated 27 February 1946.

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION

HEADQUARTERS, ARMY AIR FORCES (AFDMA-2F)
WASHINGTON

14 September 1944.

SUBJECT: Remotely Controlled Guided Missiles

MX-543

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

ATTN: Engineering Division, Col. French

1. It is directed that a study be made on the possibility of remotely controlling the JB-1 flying wing missile for the full length of flight, including reasonably accurate control into the target. In connection with this study, it is requested that the following information be forwarded to this office not later than 9 October 1944:

a. Revisions necessary to the JB-1 airframe and power plant installation.

b. Types of aircraft radio, ground radio, and equipment recommended.

By command of General ARNOLD:

R C Wilson
R. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Mat. Div.
Office, Asst. Chief of Air Staff,
Materiel and Services.

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"Remotely Controlled Guided Missiles."

TSENG TSELA-4C5 151502
Lt. E. N. Moorman:hle
Ext. 2-7127

1st Ind.

Hq., Air Technical Service Command, Wright Field, Ohio. 3 Oct 1944

To: Commanding General, Army Air Forces, Washington 25, D. C.
Attention: Development Engineering Branch, Materiel Division, Asst. C/AS, M & S.

1. A study of the possibility of remotely controlling the JB-1 flying wing missile indicates that in addition to the application of radio signals to the control mechanism, the long ranges encountered require that some means be provided for determining the position of the bomb with respect to the target throughout the flight. Two systems of automatic position finding have been proposed by the Aircraft Radio Laboratory, but as yet there is no authorization for development work on this project.

2. One of the proposed systems would employ a standard S.C.R. 584 gun laying radar set on the ground and a radar or transponder unit in the bomb. Automatic tracking in azimuth and range would provide a visual location of the missile on a screen throughout the flight. The accuracy of this system is believed to be plus or minus 15 yards in range and plus or minus 250 yards in azimuth at a distance of 60 miles. The operating range is limited to approximately 60 miles unless the bomb is flown at altitudes of 15,000 feet to 20,000 feet. At these altitudes, ranges up to 150 miles could be expected.

3. The other system would be similar to that described in paragraph 2, above, except that low frequency radio would be used in place of radar. A modified SCR-183 receiver could be used for the transponder unit in the bomb, but the ground transmitter would have to be built. It is believed that this low frequency system would operate satisfactorily at a range of 200 miles, and that at such a distance, the range accuracy would be plus or minus 250 yards. The accuracy in azimuth is expected to be better than one-half degree. Calculations based on the above estimates and the accuracy of the present type altitude control device indicate that with perfect radio control, the bomb could be guided into an area 1000 yards deep and 6000 yards wide at a range of 200 miles.

4. A system of radio control believed to be applicable to the JB-1 is one in which azimuth corrections of perhaps one-half degree or one degree are applied from the ground station to the bomb at intervals throughout the flight. Thus after, say, 30 seconds of flight, if the actual course of the bomb as indicated on a plotting

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1st Ind. to CG, AAF, Washington 25, D. C.
Attn: Devel. Engin. Br., Mat. Div., AC/AS, M & S.
"Remotely Controlled Guided Missiles."

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screen differs from the true course to the target, an azimuth
correction would be applied. It is believed that this system
would tend to eliminate over-control as encountered in the
controlling of other types of guided missiles. Control of the bomb
in elevation would be accomplished by the altitude control mechanism
until the position finding device indicated that a predetermined
point near the target was reached. At this instant, a radio signal
putting the bomb into a dive would be applied. It is believed that
the radio equipment for controlling the bomb could be incorporated
in the position finding unit.

5. Due to changes now being made in the flying wing airframe
to accommodate a different power plant, it is not possible to specify
any changes that might be necessary to accommodate the radio equipment.

6. Although this study was made for the purpose of remotely
controlling the JB-1, it is believed that the method as outlined
herein is also applicable to the JB-2.

For the Director:

A. H. Winslow

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

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R. S.

"Remotely Controlled Guided Missiles." (AFDMA-2C)

2nd Ind.

Hq. Army Air Forces, Washington 25, D.C. 17 November 1944.

TO: Director, AAF-Air Technical Service Command, Wright Field, Dayton, Ohio.
ATTN: Engineering Division (TSELA-4C5)

1. Confirming telephone conversation with Lt. Moorman, information is furnished that since the writing of the 1st Indorsement, Aircraft Radio Laboratory has been furnished authorization for development work on the JB-2.

2. It is requested that the study continue, in coordination with the Aircraft Radio Laboratory, for installing remote control in the JB-1 and that the progress of this study be included in the reports sent to this office twice a month on the JB-1 and JB-2.

By command of General ARNOLD:

for M. C. Demler, Col. A.C.
R. C. WILSON
Colonel, Air Corps
Actg. Chief, Engr. Br., Mat. Div.,
Office, Asst. Chief of Air Staff,
Materiel and Services

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INTER-OFFICE MEMORANDUM

ARMY AIR FORCES
~~MATERIEL CENTER~~
~~Office of The Commanding General~~
AIR TECHNICAL SERVICE COMMAND

Colonel P. F. Helmick:hle
Ext. 2-5220
Wright Field, Dayton, Ohio

Date 9 December 1944

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TO: Director, Air Technical Service Command.
Attention: Chief, TSEPL-3.

SUBJECT: Preliminary Report on Project MX-543 (Northrop JB-1); First Launching Conducted 7 December 1944.

1. For the past two weeks, the first JB-1 powered with two G-E turbo units of 200 pounds thrust each has been undergoing preparation for flight test. While much of this delay was due to the temporary shortage of reliable rocket propellant, the engine installation was also a contributing factor, and failure of the engines to start caused postponement of the launching scheduled for 6 December. On the previous day, 5 December, the launching was postponed due to the leaking of the integral fuel tanks, which flooded the control equipment with gasoline and created a dangerous fire hazard.

2. The first article was finally launched 7 December. This unit was flown in a light weight condition because of the fifty per cent reduction in thrust of the G-E turbos, and had an all-up weight of slightly over 3000 pounds. Two Monsanto rockets were used for the launching, which was perfect in all respects. However, the flight was of very short duration and resulted in a stall and subsequent crash about 1200 feet off the launching ramp. This may be attributed to lack of sufficient knowledge of pitch characteristics for this type airframe, too high a launching speed, or the low speed of the pitch control servo equipment. At this writing, the recording devices are not yet recovered, and pending analysis of the film it is not possible to definitely state all causes contributing to the unsuccessful flight.

3. Extreme difficulty was encountered in this unit due to the multitude of leaks in the integral fuel tanks, the inaccessability of the engines, and the fact that it is necessary to remove some 270 screws in each wing panel to gain access to the flight control equipment. It is apparent that this design will have to be modified in almost all respects before it will be successful as a "buzz bomb," and will involve a considerable development program. The next test is dependent, at present, on the delivery of G-E turbo engines, which are promised before the end of this month. Work is at present going on at Northrop to adapt the German type reaction-duct engine to this airframe, but perhaps two months will elapse before this version may be tested if proven feasible.

Classification cancelled
or changed to
AUTH:
By
Signature and Grade
Date

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MX-543

673-43
File No. 1

Y-111015

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IOM to Director, ATSC. Att'n: Ch., TSEPL-3.
"Preliminary Report on Project MX-543 (Northrop JB-1): First Launching Conducted 7 December 1944.
9 December 1944.

4. After complete analysis of recording films a detailed report on this first article will be submitted by the Project Officer, Lt. E. M. Moorman.

F. F. Helmick
F. F. HELMICK,
Colonel, Air Corps,
Acting Chief, Special Weapons Branch.

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ARMY AIR FORCES
AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

Lt. E.W. Moorman:kt
Ext. 2-7127

Date 21 December 1944

SUBJECT: JB-1, Jet Propelled Bomb

OFFICE TSEPL-316 Contract or Order No.

SERIAL No. TSEPL-3-673-39B Expenditure Order No. 673-43

A. PURPOSE:

1. To report on launching test of the JB-1, Jet Propelled Bomb, conducted at Eglin Field, Florida, on 7 December 1944.

B. FACTUAL DATA:

1. The first power driven model of the JB-1, was tested at Range 64, Eglin Field, Florida, on 7 December 1944. The Northrop flying wing type bomb was launched from a level track using a modified JB-2 launching sled and two (2) Monsanto rockets. The duration of the flight was approximately five seconds as the bomb climbed rapidly after leaving the sled and went into a stall. It crashed approximately 400 yards from the point of take-off. Pictures indicate that the bomb nosed up approximately 45 degrees by the time it had risen 10 feet from the launching sled. It is very probable that the control gyros were dumped by this time.

2. Power plants for the JB-1 consisted of two (2) General Electric Type B1 turbo supercharger jet engines having a rated power of 200 pounds of thrust each. The 50 per cent power reduction of these units from the original requirements necessitated the flying of this bomb in a light-weight condition. Starting of the engines was accomplished by turning the turbines with compressed air and at the same time applying a spark through the spark plugs by means of a high voltage transformer. Considerable difficulty was encountered in starting the engines and the test was delayed 24 hours because of faulty operation of the ignition system. Approximately thirty (30) seconds before launching, when both engines were running at full speed, considerable sparking was noticed in the tail pipe of the right unit. Later, salvage of the airframe and engines revealed that approximately half of the buckets on the right turbo were missing. It is doubtful if this damaged engine could have permitted a successful flight even if other difficulties were not encountered.

3. Automatic control equipment for the bomb was mounted in the outer wing panels and consisted of a roll gyro and servo, a pitch gyro

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No. of pages - 4

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and servo and an aneroid altitude control device. This all-electric equipment was manufactured by the Hammond Instrument Company, Chicago, Illinois. Complete details of the JB-1 control system are contained in Memorandum Report No. TSEPL-3-673-39C. A flight box containing a movie camera set to record readings of air speed, elevon position, jet velocity, and altitude also was contained in the missile; but the salvaged record proved to be of no value, as apparently smoke from the faulty right engine obscured most of the instrument dials.

4. The airframe was mounted on the launching sled at an angle of nine (9) degrees up from the horizontal and both elevons were carefully adjusted to nine(9) degrees up from the streamlined position according to information furnished by engineers from the Northrop Company. The assembly, adjustment, and test of the first unit revealed minor weaknesses in the airframe in its present design. Great difficulty was experienced in assembling and removing the wing panel covers due to the large number of self-threading screws employed. Several minor leaks and one serious leak in the integral gas tanks caused difficulty and delay of the launching for 24 hours. Finally, accessibility to the power plants for control, adjustment and repair was difficult and, in some instances, required the cutting of access holes in the airframe skin.

5. Records from a recording oscillograph indicated a launching speed of approximately 230 feet per second. This speed is within four (4) per cent of the calculated value. Records from the moving picture film indicate a launching time of approximately 1.7 seconds. A series of still pictures shows a launching distance of 254 feet.

6. Personnel present at the test were:

Air Technical Service Command

Col. P. F. Helmick	Lt. E. W. Moorman
Capt. C. H. Pierce	Lt. T. A. Mahan
Capt. C. O. Kerner	Lt. J. C. O'Connor
Capt. L. L. Dreibelbis	Lt. T. B. Parker
Capt. H. A. Klein	Lt. R. S. Stewart
	Lt. W. D. Hechler

Army Air Forces Proving Ground Command

Brig. Gen. Grandison Gardner	Lt. A. R. De Nice
Capt. Allan Andrews	

WX-543

T-121563 - 8

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Memorandum Report No. TSEPL-3-673-59B
21 December 1944

Northrop Aircraft Inc.

Dr. W. R. Sears
Mr. C. F. Ballard
Mr. D. B. Smith
Mr. R. O. Pennick

Monsanto Chemical Company

Mr. Ray Hopkins

General Electric Company

Mr. R. S. Hall
Mr. C. B. Woodward

C. CONCLUSIONS:

1. That failure of the flight was due primarily to improper setting of the elevons prior to take-off.

2. That the launching speed was not excessive.

3. That the General Electric turbo units are not suitable power plants for the JB-1 inasmuch as damage occurred to the turbines at speeds great enough to provide only one-half the required thrust.

4. That no test of the control equipment was obtained in this flight.

5. That modifications to provide for better access to control equipment and power plants, and to provide for more reliable gas tanks should be made in the next airframe delivered for test.

D. RECOMMENDATIONS:

1. It is recommended that the following action be taken by the organization designated below:

a. Engineering Division, Air Technical Service Command, Equipment Laboratory.

(1) That studies be conducted to determine the correct elevon setting for the next test.

(2) That no more General Electric turbo units be procured.

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Memorandum Report No. TSEPL-3-673-39B
21 December 1944

(3) That a set of control equipment essentially the same as that used in this bomb be procured for the next test.

(4) That Northrop Aircraft Inc. be requested to improve the accessibility to control equipment and power plants, and to throughly check under pressure all integral gas tanks for leaks in the next airframes delivered for test.

Distribution: Asst. C/AS, M & S, 1-30-45 hle
TSEAL-6D 1-30-45 hle
TSEPL-5
TSESE-2 1-30-45 hle
HIS (5) 8 thru 12
HDQ USSTAF 6, 7 17 APR 45

Prepared by E. W. Moorman
E. W. MOORMAN, 1st Lieut., Air Corps

Approved by Raymond J Stalnaker
R. F. HOLLOMAN, Colonel, Air Corps
Chief, Equipment Laboratory.

Approved by
F. O. CARROLL, Brig. General, U.S.A.,
Chief, Engineering Division.

Concurrence:

MX-543

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SEMI-MONTHLY PROGRESS REPORT ON JB-1 AND JB-2

14 February 1945

A. JB-1 AIRCRAFT

NOTE: This report will cover the status of Project MX-543 for the period from 15 January 1945 to 15 February 1945.

1. Present status of project.

a. The most satisfactory method of cooling the submerged jet engine has been determined and center sections for the remaining ten airframes are being fabricated accordingly. It is expected that the first complete unit will be ready for shipment by 15 February 1945.

b. The Ordnance Department has submitted comments and suggestions on the proposed cast magnesium warhead. These suggestions are being incorporated in units now under construction at the Northrop plant. Ten warhead bodies of the final size and form will be furnished the Ordnance Department for use in special tests necessary for final approval of the article.

2. Future plans for project.

a. The type designation, JB-10, has been requested for the Northrop vehicle incorporating the intermittent jet engine. After approval of the above request this bomb will be designated "Pilotless Aircraft, Type JB-10".

b. It is anticipated that the first unit will be tested at Eglin Field, Florida on approximately 25 February 1945.

c. A modification of the AN/APW-1 will definitely be suitable for this missile on line of sight range.

B. JB-2 AIRCRAFT

1. Present status of project.

a. Results of tests.

(1) Since semi-monthly progress report submitted 15 January 1945, tests 26 through 35, inclusive, have been made at Eglin Field, Florida. With the exception of test No. 35, all launchings were made from the level launching track using 4 rockets on the launching sled and 400 feet of track. Successful take-offs were obtained in all launchings except Numbers 31, 33, and 35. Failure of Launching No. 31 was caused by failure of one rocket to ignite due to faulty wiring. Launching No. 33 was unsuccessful due to the explosion of one rocket on launching. (The cause of the rocket explosion has not yet been definitely determined.) Launching No. 35 was made in the same manner as No. 25, previously reported, using a ramp 20 feet in length and with rockets so arranged that

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their thrust acted through the center of gravity of the bomb and launching cart combination. Due to inaccurate location of the combined center of gravity, the bomb dropped its nose and dived into the ground as soon as launched.

(2) The AN/ART-19B was successfully flight tested at Eglin Field. The JB-2 was located within a triangle one mile on a side at approximately eighty miles with the three (3) SCR-291 sets now installed at Eglin Field.

b. Production.

(1) Aircraft.

(a) The total acceptances of jet bombs for February are estimated to be 100. As of 12 February 1945 a total of 52 bombs have been accepted by Willys-Overland and Republic combined. Actual acceptances for the month of January were 44, 26 of which were completed by Republic and 18 of which were completed by Willys-Overland.

(b) Although the production and inspection difficulties which Willys-Overland has been experiencing have been overcome, it is felt that with present facilities a total of 200 jet bombs per month will be the maximum that Willys-Overland can produce. Further, the following revised schedule which is believed to be an accurate estimate of the quantity of buzz bombs that will be produced in the next few months is submitted.

February	March	April	May	June
100	125	150	175	200 and 200 per month thereafter

(c) As of this date, a directive has not been received authorizing any additional procurement of buzz bombs over and above the 2050 now on contract.

(2) No difficulty is anticipated in securing adequate Government Furnished Equipment to meet the above production schedule.

(3) Launching Carts - no change since previous report.

(4) Launching Sites.

(a) Launching Ramp - No change since previous report.

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(b) Compressors. Procurement of necessary modification parts for compressors in process. Seventy two compressors will be modified in the near future.

(5) Rocket Motors. A complete rocket motor with grain has been shipped to the Ordnance Department for the purpose of conducting packaging tests. Otherwise status is unchanged.

(6) Propellant Fuel. All propellant grains are now being shipped via rail express apparently without damage to the grains. They are now being shipped in a horizontal position as a result of recent damage (chipping) that occurred to grains shipped in a vertical position. Grain production has reached and is being maintained at 40 per week. This represents maximum plant output with present facilities.

(7) Warheads. A check installation of two 3/8 inch aluminum warheads has been made at Eglin Field. This check installation indicated that the dimensions of the aluminum warheads are entirely satisfactory with one minor exception. Information has been received from the Ordnance Department that this minor misfit was the result of a dimensional change by the aircraft manufacturer without proper notification of the Ordnance Department. The Ordnance Department has taken action to make a dimensional change on the warhead so that the production warheads will fit the production nose sections of the aircraft

(a) Fuzes.

(1). As previously reported, tests of the T84 fuze at Eglin Field indicated the effective air arming distance was 2¼ miles. T74[illegible] fuzes having an estimated air arming distance of 2 miles are also available at Eglin Field. The latest fuze information available at Air Technical Service Command indicates that there is some controversy in Headquarters, Army Air Forces, as to the desired air arming distance.

(2) In connection with the electrical fuze system, new nose impact switches have been developed by the Ordnance Department. Tests conducted at Wright Field indicate that the vibration which may be expected in the flight of JB-2 will not cause these switches to close. A quantity of these switches have been furnished Eglin Field for flight tests. Action has been taken with the aircraft manufacturer to make provision for the installation of these switches in the aircraft.

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(b) Spoiler Detonators. Static tests of the latest design of spoiler detonators at Eglin Field indicated satisfactory performance. In addition a satisfactory flight test of these spoiler detonators has been obtained.

2. Future plans for project.

a. Launching methods. - No change since previous report.

b. Maintenance provisions. - No change since previous report.

c. Intermittent jet engine development. - A soundproof wall is being constructed around jet engine dynamometer stands at Wright Field and no testing has been done since previous report.

d. Future developments. - At present, the AN/ART-19E and SCR-291 supply the only practical means of plotting beyond line of sight, although two (2) alternative systems are under development. A radio control system has been developed which will use a modified SCR-274 receiver.

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ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

WMD:ejb:TSESA-7
Date 8 March 1946

SUBJECT: "Pilotless Aircraft, Type JB-10, Expenditure Order 448-18".

OFFICE Aircraft Projects Section Contract or Order No.

SERIAL No. TSESA-1261 Expenditure Order No. 448-18

A. PURPOSE:

1. To close out Expenditure Order 448-18.

B. FACTUAL DATA:

2. Thirteen airframe units were procured from Northrop Aircraft Corporation on Contract W33-038-ac-4142 for experimental test purposes on Expenditure Order 448-18.

a. The first unit procured was a man carrying glider, prototype of the Pilotless Aircraft, which was used to obtain preliminary flight characteristics on stability and control.

b. The second unit, known as the JB-1, was flight tested as the first pilotless aircraft under Expenditure Order 448-18. The JB-1 was powered by two General Electric BI turbo-jet engines which were rated at 400 pounds thrust each. These engines were capable of developing approximately 200 pounds thrust each. The explosive load carried by the JB-1 was two standard AN-M-65 2,000 pound bombs. The JB-1 design was discontinued due to the inability of the engines to develop the design thrust.

c. Eleven redesigned pilotless aircraft units, type JB-10, were procured for flight tests. The JB-10 used an intermittent jet engine, type PJ-31-1, the same as used on the JB-2 Pilotless Aircraft. Two cast magnesium warheads containing a total of 3400 pounds of explosive were incorporated as part of the wing, one on each side of the center section.

3. All flight tests with the exception of two were made with electric gyro and servo control equipment which was designed and manufactured by the Hammond Instrument Company. An attempt to use the JB-2 pneumatic control equipment, modified to meet the theoretical stability requirements of the JB-10, was made but was unsuccessful.

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4. Eleven experimental tests were made, one on the JB-1 and ten on the JB-10 design. Only two flights were obtained from the eleven launchings attempted. The two flights which were obtained were for approximately 25 miles range each and were terminated prematurely due to longitudinal instabilities apparently induced by the control equipment. The failures of the nine unsuccessful units were caused by mechanical malfunctions at launching or during the take-off portion of the flight.

5. The design performance of the pilotless aircraft under experimental development on Expenditure Order 448-18 was to be an improvement over the performance obtainable from the JB-2 Pilotless Aircraft, Expenditure Order 448-17, which was a copy of the German V-1 "Buzz Bomb". The design performance was: 400 mph maximum speed; 200 mile range; operating altitude 2500 feet; explosive pay load 3400 lb.

6. The cast magnesium warheads which were designed for the JB-10 were to be tested at Picatinny Arnsenal, Dover, New Jersey, by Army Ordnance. No final report has been received on the test of these warheads, but it has been learned informally that Ordnance was unable to make explosive tests due to cracks which developed in the magnesium casting which made it unsafe to load with high explosive.

7. Details of all tests and operating characteristics of all equipment used on Expenditure Order 448-18 are contained in the list of Memorandum Reports contained in Appendix 1.

C. CONCLUSIONS:

8. That the two flights obtained from the eleven launching attempts were for too short a range to make any conclusions as to the basic design or to check the design performance.

9. That an extensive development program would be required to make consistent successful launchings and flights with the present equipment.

10. That Expenditure Order 448-18 should be closed out due to the extensive development required to successfully complete the project and due to the receipt of new military characteristics for Pilotless Aircraft which make obsolete the military characteristics for this project.

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Memorandum Report No. TSESA-1261, "Pilotless Aircraft, Type JB-10, Expenditure Order 448-18".
8 March 1946.

D. RECOMMENDATIONS:

11. That Expenditure Order 448-18 be closed out.

THIS MEMORANDUM REPORT CLOSES OUT EXPENDITURE ORDER 448-18.

Distribution:

Prepared by W. M. Darling
W. M. DARLING, CAPTAIN, A.C.

Approved by George E. Price
GEORGE E. PRICE, Colonel, A.C.
Aircraft Projects Section

Approved by John R. Kelly
JOHN R. KELLY, COLONEL, A.C.
Ch. Pilotless Aircraft Br.

Concurrence:

Wash. AC/AS-4 CG., AAF (5)
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APPENDIX I

MEMORANDUM REPORTS ON EXPENDITURE ORDER 448-18

TSELA-4C-673-39	23 Oct. 44	"Northrop Type Jet Propelled Bomb Proj. MX-543" (To review status of)
TSELA-4C-673-39A	25 Oct. 44	"Northrop Type Jet Propelled Bomb"
TSEPL-3-673-39B	21 Dec. 44	"JB-1 Jet Propelled Bomb"
TSEPL-3-448-4-A	28 June 45	"Jet Propelled Bomb, Type JB-10, Proj. 543"
TSEPL-3-448-4-C	3 Aug. 45	"Jet Propelled Bomb, Type JB-10, Proj. 543"
TSEPL-3-448-4-D	25 Aug. 45	"Control Systems for JB-10 Pilotless Aircraft"
TSEPE-3-448-4-G	28 Nov. 45	"Pilotless Aircraft, Type JB-10, Proj. MX-543"
TSEPL-3-448-4-B	24 July 45	"Automatic Control Equipment"
TSEPL-3-448-4	29 May 45	"Automatic Control Equipment"
TSEPL-3-673-39-C	19 Dec. 44	"Automatic Control Equipment"

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HqATSC Form No. 80-507 (20 Jan 45)
(Old AAFMC-266)

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No. Of Pages - 7

ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
ENGINEERING DIVISION

MEMORANDUM REPORT ON

TSEPE-11E/EWM/mmh
Ext. 2-7127
Date 28 November 1945

SUBJECT: Pilotless Aircraft, Type JB-10, Project MX-543.

OFFICE TSEPE

Contract or Order No.

SERIAL No. TSEPE-448-4-G

Expenditure Order No. 448-18

A. PURPOSE:

1. To report on final tests of the JB-10 Pilotless Aircraft conducted at Range 64, Eglin Field, Florida, during the period of 15 September to 7 November 1945.

B. FACTUAL DATA:

2. Two (2) JB-10 bombs were flight tested at Range 64, Eglin Field, Florida. Launchings were made from the level ramp using 370 feet of track with modified JB-2 launching sleds. In each test the sled was equipped with five (5) Monsanto rockets having a burning time of 1.8 seconds.

3. Control equipment for the bombs was the same as used on previous tests and consisted of a roll gyro and a roll servo, a pitch gyro and a pitch servo, and an aneroid altitude control device. Power for this all electric equipment was obtained from eight (8) Delco Remy, 14-volt, type 9 AC batteries. A slight modification in the rigging of the control surfaces provided for symmetrical elevon control in both pitch and roll.

4. In addition to the Hammond control equipment, each bomb contained a telemetering transmitter designed to transmit flight data from the missile to the test sight for a period of approximately six (6) minutes, starting at the instant of firing of the rockets. Very satisfactory results were obtained from this equipment and the records provided the first definite flight data obtained in a successful launching of the JB-10. Curves plotted from the telemetering data are contained in Appendix 1 attached hereto. Complete information on the telemetering equipment itself is contained in Memorandum Report Serial No. TSEPE-448-4-F.

5. Considerable difficulty and delay in the test program was experienced due to an error in the loading of the inert warheads. During the weight and balance measurements, it was discovered that the weight of the plaster and lead added to the warheads at the factory was approximately 750 pounds too great. The correct weight and balance for each bomb finally was obtained by the removal of a portion of the plaster from the warheads, and the addition of approximately 100 pounds of lead to the airframe trailing sections.

6. Of the two (2) bombs tested, one successful launching was obtained. In this test (JB-10 No. 9) the bomb climbed to an altitude of 1300 feet and flew level for 90 seconds at approximately 225 miles per hour. It then began a divergent pitch oscillation and crashed into the water after a total flight of approximately 16 miles lasting 280 seconds. A study of the telemetering record (Appendix 2) indicated a necessity for a modification of the aneroid altitude control unit. This flight represented the first complete test of the Hammond automatic control equipment in the JB-10.

7. Slight modifications in the altitude control were made in the next bomb (JB-10 No. 10) in an effort to obtain improved pitch control. However, as the bomb separated from the sled, it nosed up sharply and went into a spin to the right. Failure was attributed to a malfunction of the control equipment, although the definite cause has not been established.

8. Bomb No. 11 was prepared for launching with the same conditions as the previous test. However, as this was the last unit available, the decision was made to save it for a museum piece. Accordingly, the bomb was recrated for shipment to Freeman Field, Seymore, Indiana, where it will be placed on display with other Army Air Forces material.

9. Personnel present for one or more of the tests were as follows:

ATSC	Northrop Aircraft Inc.
Capt. E. W. Moorman	Mr. Irving Ashkenas
Lt. R. S. Stewart	Mr. H. G. Blinn
Lt. W. M. Darling	Mr. F. J. Fikel
Mr. W. L. Andre	Mr. B. O. Pennick
Pfc. R. L. Sears	
Pvt. C. M. Zimney	

HqATSC Form No. 80-507 (20 Jun 4
(Old AAFMC-266)

Memorandum Report Serial No. TSEPE-448-4-G
28 November 1945

C. CONCLUSIONS:

10. That very satisfactory results were obtained from the telemetering equipment.

11. That the first complete test of the automatic control equipment was obtained in test No. 9.

12. That failure in the tenth and final test was due to a malfunction of the control equipment.

13. That JB-10 No. 11 will be retained at Freeman Field, Seymore, Indiana, as a museum piece.

D. RECOMMENDATIONS:

14. It is recommended that the following action be taken by the organization designated below:

a. Performance Test Unit, Control Equipment Branch, Equipment Laboratory, Engineering Division, ATSC:

(1) That a project be initiated for further development of the type of telemetering for use in future tests of related missiles. Action to be initiated.

This Memorandum Report closes out Sub-Project 448-18-a.

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TSEPE-5
TSEPE-11E
TSESA-7
HIS (5)

Prepared by EDWARD W. MOORMAN, Capt., A.C.
(Name)

Approved by C. O. French Jr.
C. O. FRENCH, JR., Lt. Col., A.C.
Chief, Control Equipment Branch
Equipment Laboratory

Approved by
P. H. ROBEY, Colonel, A. C.
Chief, Equipment Laboratory
Propulsion & Accessories Subdiv.
Concurrence: Engineering Division

MX-543

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IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF ORIGINATING OFFICE SYMBOL:
SENG (TSEPL-316)

ARMY AIR FORCES
HEADQUARTERS AIR TECHNICAL SERVICE COMMAND
WRIGHT FIELD, DAYTON, OHIO

Captain D.W.Pearsall:hle
Ext. 2-7127

18 NOV 1944

Subject: Ordnance Items for Project MX-570.

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To: Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Development Engineering Branch,
Materiel Division, Asst. C/AS, M & S.

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1. The completion of preliminary wind tunnel tests of the N.A.C.A. design for an air-to-air missile makes it possible to set down definite requirements for its ordnance items.

2. It is requested that your Office furnish Chief of Ordnance the following requirements:

Special Fragmentation Bomb

Maximum weight permissible 150 lbs.

Maximum dimensions 15" diameter 15" long

Design to be such that within above weight and dimensions the most efficient fragmentation can be had against aircraft structures at 25 ft. radius.

b. Design requires a proximity fuse remotely placed in the structure with respect to the bomb. This will require an electric detonator placed in the bomb. The detonator must include a safety switch to be operated by an external electric circuit. This external circuit includes the air travel safety feature. It is important that the fuse be kept within the structure proper. See the attached sketch for permissible location of fuse.

3. It is requested that sketches showing external dimensions of the bomb, detonator with switch, and proximity fuse be furnished the Air Technical Service Command by 1 January 1945. It is also requested that 10 inert sets of these items be available 1 March 1945, and that 100 sets be available 1 April 1945. The inert items should be suitable for flight tests with correct weight and external dimensions. A portion of the inert items should be furnished with

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C.G., AAF, Washington 25, D. C., Attention: Development Engineering Branch, Materiel Division, Asst. C/AS, M & S.
"Ordnance Items for Project MX-570."

16 NOV 1944

some signaling device for checking operation of the proximity fuses.

4. It is imperative that proximity fuses be so designed and shielded that they will not be activated by the operation of the rocket motor.

5. Major Hatcher of Air Ordnance Office at Wright Field and Captain Pearsall of this Office will be available for conference concerning this project at any time convenient to the Office, Chief of Ordnance.

For the Director:

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

1 Incl.
Sketch, "Tiamat" - Air to Air Missile.

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COM. GEN.
CH. STAFF
DEP. CH. STAFF
TECH. EXEC.
ADJ. GEN.
EXEC. PROC.
AIR. INSP.
INTELL.
COMPTROLLER
C.O.
SUP. OFF.
PERS. SEC.
ENG. DIV.
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS

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[illegible] 1500 [illegible],
[illegible]

Dear [illegible]:

[illegible] to the Air Technical Service Command [illegible] preliminary [illegible] [illegible] proposed [illegible] Wright Field. [illegible] of a vehicle [illegible] is now [illegible].

[illegible] progress on Project [illegible]-570 [illegible] scale [illegible] laboratories. Priority [illegible] Forces projects will [illegible] Liaison Officer [illegible].

[illegible] Advisory Committee for Aeronautics.

[illegible] tests will [illegible].

[illegible] information [illegible].

Preliminary reports are requested [illegible] test and a final report as soon as possible [illegible].

[illegible] Air Forces [illegible] December 1941.

[redacted]

[illegible]-570

Col. [illegible]
J. P. [illegible]

AAFMC [illegible]

CENTRAL FILES

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[redacted]

Mr. G. W. Lewis, N.A.C.A., 1500 New Hampshire Ave., N.W., Washington, D. C.
21 November 1944

Reports and information may be made available to the contractor through the Air Technical Service Command Liaison Officer at the Laboratory.

It is requested that the necessary arrangements be made to permit Mr. Robert T. Jones of the N.A.C.A. Langley Memorial Laboratories to make trips in connection with the development of Air Technical Service Command Project MX-570. Mr. Jones has been doing considerable work on the Air Technical Service Command guided missile devices and his work has been an important factor in the development of these items. His untiring efforts and the inconveniences to which he has been subjected during tests of the JB-2 "Buzz Bomb" are greatly appreciated.

Very truly yours,

Copy to:
Mat. Div., AC/AS, M & S.
ATSC Lia. Off., NACA Lab., Langley Fld., Va.
ATSC Lia. Off., Ames Aeronautical Lab.,
Moffett Fld., California.
ATSC Lia. Off., NACA Airc. Engine Res. Lab.,
Cleveland Airport, Cleveland, Ohio.
TSTEX
NACA Liaison Branch

DEC 13 1944

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~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Records Letter

A/K 57

JB3

ESTIMATED COST AND SCHEDULE FOR JB-3 DEVELOPMENT AND PRODUCTION AND WIND TUNNEL TEST MODEL

Supersedes Quotation And Delivery
Schedule, Dated 7 December, 1944

Prepared for Special Weapons Branch
Air Technical Service Command
Wright Field, Dayton, Ohio

BY

Hughes Aircraft Company
Culver City, California

5 January 1944

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ESTIMATE OF DEVELOPMENT AND PRODUCTION COSTS OF 25 AAF TYPE JB-3 AIRPLANES.

Item #1 -	25 Units AAF Type JB-3 Airplane.		
	Subcontract Material (Includes $50,000.00 for Development of Gyro Controls by Summers Inst. Co., Santa Monica, Calif.)	$ 71,000.00	
	Prime Material	22,750.00	
	Direct Labor	60,755.00	
	Overhead	100,707.70	
	Engineering	37,010.00	
	Modification Parent Aircraft (2) (Northrop P-61)	6,052.40	
	Sub Total	298,275.10	
	Contingencies 15%	44,741.26	
	Total Estimated Cost - Item #1 (Unit Cost $13,720.66 Each)		$ 343,016.36
Item #2 -	One Wind Tunnel Test Model		
	Production and Testing	48,750.00	
	Contingencies 15%	7,312.50	
	Total Estimated Cost - Item #2		56,062.50
	Total Estimated Cost - Items #1 & #2		399,078.86
	Proposed Fixed Fee 5% of Estimated Cost		19,953.94
	Grand Total		$419,032.80

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ITEM #1 25 UNITS AAF TYPE JB-3 AIRPLANES

PROPOSED DELIVERY SCHEDULE

Delivery shall be F.O.B. the Hughes Aircraft Company Test Station at Harper Lake, California, as follows:

4 Airplanes Within 120 Days After Date Of Contract
5 Airplanes Within 135 Days After Date Of Contract
5 Airplanes Within 150 Days After Date Of Contract
5 Airplanes Within 165 Days After Date Of Contract
6 Airplanes Within 180 Days After Date Of Contract

TEST PROGRAM

The Test Program shall be carried out as provided in the applicable A.T.S.C. Specification JB-3.

The flight tests will begin upon delivery of the first airplane and will continue on the balance of the airplanes called for herein as they are delivered as set forth in the delivery schedule.

The flight test program shall be completed within 200 days after date of contract.

PRIORITY

This Estimate and Delivery Schedule is contingent on the assignment of suitable priority rating and precedence listing.

SPECIAL PROVISIONS

This Estimate is subject to the conditions of the following paragraphs:

(1) The Airplanes shall be in accordance with A.T.S.C. Specification JB-3 as modified by Hughes Aircraft Company Amendments to Specification JB-3 dated 6 December 1944.

(2) The Contractor will make reasonable effort to conclude the required field test program within 200 days after date of contract. However, delay caused by factors associated with the test program beyond the control of the contractor which prevent completion of the test program within the above specified

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time shall permit the contractor to waive all tests remaining to be done at the end of said time, consider the test program completed, deliver all untested airplanes to the Army, and be held free from responsibility for any and all further tests under the terms of the contract.

(3) Non-receipt by the Manufacturer of any: (1) applicable specification, (2) GFE and information concerning same, or (3) engineering decision to be reached by the A.T.S.C., as it affects engineering and construction by the Manufacturer, and Acts of God and other contingencies beyond the reasonable control of the Manufacturer, shall be deemed cause for revision of the contract price and postponement of delivery and testing beyond scheduled dates.

(4) Any commitment hereunder shall expire on 5 February 1945 unless extended.

ITEM #2 ONE WIND TUNNEL TEST MODEL

The Hughes Aircraft Company proposes the following Aerodynamic and Wind Tunnel Tests and studies to be carried on as a separate project concurrent with the development of 25 AAF Type JB-3 Airplanes:

(1) Theoretical Aerodynamic studies of the airplane design detailed in A.T.S.C. Specification JB-3 and of a design to be proposed by this Company. The study will be carried out in consultation with the A.T.S.C. and the N.A.C.A.

(2) Construction, test, and performance analysis of one (1) High Speed Wind Tunnel Model of the design specified in Paragraph 1 above.

REPORTS

Copies of reports covering the Aerodynamic studies and the Wind Tunnel data will be submitted as specified by the A.T.S.C. The reports called for herein shall constitute the entire material to be delivered under the terms of this proposal.

COMPLETION SCHEDULE

The work called for under the terms of this proposal

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shall be completed 90 days after date of Contract, contingent upon the availability of the necessary high speed wind tunnel facilities. The A.T.S.C. shall assist the Contractor in obtaining the use of said wind tunnel facilities.

HUGHES AIRCRAFT COMPANY

C W Perelle
C. W. Perelle
General Manager

All places in this document where the word airplane appears shall be replaced by the words pilotless aircraft

Hughes Aircraft Co
by F.B. Christian
Spec. Rep

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P-1

AAFMC-2..-WF-...-14-30M

Auth: DIR., ATSC
Initials DAS
Date 3 Feb 1945

ARMY AIR FORCES

AIR TECHNICAL SERVICE COMMAND

ENGINEERING DIVISION
MEMORANDUM REPORT ON

Capt. R. A. Cole:rjg
Ext. 2-5220

Date 3 February 1945

SUBJECT: Conferences at Langley Field, Virginia

OFFICE TSEPL-3I7

Contract or Order No.

SERIAL No. TSEPL-3-673-47-C

Expenditure Order No 673-47

A. PURPOSE:

1. To report on conferences held at Langley Field, Virginia from 24 January 1945 to 25 January 1945 regarding Projects MX-570, MX-600, and MX-109.

B. FACTUAL DATA:

1. Personnel present:

ATSC

Capt. D. W. Pearsall
Capt. R. A. Cole

ATSC Liaison at Langley Field

Capt. Carl

NACA Langley Field

Mr. H. Soulé
Mr. R. T. Jones
Mr. Greenberg

Hughes Aircraft Co.

Mr. Babegger
Mr. Black
Mr. Perrine

2. A discussion was held on the control system for Tiamat. In general, it was decided to use a pendulous gyroscopic mount for the radar seeker such that flight path accelerations precess the target seeker toward the target. In order to get high control response, it was decided to use the Jack & Heintz air servos (same as used on JB-2) if practicable. The two axis intelligence from the seeker can be scrambled for the three wings quite readily in the air lines to the servo diaphragms. Details of this design as proposed are shown in appendix I. Discussion is now under way with Jack & Heintz Co. relative to this use. Weight, space, and response consideration appear favorable.

3. Some possibility of changing the aerodynamic design from the Tiamat proposed by Mr. Jones of NACA was suggested by Hughes Aircraft personnel. Mr. Jones voiced his reasons for the various design details. It

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No. of pages - 12

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MX-570 - MX-600 - MX-109

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Memo. Report No. TSEPL-3-673-47-C
3 February 1945

was felt that few changes should be made inasmuch as wind tunnel tests have shown the present configuration to be sound. However, the wing area may be increased if necessary, maintaining the same plan form. It will also be allowable to make minor changes in the fineness ratio in order to change the overall length to accommodate various interior arrangements of equipment.

4. The situation relative to radar target seeker (RHB) appears somewhat obscure inasmuch as some difficulties have developed at the NDRC group at Bureau of Standards, Washington, D. C. in aiding in this problem. Details of this difficulty are not known. In order to get certain constants of this equipment it will probably be necessary to obtain the equipment and determine these constants by tests. NACA Instrument Research Division has expressed a desire to do this, and action has been initiated to obtain this equipment for them.

5. Discussion was held with Mr. Jones relative to controls for direct sighted missiles. Mr. Jones had made an analysis of the azimuth problem and felt that the pitch problem was analogous. A resume of this study appears in appendix II. In general, rapid response of the vehicle to control is imperative as is the use of a pitch gyro. When applied to a glide bomb, the rapid response requirement means that ailerons must be used.

6. Discussion was held relative to progress being made on Project MX-600--Rockette. Authorization has not yet been received by NACA from their headquarters to work on this project. However, considerable study has been made. It appears that sighting errors, launching errors, and windage errors will be much larger than control errors. Hence NACA is desirous of including these items in their work and has requested their office for permission to do so. Mr. Jones is making some quantitative calculations relative to the magnitude of the various errors to determine which will be most troublesome. Methods of eliminating these are under consideration, but no conclusions have been reached as yet.

C. CONCLUSIONS:

1. That control for Tiamat should consist of a pendulous, gyroscopic radar seeker, the output of which operates pneumatic servos to the three wings.

2. That only minor changes from the present aerodynamic configuration should be made.

3. That NACA should obtain the RHB radar target seeker constants by experimentation.

4. That further tests of direct sighted missiles should be made using control constants as recommended by Mr. Jones.

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5. That satisfactory progress is being made on Project MX-600.

D. RECOMMENDATIONS:

1. It is recommended that the following action be taken by the organization designated below:

a. Air Technical Service Command, Engineering Division, Equipment Laboratory:

(1) Investigate the gyro-stabilised seeker control with air servos. (Action initiated)

(2) Permit only those changes mentioned from present desig of Tiamat. (Action Taken)

(3) RHB target-seeker be furnished NACA for study and tests. (Action initiated)

(4) Conduct further tests on direct sight control of glide bombs. (Action to be initiated)

Distribution:

AC/AS, M & S
Tech Data Lab TSEAL-6D
Research Project Br. TSESE-4I
ATSC Liaison Office at Langley Fld.

Prepared by ROBERT A. COLE, Captain, Air Corps, Robert A. Cole
(Name)

Approved by G. V. HOLLOMAN, Colonel, Air Corps, for Albert O. Hofstein Capt. A.C.
Chief Equipment Laboratory.

Approved by H. Y. SMITH, Lt. Colonel, Air Corps, for P. Van Wasten Maj. A.C.
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

Concurrence: Robert A. Wright, Capt. A.C.

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MX-570, MX-600, MX-109

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Memo. Report No. TSEPL-3-673-47-C [redacted]
3 February 1945

APPENDIX I

I. DETAILS OF THE TIAMET CONTROL AS DECIDED ON AT CONFERENCES

A. The RHB Target Seeker is to be gimbally mounted and have the mass
of this dish increased so that it will act as a gyroscope. The Target Seeker
Gyro will either be mounted on lead screws, or have pendulous weights such
that flight path accelerations will precess the target seeker toward the
target. (See Figure 10)

B. The output of the RHB set will be fed into an amplifier, the out-
put of which will operate a solenoid which is spring restrained so that its
position is a function of the input voltage. This solenoid will then operate
an air nozzle which plays upon 3 pair of holes. The differential pressure
from each of these 3 pair of holes is fed to its servo motor diaphragm.
(See Figure 11) Thus, the two axis motion of the air nozzle is converted into
the proper pressures for control at the three wings.

C. Roll control is accomplished by a solenoid operated air nozzle at-
tached to the other side of all three servo diaphragms. It received its
intelligence from a roll gyro of the type standardized for Azon.

D. Response characteristics of the air servos is very good. The actual
rates are not as yet determined exactly. Electric servos tested by this lab-
oratory will not oscillate at much more than 4 c.p.s. when operated in a
control network. Mr. Jones of NACA calculated that at least 10 c.p.s. will be
required. The air servos contemplated are now in production.

E. Air consumption is a function of how fast and with how much work output
the control is operated. It is estimated, however, that total air consumption
should not exceed 5 cu ft/min at 100#/sq in. At 2000 lbs/sq in, this will
require an air bottle of about 1/4 cubic foot capacity for one minute flight.
To allow a safety factor probable size of air bottle should be from 1/2 to 1
cubic foot at 2000#/sq. in. The air bottle should be sealed with a seal which
can be punctured by a trigger operated firing pin or an explosive charge so
that the air can be turned on nearly instantaneously at drop away.

F. Despite the fact that an air bottle must be carried, total weight
and space will probably be less than a comparable electric system.

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SCHEMATIC DIAGRAM
"TIAMAT" CONTROL

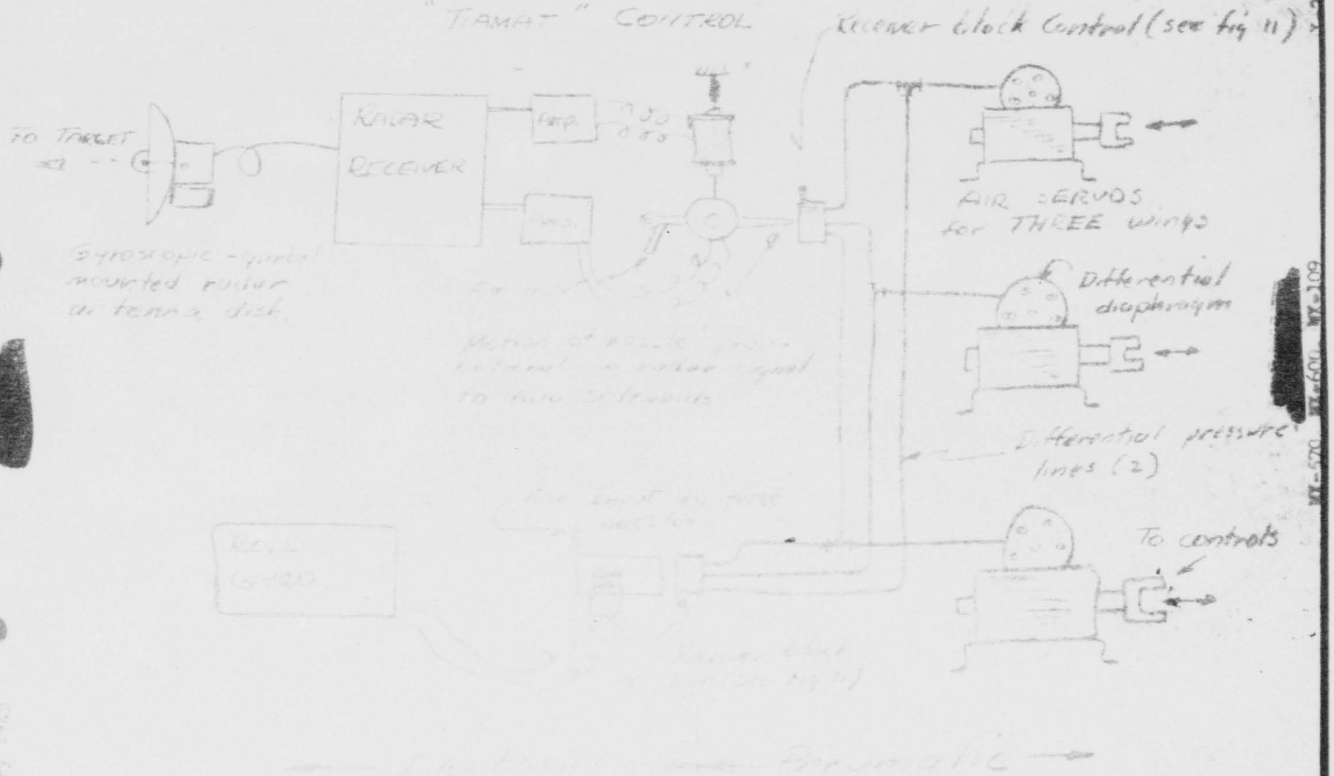

Figure 10

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FIGURE 11

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MX-570, MX-600, MX-109

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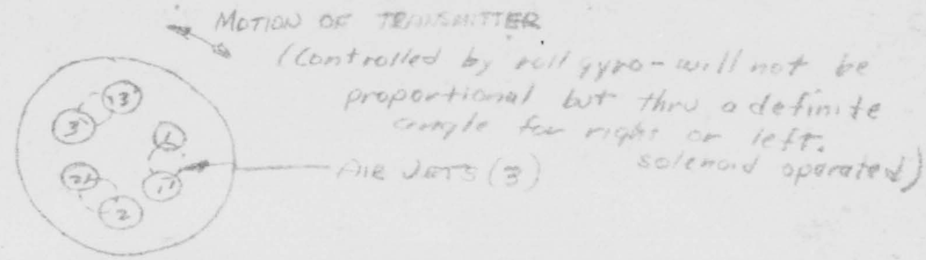

ROLL RECEIVER PLATE
(6 HOLES)

NOTE: Pressures from roll receiver are blended with those from control receiver to produce proper motion of surfaces.

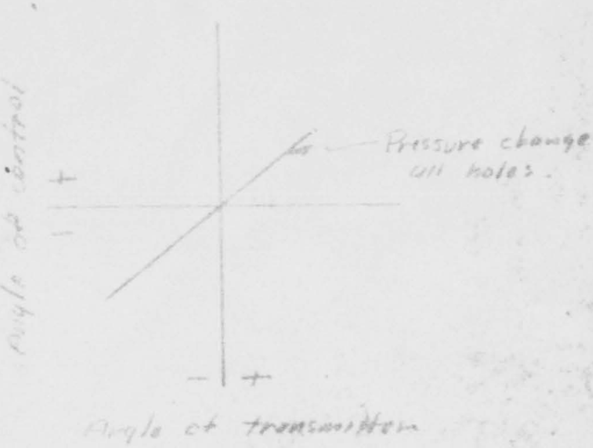

FIGURE 11a.

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Memo. Report No. [redacted] EPL-3-673-47-6 [redacted]
3 February 1945

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APPENDIX II

I. ANALYSIS OF DIRECT SIGHT CONTROL

A. Direct Sight Control is defined as control from another vehicle wherein the image of the missile is superimposed on the target by the operator and maintained there until impact. The control must also account for the relative motion of the controlling vehicle to the target.

B. Several types of control can be analyzed. Basically, three types as illustrated in Figures 1, 2, and 3, will be considered. They can best be illustrated by a curve showing the flight path for continuous signal. These curves are shown on Figures 1, 2, and 3 with description of how it is obtained.

C. It is important to note that lag in control, or lag in the vehicle in response to control, makes the oscillations [illegible] the most rapid response possible is desirable. In glide bombs this is by use of ailerons and rudder in a fixed proportion.

D. Although this analysis was made of the yaw [illegible] problem, the pitch problem is analogous and similar. It should be emphasized that a [illegible] will be required in pitch.

E. Case 1.

FIGURE 1

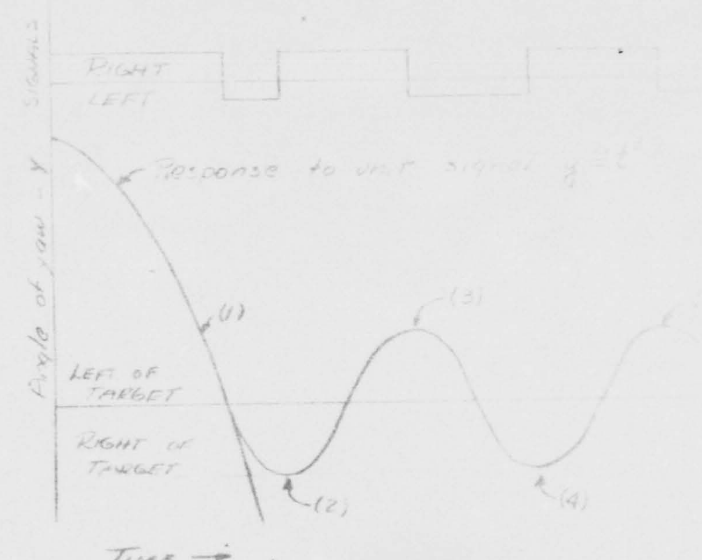

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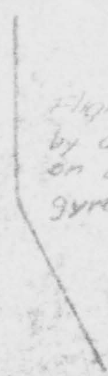
FIG 1

Flight path obtained by a constant trim rate on a roll (aileron) gyro.

FIG 2

Flight path obtained by a constant trim rate on an azimuth gyro

FIG 3



Flight path obtained by a step pick-off on an azimuth (rudder) gyro.

FIG 4

Flight path obtained by a step-time-step combination on azimuth.

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Case 1 uses a roll gyro and effects control through a trim motor on the aileron. The trim motor runs as long as the signal is given. Thus the angle of bank increases or decreases as time. The flight path for a continuous signal with this control can be shown as in Figure 1. Figure 4 shows the response to a unit signal. In order to get the missile to oscillate around the target line it is necessary to reverse control at point (1) in order to stop the oscillation at (2) and to reverse at (2) in order to stop at (3). It should be noted that control is 180° out of phase. If point (2) is right of the target, for example, it is necessary to call for right at this point in order to get the oscillation stopped by (1) and to then call for left at (3).

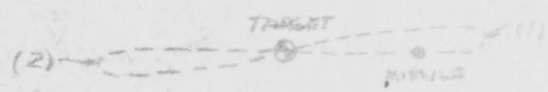

FIGURE 5

Figure 5 shows the apparent motion of the missile with respect to the target looking directly from the rear. The missile appears to oscillate from point (1) to point (2). As was stated above, in order to make the oscillation stable, it is necessary to call for right as the missile reaches point (1) and for left at point (2).

It can be seen, therefore, that control of this type is very difficult for the operator as he must sense the rate of change of motion of the missile to determine when this is zero, and reverse control at that point. At best, when he succeeds in this, he will have a large oscillation making it impossible to hit a point target. Some damping may be possible by proper anticipation by the operator, but experience has shown this to be difficult if not impossible.

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Appendix II Memo. Report No. TSEPL-3-673-27-C
3 February 1945

F. Case 2.

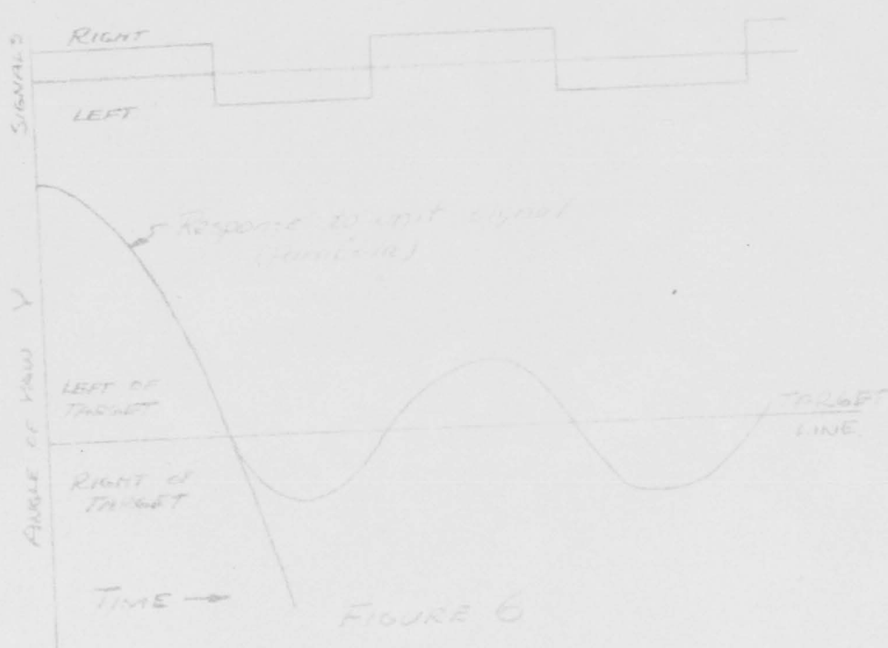

FIGURE 6

Case 2 is with a rudder gyro and a trim motor in yaw (similar to GR-8 control) wherein the yaw trim motor runs constantly, when the signal is given. The flight path may be shown in Figure 2. To aid analysis, let us assume instantaneous response of vehicle. Thus when left, for example, is called for it is assumed that zero time is required to get into the proper bank angle. In this hypothetical case, if the operator reverses control when the missile passes the target, and in phase, i.e., when going from right to left, right is called for-- the oscillation will be stable and through some angle as shown in Figure 6. The effect of the actual control time required ~~micens~~ the oscillation. Thus, if the operator reverses control at or before the cross over, he will have a stable oscillation, the magnitude of which is a function of response lag and the dynamics of the vehicle itself.

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There also exists the possibility of the operator [illegible] damping by anticipating the cross over and reversing [illegible] occurs. The control used on GB-8, with a triple pick off, [illegible] somewhat. However, the response of the vehicle [illegible] control only.

9. Case 3.

FIGURE 7

Case 3 assumes a change of heading through a definite angle each time control is directed. The general flight path resulting is shown in Figure 3. If response of the vehicle to the control were instantaneous, control could be accomplished by a "triple pick off" on the yaw gyro. The effect of the actual time lag required will be mentioned later. Figure 7 shows these angles with instantaneous response to control. If the operator reverses control when the missile passes the target, no further action is required. If, however, he reverses at some time after the cross over, a small stable oscillation will occur. If he reverses previous to cross over, an additional correction will be required.

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Appendix II Memo. Report No. TSEPL-3-673-47-C
3 February 1945

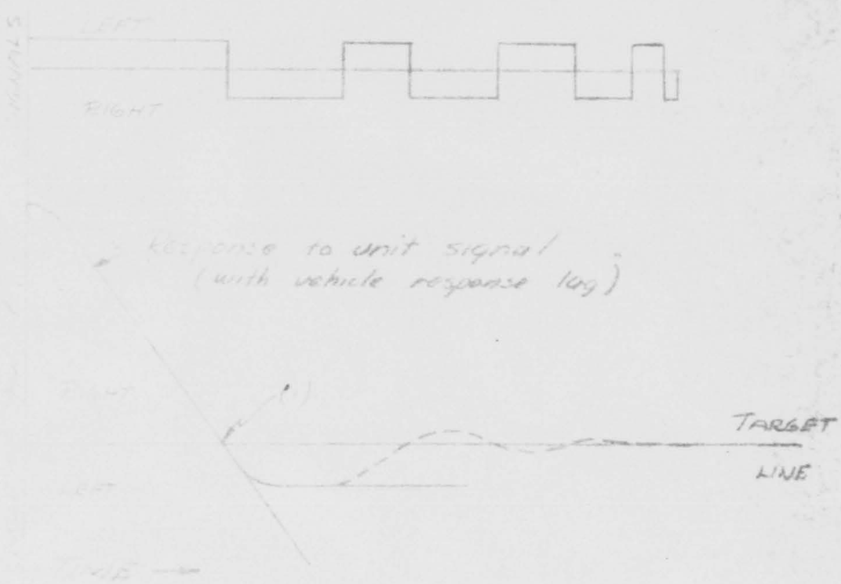

FIGURE 8

Figure 8 shows what happens considering the actual time required for the change in heading to occur. The solid line indicates what happens if only one correction is made at (1); the dotted portion shows the damped oscillation resulting from continuous corrections. Note that this control has a "zero" in that no change occurs unless either right or left is given. Since this method is considered the most practical, some considerations will be given to design details.

Specifically this can be accomplished with the standard Hammond Gyro tilted at the usual 22-1/2°. The trim motor is not used, however, the "triple pick off" must be enlarged to have probably 20 steps, each of 6°. Thus when right is called for, the pickoff 6° to the right of the one in use will be energized and this will call for a course change of about 6°. In order

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to turn more to the right it is necessary to again call for right, which energizes the pick off 6° to the right of the one in use. Thus each time a control is called for, a course change of about 6° results. This particular amount may have to be modified, however, it is not desirable to have the steps too small or the operator will unconciously make the control like case 2 by calling for frequent changes.

Since rapid response to control is imperative to success, the most rapid control possible is desired. This has been previously worked out by NACA (Reference NACA Preliminary Data Report for Theoretical Analysis of Stability of Aeronca Glide Bomb, Part IV, Bank Control) and requires use of ailerons. The configuration of air frame recommended is that for the GB-6.

Response to Signal to step to next pick-off

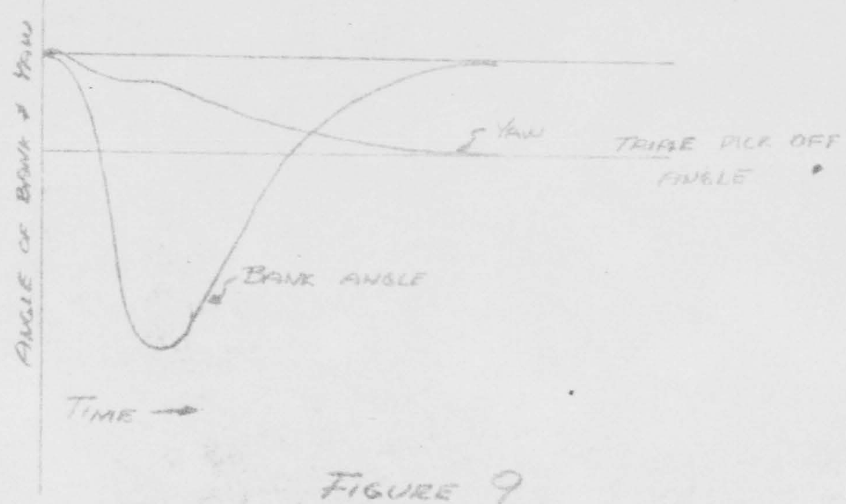

FIGURE 9

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Figure 7 illustrates the bank angle and the yaw angle as a function of time when the signal to step from one pick-off to another is given. It is desirable to have the bank angle curve as steep as possible. This is a function of the tilt angle of the tilted gyro. However, if the tilt is made less than 22 1/2° in an effort to steepen this curve, undesirable oscillation and overshoots are apt to occur. The tilt angle of 22 1/2° is near the optimum angle. Calculations and curves showing this are shown in the NACA Report referred to above.

H. Case 4 is illustrated in Figure 4. The advantages of this method over Case 3 are not considered great and in view of the additional complications required, probably not practical. Therefore, a detailed analysis will not be made.

II PITCH PROBLEM

A. The problem in pitch is quite analagous with the azimuth problem. It is felt, therefore, that the pitch control should be through a pitch gyro and with a step pick-off as described in Case 3, azimuth problem. The follow up ratio in pitch should be low--probably about 1:1 or 1:0.65 as is used on GB-6 and GB-5. The magnitude of the steps in pitch should probably be about 1° or 2°--the exact figure to be determined by tests.

III CONTROL

A. Azimuth control must be rapid if good results are to be had. It cannot be recommended too strongly that the combined aileron rudder configuration which has proven so successful in GB-6, GB-5, be used for this problem.

B. It is felt that a pitch gyro must be used in order to keep pitch errors to a minimum.

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TSEPL-316/JM/ale
12 JUN 1945

TSEPL-3I (TSEPL-3I6)

Project MX-570

Commanding Officer
Special Weapons Field Test Unit
Wendover Field
Wendover, Utah

Attention: Captain . . Cribs

1. Project MX-570 is concerned with developing a self-guided, jet powered missile, JB-3 or "Tiamat." The Project personnel are:

Captain . . Pearsall - Project Officer - TSESR-23
Captain E. I. Voan - Radar Liaison - TSERR
Lt. . L. Yingling - Control Equipment - TSEPL-3I7
Lt. J. Mahler - Jet Powered - TSEPL-316

2. The project is still in the exploratory stage. Some of its components, particularly the target seeker, are in the development stage and preliminary versions of the aero-control system are in the design and mock-up stage. However, a number of the missiles are now being prepared for pre-set flight tests at Wendover Field, Wendover, Utah. These will be guided by a modified Jack & Heintz JB-2 auto-pilot.

3. Flight paths in both azimuth and altitude will be recorded by radar tracking equipment. This equipment has been tried and found quite acceptable to the N.A.C.A. for this type of work. On 13 June 1945, Captain E. L. Voan and Captain R. E. Houser of Radio and Radar Subdivision, Air Technical Service Command, should arrive at Wendover Field, Wendover, Utah. They wish to determine a site and examine the base facilities in order that this tracking set (SCR-584), can be set up and operated. It may be that the setting up and use of this equipment on the Glide Bomb Range would not only provide excellent practical problems for the radar team, but would also be a valuable adjunct to the usual base facilities.

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EPL-316
ale

[redacted]

COM. GEN.
CH. STAFF
DEP. CH. STAFF
TECH. EXEC.
ADJ. GEN.
EXEC. PROC.
AIR. INSP.
INTELL.
COMPTROLLER
C. O.
BUD. OFF.
PERS. SEC.
ENG. DIV.
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS

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[redacted]

12 JUN 194[illegible]

Ltr to Commanding Officer, Special Weapons Field Test Unit, Wendover Field, Wendover, Utah. Attention: Captain [illegible]. Chiba. "Project MX-570."

4. It is expected that four pre-set JB-3 flights will be made the latter part of July. It is requested that 15 commercial bottles of nitrogen at approximately 2000 pounds p.s.i., as well as a source of supply for more nitrogen, be available for these tests. This matter was previously discussed with the Chief of the Test Unit at Wendover, by telephone at an earlier date. Before these tests are to be conducted, Wendover Field will be notified and a conference between interested personnel arranged. Requirements and a tentative test procedure will be submitted at that time.

BY COMMAND OF MAJOR GENERAL MILLER:

[illegible], Jr.
Lt. Colonel, Air Corps
Chief, Special Weapons Branch
Equipment Laboratory

Copy furnished:
Captain Pearsall - TSESE-2G

[redacted]

Y-15-2625

1778

HqATSC Form No. 60-507 (20 Jan 45) (Old AAFMC-266)

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Total No. of pages - 3

ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND

MEMORANDUM REPORT ON

TSEPL-317/JM/gl
Date 20 July 1945

SUBJECT: "Tiamat" Air to Air Missile.

OFFICE TSEPL-317 Contract or Order No.

SERIAL No. TSEPL-3-448-5-A Expenditure Order No. 448-22

A. PURPOSE:

1. To report on travel to Hughes Aircraft Company, Culver City, California, and Wendover Army Air Base, Utah, from 25 June to 9 July 1945 to arrange a test schedule for equipment being developed on project MX-570. 245

B. FACTUAL DATA:

2. A contract between AAF and Hughes Aircraft Company calls for development, manufacture and testing of twenty five (25) Tiamat units. Four (4) of these should be completed and ready for testing at Wendover Army Air Base about 30 July 1945.

3. At present Hughes Aircraft Company has four (4) satisfactory fuselage castings. These are being machined for fitting to the rest of the assembly. To date, there are no satisfactory wing castings but wing sections of sheet metal are being fabricated.

4. A test stand for adjusting and thoroughly checking the operation of JB-2 servo-gyro combinations has been built. The first four auto-pilots will be set up and adjusted in the same manner as those being flown by the NACA, that is, control gearing 2:1, rate constant 1/3. A report by Mr. Harry Ribner of NACA provides the basis for an analytical approach to the auto-pilot problem. Hughes Aircraft Company has engaged the Marquardt Engineering Company of Los Angeles, California, to make a similar but more extended study on the same subject. This will include correlation and interpretation of flight test data.

5. Modification of AAF A-26-41-39100 for preliminary flights (auto-pilot but no seeker mechanism) is almost complete. About one week before tests are to begin, Hughes Aircraft Company will request an AAF pilot for check-out flights at the factory, and to ferry the aircraft to Wendover Army Air Base.

6. Flight testing of the "Tiamat" will be done at Wendover, Utah. Air Technical Service Command will:

a. Select and Prepare a suitable site.

[redacted]

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[redacted]

Memorandum Report No. TSEPL-3-448-5-A
20 July 1945

b. Procure Government furnished equipment (only when equivalent cannot be obtained by contractors).

c. Supply pilots aircraft and ground observers.

d. Arrange for Monsanto Chemical Company to send rocket motors, and men qualified to handle them, to Wendover.

7. The missiles to be tested are divided into two groups. The first (ten units) will be auto-pilot controlled by modified Jack and Heintz JB-2 units. They will be flown solely to determine the aerodynamic, stability and control characteristics of the airframe. Ten flights should be sufficient to obtain necessary data for subsequent work. The second group will be seeker controlled. Since seeker controlled missiles will not be flown before the middle of September, the only program outlined is for this first group of ten flights.

8. The following schedule shows the estimated completion and proposed flight date for each series of missiles. Serious difficulties in any of the early flights may, of course, require revision of the schedule:

Serial Number	Completion Date	Flight Test Date
1-2 3-4	16 July 23 July	3 July-6 August
5-6 7-10	6 August 14 August	20 August-27 August
11-14 15-18	4 September 18 September	23 September-30 Sept.
19-22 23-25	1 October 15 October	15 October-25 October

This schedule presupposes the desirability of testing at least four units at one time and the undesirability of Hughes Aircraft Company maintaining a crew at Wendover. If it is felt that a group should be kept there, the schedule could be spread out more evenly. However, the testing time would not be appreciably shortened.

9. The missiles will be fired from the modified A-26 at a predetermined altitude. The first four will be flown straight and level at a fairly high altitude approximately 10000 feet to allow for eventualities. Later flights may be lower to facilitate tracking the missile and salvaging instrument camera equipment.

MX-570

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Memorandum Report No. TSEPL-3-108-5-A
20 July 1945

10. Three minutes before launching, the air supply to the missile will be turned on to bring the gyros up to speed. With the airplance in a level attitude, the control gyros will be uncaged and checked by indicator lights in the cockpit. The missile will then be released. It will be in controlled flight with power off for 10 seconds before the motor is ignited. The auto-pilot is so arranged that it can fly either a straight course or a series of maneuvers of any desired degree of violence. After a time delay of one minute, 25 seconds (the motor runs for 67 seconds) the camera will be ejected and recovered by parachute. The camera is armor cased. During flight it will record a sweep second clock face, the attitude of the missile, the position of the control surfaces and, in maneuvering missiles, lateral and vertical load factors.

11. Captain R. E. Houser of Radio and Radar Subdivision is sending an SCR-584 radar tracking and plotting unit to Wendover. It will be used in these as well as JB-2 tests. The unit will be modified in order to synchronize the time plotted path with the recorded Tismat instrumentation in conjunction with this, an installation for the A-26 is being prepared by Mr. Max Sallach of Radio and Radar Subdivision. This will be installed at Wendover.

12. About 25 July 1945, Mr. John Black of Hughes Aircraft Company will be at Wendover to confer with project and field test personnel regarding the testing program.

C. CONCLUSIONS: None.

D. RECOMMENDATIONS: None - Data merely submitted.

Distribution:
AC/AS, M & S (5) #2-#4,10 Aug 1945
TSEAL-6D, Tech.Data.Lab. #3 Aug 1945
TSEPL-217, Equip.Lab. #1
TSESE-2G, Aircraft Proj.Sect. #4 Aug 1945
Attn: Capt. D.W. Pearsall
TSERR-2CE, Radio & Radar Sect. #5
Attn: Capt. R.E. Houser Aug 1945
TSERR Radio & Radar Sect. #6
Attn: Mr. Max Sallach Aug 1945
HIS (5) 11 thru 15

Joseph Mahler
Prepared by JOSEPH MAHLER, 1st Lt., Air Corps
(Name)

R. R. Swanson, Maj. A.C.
Approved by for C. O. FRENCH, JR., Lt.Colonel, AC
Chief, Controlled Aircraft Branch

H. R. Collins Maj AC
Approved by T. B. HOLLIDAY, Colonel, Air Corps
Chief, Equipment Laboratory
Propulsion and Accessories Subdivision

Concurrence: Engineering Division
R.W. Cole Capt AC

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TSECO Form No. 8B
(20 Mar 45)

SAVE

ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
OFFICE OF THE LIAISON OFFICER
AT THE N. A. C. A. LABORATORY

679

7150
TSEMP:[illegible]
LANGLEY FIELD, VIRGINIA
4 September 1945

Subject: Progress Report on Pilotless Aircraft.

To: The Director,
Air Technical Service Command,
Wright Field, Dayton, Ohio.
(Attention: Engineering Division,
Research Projects Branch, TSESA-41)

Project	R.A.No.	Laboratory	Per Cent Complete	Project Started	Estimated Date of Completion
JB-3 (MX-570)	1316	Stability Research Division	[illegible]	1-30-45	Indefinite
		Instrument Research Division			
JB-5 (MX-595)	1316	Stability Research Division	15	[illegible]	[illegible]
		Instrument Research Division			
JB-6 (MX-606)	--	Stability Research Division	10	[illegible]	
Tarzon (MX-674)	--	Stability Research Division	[illegible]	3-30-45	Indefinite

JB-3

1. The second JB-3 model was launched successfully 24 August 1945. The boosting rocket functioned very satisfactorily. The roll stabilization was very satisfactory, however, there was an oscillation on both yaw and pitch and the vehicle dived into the sea about four miles off shore. All of the telemetering and radar tracking functioned perfectly and the records are now being analyzed to determine the cause of the yaw-pitch oscillation.

2. The third model will be launched approximately 17 September 1945 unless a major change in configuration is involved.

3. The report on the first launching has been prepared and will be forwarded to the ATSC approximately 5 September.

TSESE-261 81 filed [illegible] 1945

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6-8

The Director, A.T.S.C.,
Wright Field, Dayton, Ohio.
4 September 1945.

4. The Cordite rockets which were originally intended for the boosting units of the [illegible] units are now being used to boost basic research models, to evaluate different methods of automatic control applicable to this project.

[illegible]

1. No further work has been done on this project.

[illegible]

1. Further work has been done on this project which is reported in the Progress Report on Free Falling Bodies dated [illegible] August 1945.

Tarzon

1. The report "Free-Flight Tunnel Tests of a Low-Aspect-Ratio, Triangular-Plan-Form, Double-Thick Wing Design for [illegible]," dated [illegible] August 1945, was forwarded to the ATSC on 17 August 1945.

2. The report "Tests at Transonic Speeds [illegible] Effectiveness of a [illegible] Trailing Edge Flap on a Wing Model with Low Aspect Ratio and Pointed Plan Form," dated August 1945, was forwarded to the ATSC on 8 August 1945.

3. The Laboratory would like to be informed [illegible] the Gulf Research Corporation take the [illegible] as planned [illegible] conference in order that a representative of the Laboratory may attend.

A. M. Carl [illegible]
Major, A.C.

for: CARL F. GREENE, COLONEL, A. C.,
AIR TECHNICAL SERVICE COMMAND
LIAISON OFFICER AT THE N. A. C. A.
LANGLEY FIELD, VIRGINIA

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L.M.A.L.

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TSENG Form No. 33 (3 Oct 45)

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ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
OFFICE OF THE LIAISON OFFICER
AT THE N. A. C. A. LABORATORY

file Bombs
WHW
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FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

LANGLEY FIELD VIRGINIA
[illegible]

Subject: Project [illegible]-570: Summary Report.

To: The [illegible] General,
Air Technical Service Command,
Wright Field, Dayton, Ohio.
(Attention: Chief, [illegible] Section, [illegible])

Copy sent to
ESA-7
EAG-3
ENG-1

1. [illegible] of the [illegible] missile, [illegible] has progressed through [illegible] stages [illegible]:

a. [illegible]

b. [illegible]

c. [illegible]

2. [illegible] analysis, reported in preliminary [illegible] that [illegible] tests in the free-flight [illegible] and reported in [illegible] report entitled "Investigation of Stability [illegible] of a 1/2-scale model of an [illegible] (X-570) in the Langley Free-Flight Tunnel - I - [illegible] ment," by Paulson, Schade, and Johnson, dated [illegible] 1945.

3. Later a flight test of the actual [illegible] N.A.C.A. was conducted at the N.A.C.A. Auxiliary Flight Station, [illegible] Wallop's Island. The actual missile was 120 inches long. The results of this initial test were published in the N.A.C.A. Memorandum report entitled "Results of First Flight Test of [illegible]," by [illegible] L. Seacord, Jr., dated 10 September 1945.

4. At that time another analysis indicated the missile would be more stable and more controllable with the four-fin [illegible] Paragraph 1b. Again model tests were conducted in the free-flight Tunnel and reported in a memorandum report entitled "Investigation of Stability and Control Characteristics of a 1/2-Scale Model of an NACA Configuration for Guided Missiles (X-570) in the Langley Free-Flight Tunnel - II - Four-Fin Arrangement," by Paulson, Johnson, and Schade, dated 16 October 1945. The results of the tests indicated

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Air Technical Service Command,
Wright Field, Dayton, Ohio,
15 March 1946.

the arrangement to be much more satisfactory than the three-wing configuration.

5. Two (2) flight tests of the four-fin arrangement have been conducted at the Auxiliary Flight Station. The results obtained indicated adjustments to the servo system of the missile were necessary for the improvement of the yaw and pitch stability. This system, therefore, has been studied on a bench test and has been modified so as to reduce the lag in the system, thereby allowing quicker and larger amounts of control deflections to be obtained when required.

6. A fourth missile is now being prepared for launching with these modifications and should be available for tests within the next two (2) weeks.

7. A report on the second flight will be ready for transmittal to Wright Field within the next two (2) weeks and is entitled "Results of Flight Tests of MX-570 (Model 2, Four-wing Tiamat)," by Seacord.

8. The results of the third test will not be reported as this flight lasted only two (2) seconds after the launching booster was disengaged.

9. Another report entitled "Correlation of Computed Rolling Motion of the MX-570 (Model 2 Tiamat) Guided Missile with that Obtained in Flight," by Seacord and Pitkin, will also be available for transmittal to Wright Field within two (2) weeks. This latter report indicates the rolling motion can be computed satisfactorily for flight tests and compares quite favorably with flight test results.

10. Two (2) additional reports are now in preparation by the Auxiliary Flight Division. The first of these is on the launching technique employed by the N.A.C.A., and the second is on the effect of rate of control system operation on missile performance.

11. The latest configuration involving four (4) sweptback wings, mentioned in paragraph 1c is now being constructed and should be ready for tests within thirty (30) to sixty (60) days. This configuration will have a higher critical Mach number, and the effectiveness of the controls will be somewhat greater at the high Mach numbers obtained. The actual launching tests will be preceded by tests of the actual article in the 7 x 10 High-Speed Wind Tunnel. The future outline of the N.A.C.A. program on this missile will depend on the outcome of these tests.

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Air Technical Service Command,
Wright Field, Dayton, Ohio,
13 March 1946.

12. It may appear to the Air Technical Service Command that this project is moving rather slowly. However, it should be kept in mind this is the first project of this type ever attempted by the N.A.C.A., and that in addition to the actual development of the missiles, systems of operation are being developed and refined along with the construction and development of the actual operating site at Wallop's Island. This office is assisting the Laboratory materially in the procurement of surplus Army property for use at Wallop's Island. The construction of the facilities is currently underway at the expense of several millions of dollars to the N.A.C.A., and when completed will constitute one of the best missile research facilities in the world.

D. L. Eastman, Jr.
DONALD R. EASTMAN, JR., MAJOR, A.C.,
A.T.S.C. ENGINEERING LIAISON OFFICER
AT THE N.A.C.A. LABORATORY,
LANGLEY FIELD, VIRGINIA.

Copy to:
TSESA7

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11/14/41

Dr. J.[illegible]

[illegible] development of non-visual bombs. [illegible] Dual-sight rather [illegible]. It is clear that while [illegible] a way around [illegible] system described [illegible]

[illegible] as follows:

[illegible]

[illegible] conditions and restrict one [illegible] if you will let [illegible] suggest another which [illegible] may relieve the present [illegible]

Sincerely yours,

[illegible] Bradford
Technical Aide
Division A

[illegible]
Capt. [illegible]
Major [illegible]
Dr. [illegible]
Lt. Col. [illegible]
Dr. [illegible]
[illegible] Elliott

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1134

MDAC-265-A-WF-12-22-41-500M

NDRC

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File
AC-36

INTER-OFFICE MEMORANDUM
WAR DEPARTMENT, AIR CORPS
Office, Assistant Chief
Materiel Division

DS/beg/50

[redacted]

Wright Field, Dayton, Ohio
Date November 26, 1942

TO: Commanding General, Materiel Command,
Headquarters Army Air Forces,
Washington, D. C.
(Att: Ass't. Chief of Staff (E))

SUBJECT: NDRC Project AC-36.

1. Reference is made to your IOM dated November 18, 1942, forwarding information on glide bombs being developed by the NDRC.

2. The project is mentioned as AC-36, however, it is believed that no development of glide bombs has been requested by the Materiel Center in this project. AC-36 was to deal only with high angle controllable bombs as are being developed by Section D of the NDRC. The glide bomb being developed by Section A of the NDRC is not considered vital since the Materiel Center has already developed this type of bomb to the point of standardization.

3. It is therefore believed that all effort should be made to develop the high angle bomb even to the extent of dropping the glide bomb development. It is also believed that it should be made clear that the Army Air Forces is not interested in the glide bomb.

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Experimental
Engineering Section.

cc - Equipment Laboratory, Wright Field.

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Signature

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1670

WAR DEPARTMENT
HEADQUARTERS, MATERIEL COMMAND

a copy of CTI-1350
as received by Sgt Josiah R. Bonner
of the Counter-Intelligence Branch
for transmittal to Col. R.H. Boling in
Washington. Josiah R. Bonner Sgt
10/23/45 34565855

Wright Field, Dayton, Ohio
June 5, 1943.

TECHNICAL INSTRUCTIONS

Serial No.: CTI1350

4716 2

Subject: High Angle Controllable Bomb in Azimuth.

TO: Engineering Division.

K-334.8-MCRE-
ac-36-Conf.-c.

1. Problem Presented:

a. That a program will be immediately initiated and expedited to procure a quantity of high angle controllable bombs (in azimuth) direct sighted for test purposes. These bombs will have the following characteristics:

(1) Standard bomb cases will be used and if possible both the nose and tail fuzes will remain unchanged, that is, the equipment to be attached to the bomb will be so designed, if at all possible, in order that present standard fuzes may be used.

(2) The first objective will be to design around the 1000 lb. G. P. bomb. Every effort will be made to have the final bombs with controls, etc. loadable on all 1000 lb. bomb stations of heavy and medium bombardment airplanes. These bombs will be carried internally.

(3) The bombs will be controlled in azimuth only. It will be highly desirable to have them controlled in both directions; however, the prosecution of this project will not be delayed pending the time control and sighting in both directions becomes feasible.

(4) The finished bomb will have good ballistic characteristics.

(5) Suitable radio control apparatus will be included.

(6) Every effort will be made to obtain the simplest and most durable components possible.

(7) A means will be included for visually following the bomb in flight, such as a flare or smoke trail.

b. Development will proceed at the same time for a device to be installed in the airplane to aid in visually controlling the flight of the bomb when the target is an isolated point. It is visualized that this development could take the form of a rotatable screen similar to a drift meter. What is really desired is some means of maintaining a line of sight from the operator to the target so that

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CENTRAL FILES

AAFMC-190 WF-4-20-43-5 MH

1671 [redacted]

Serial No.: CTI-1580

Subject: High Angle Controllable Bomb in Azimuth.

when and if the airplane should change direction or vary its position in azimuth a line of sight for the bomb could still be maintained.

g. The development and engineering of this phase of project AC-36 will be considered as an interim only and will not stop or hinder the development and successful conclusion of the radar or television controlled versions with two-axis control.

2. **Factual Data:**

a. In a letter dated June 1, 1943 received by this office from Chief, Materiel Division, Office of Asst. Chief of Air Staff, Materiel, Maintenance & Distribution, it was stated that the Asst. Chief of Air Staff, Operations, Commitments and Requirements, has issued a directive to the effect that this project is to be expedited and expressed an immediate requirement for this equipment. They indicated their belief that this bomb would materially increase the accuracy of bombing of limited classes of objectives, such as maneuvering ships, bridges, and other targets of this nature.

3. **Authority:**

a. Commanding General, Army Air Forces. By letter dated June 1, 1943 from Chief, Materiel Division, Office of Asst. Chief of Air Staff, Materiel, Maintenance & Distribution, subject: Direct Sight - High Angle Bomb Controllable in Azimuth. Project AC-36.

4. **Action Desired:**

a. To accomplish that which is stated under paragraph 1 of Problem Presented.

b. During the development and engineering of this equipment around the standard bomb, consideration will be given to the preparation of manufacturing drawings so that after the completion of the final test phases of this project immediate production could be anticipated if and when Requirements Division indicated a quantity required for operational use.

c. Upon the completion of this development a quantity will be procured for test purposes and a program will be prepared satisfying the attendance by the various offices concerned. It is desired that this program include bombing of actual or facsimile targets over water and land.

d. Various agencies of the N.D.R.C. concerned will be contacted immediately for the purpose of pursuing and expediting this project. Attached for your information is a copy of a letter addressed to Major

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COM. GEN.
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3/3

Serial No. CTI-1550

Subj: High Angle Controllable Bomb in Azimuth.

General G. G. Williams, War Department Liaison Officer with the N.D.R.C.

By Command of Brigadier General BRANSHAW:

C. V. WOLF,
Colonel, Air Corps,
Asst. Technical Executive.

Incl:
Cy. ltr. to Maj. Gen. Williams

Distribution:
Production Div.
Aircraft Radio Lab.
Air Service Command.

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CENTRAL FILES

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JAC-286-A-WF-6-27-41-60M
MX-224
32-3 pp
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Auth: A.C.M.D.
Date: 5 July, 1943
Initials: T.A.S.

WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION MATERIEL COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

AW no: 54:6191:5419

Date 5 July, 1943

SUBJECT: Controllable Missiles.

SECTION Equipment Laboratory

SERIAL No. ENG-54-673-5-S-2

MX-224

Contract No.
Expenditure Order No. 673-13
Purchase Order No.

A. Purpose.

1. To report on a conference with Division 5 of the National Defense Research Committee.

B. Factual Data.

1. A conference was held in Washington, D. C. on June 9, 1943 of Division 5 of the National Defense Research Committee.

2. Present at the conference were:

Materiel Command	National Defense Research Com.
Col. G. V. Holloman	Representatives of Division 5
Lt. Col. W. G. Brown	Representatives of Division 14
Lt. Col. D. H. Young	Representatives of Division 16
Lt. Col. A. Nyman	Representatives of Reviewing
Capt. J. H. Evans	Committee of N.D.R.C.

Representatives of the Army Air Forces.
Representatives of other Branches of U. S. Army
Representatives of U. S. Navy.

3. Discussion covered the progress of work of Division 5 since the previous meeting in February 1943.

4. Dr. Lyman reported on R.H.B. tests at Eglin Field and indicated that only two flights out of ten can be considered satisfactory. The failure of the remainder can be variously attributed to radar failures or the inability of the bomb to fly with the special large size nose arrangements required by the experimental R.H.B. equipment.

5. Dr. Dryden discussed progress on the 12 ft. and 8 ft. model of bomb known as the Washington project. Dr. Dryden indicated that aerodynamic control of his bomb requires improvement to overcome sluggishness but that it will accept radio control in combination with television and target seekers arranged for proportionate control. It was indicated by

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AC-1 AC-36 MX-224 252

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3 pages

mx-224
32

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Colonel Holloman that the Army Air Forces will continue testing the 12 ft. model at Eglin Field. The Bureau of Ordnance of the U. S. Navy is continuing tests of the 8 ft. model.

6. Reference was made to confining R.H.B. to Drydon bomb only. Colonel Holloman indicated that the Army Air Forces has T.G.B.1 to use and have reasons to expect that G.B.1 with plastic nose can be made to maneuver satisfactorily.

7. A discussion took place on the type of controls which may be required on different glide bombs, in particular with regard to their effectiveness when evasive action is taken by the control airplane after releasing the bomb. Colonel Maxwell indicated that generally evasive action will be slight banks and skids against antiaircraft fire (of the order of 10° at the rate of 360° in 2 minutes) and more violent against fighters.

8. Another discussion centered on the advantages of wing control as against tail controls for target seekers. Colonel Holloman indicated there is no objection to either type.

9. Reference was made with regard to operations against marine and land targets. Colonel Holloman indicated the Army Air Forces interest in both.

10. A discussion took place concerning high angle "Pittsburgh" project AC-36 and in particular the "Azon" type for azimuth control only, with a definite result advocating further development of range and azimuth control.

11. Representatives of the Army Air Forces indicated that simplicity of controls of "Azon" type and installation on internal bomb racks justified a definite program of procurement of service test models for which a project officer has been designated.

12. Dr. Grondahl stated that the program on this project included the following:

a. Six units for 15th of June.

b. Twenty-five additional units on present contract.

c. Planning and engineering for two hundred additional units, delivery to begin in October 1943.

The cost involved amounts of $200,000.00. This program appeared satisfactory to representatives of the Army Air Forces and Ordnance Section.

13. A discussion of modified bomb for external bomb racks revealed a number of advantages of the internal bomb rack as follows:

a. Device is kept more confidential by concealment.

b. There is no danger of icing.

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Engin. Div. Memo. Report No. ENG-54-673-5-S-2
5 July, 1943

c. There is no interference with fire power.

14. Colonel Holloman indicated that these advantages should not preclude the development of externally carried bombs if this latter offered definite advantages of control and improvement of accuracy.

15. Dr. Grondahl outlined the following program of azimuth and pitch control:

a. Six units of shroud type completed.

b. Six target seeking units in July.

c. Nine television units by the end of July.

16. A discussion on television and target seekers covered details of progress of work on these devices.

C. Conclusions.

1. That results on Dryden type bomb justifies tests by the Army Air Forces for comparison with other types.

2. That progress on high angle "Azon" bomb justifies definite service test program.

3. That work be continued on high angle bombs for azimuth and pitch control.

D. Recommendations.

1. That tests be carried out on Dryden bomb, "Azon" and other high angle bombs at Eglin Field. (Action being taken by the Materiel Command.)

A. NYMAN, Lt. Colonel, A. C.

G. V. HOLLOMAN, Colonel, A.C.
Equipment Laboratory,
Engineering Division.

F. O. CARROLL, Brig. Gen. U.S.A.
Chief, Engineering Division.

[redacted]

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Materiel Division. AC/AC-M.M.& D.
N.D.R.C.Lia.;N.D.R.C.Divn.5;
Central Files

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[redacted] Contract W3-038 ac-1708

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Union Switch & Signal Company
Swissvale, Pennsylvania

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1943

Approval Recommended:
27 December 1943

APPROVED: ______________________
By direction of the Under Secretary of War

W. F. Volandt

W. F. VOLANDT
Colonel, Air Corps
Chief, Procurement Branch
Office, Assistant Chief of Air Staff
Materiel, Maintenance & Distribution

Colonel

ALBERT J. BROWNING
Brig. General, General Staff Corps
Special representative of the
Under Secretary of War

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W.F.-8-21-43-10M
AAF Materiel Command
Letter Contract

WAR DEPARTMENT
ARMY AIR FORCES
MATERIEL COMMAND
OFFICE OF THE COMMANDING GENERAL

87-4A:LAM:mee

Contract No. W 33-038 ac-1706

Wright Field, Dayton, Ohio
24 November 1943

NAME: Union Switch and Signal Company

ADDRESS: Swissvale, Pennsylvania

Dear Sirs:

1. An order is hereby placed with you for the furnishing to the Government of the following supplies or services:

Item 1 - Ten Thousand Six Hundred (10,600) each Azon Tail Structure, Type AZ-1

At a total estimated price of $10,600,000.00

2. You are directed, upon your acceptance of this order (or upon its approval if required by paragraph 9) to proceed immediately to procure the necessary materials, and to commence the manufacture of the supplies or performance of the services called for in paragraph 1, and to pursue such work with all diligence to the end that the supplies may be delivered or services performed at the earliest practicable date.

3. All applicable articles (other than the article "Termination for the Convenience of the Government") now required by Federal Law, Executive Order, or War Department Procurement Regulations to be included in contracts for supplies or services of the kind herein described are incorporated herein by reference.

4. By your acceptance hereof, you undertake without delay to enter into negotiations with the War Department looking to the execution of a definitive contract which will include all applicable articles then required by Federal Law, Executive Order and War Department Procurement Regulations to be included in contracts for supplies or services of the kind herein described. The definitive contract will also contain a detailed delivery schedule and prices, terms and conditions as agreed to by the parties, which may or may not be at variance with the provisions of this order. It is expected that such definitive contract will be placed with you prior to 1 February 1944

5. You are not authorized to expend or obligate, in furtherance of your performance hereunder, more than $ 5,300,000.00 in the aggregate. Pending the execution of a defin-

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Officer not later than 4 December, 1943. Su acceptance will constitute this order a contract on the terms set forth herein, subject to the written approval of the Secretary of War or such individual as said Secretary may designate.

10. This instrument is authorized by and has been negotiated under the First War Powers Act, 1941, and Executive Order No. 9001.

UNITED STATES OF AMERICA

By J.B. Hodges

J. B. HODGES, CAPTAIN, AIR CORPS
Contracting Officer

ACCEPTED December 1, 1943

UNION SWITCH AND SIGNAL COMPANY
(Contractor)

By W. H. Cadwallader
(W.H. Cadwallader)
Vice President & General Manager.

The Finance Officer U. S. Army, Public Ledger Bldg., Independence Sq., Philadelphia, Pa. is designated as the officer to make payments in accordance with this contract.

The sums to be expended by the Government hereunder are chargeable to the following allotments, the available balances of which are sufficient to cover the same:

ACA 1942-44, 2-4005 P 110-09 A 212/40705

Type Contract Contemplated Fixed Price
Authority for Purchase No. 378558
Priority Rating AA-1
Equipment Class 11-A
Classification [redacted]
Program None

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SUBJECT: AZON

TO: AC/AS, M. M. & D., Research Liaison Section, Attn: Col. Brown   Date 10 Feb 44

FROM: Air Communications Officer   COMMENT NO. 1
Gen. McClelland/mev 6524

1. The guided missile "Azon" has finally completed successful tests, and a program for early introduction into a combat theatre has been approved and is underway. The first Azons to be used are of a pre-production order and it is considered essential that the Commanding Officer of the detachment which is to take Azon into combat have the technical assistance of one of the NDRC engineers who has been intimately connected with the development. It is requested that NDRC be asked to make available, Mr. A. J. Wollan, who has had broad experience in the development of Azon or someone with equivalent qualifications. It is desired to assign Mr. Wollan as technical aide to the detachment which will use Azon.

/s/ H. M. McClelland
H. M. McCLELLAND
Brig Gen, USA
Air Communications Officer

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ARMY AIR FORCES
MATERIEL COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

VB1 delete

Lt. Colonel [illegible]
File [illegible] Ext. [illegible]
Date 20 July 1944

SUBJECT: VB-1 (Azon)

OFFICE
~~SECTION~~ Equipment Laboratory

SERIAL No. [illegible]

Contract No.
Expenditure Order No. [illegible]-1
Purchase Order No.

A. PURPOSE:

1. To recommend further development of VB-1.

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B. FACTUAL DATA:

1. Up until the introduction of the VB-1 to combat, nearly all drops had been made with single bombs. Employed in this manner, the fact that each bomb had slightly different aerodynamic and control characteristics was of no importance.

2. Most of the targets which it was desired to attack in the Italian Theater were defended so heavily by anti-aircraft fire and enemy fighters that more than one run-in on the target was not practicable. Therefore, the entire bomb load had to be released at one time. The controllability of VB-1 under these conditions was still of great value, inasmuch as it would conceivably permit the accurate placement of the bomb pattern.

3. However, the dispersion resulting from the discrepancies noted in paragraph 1, above, caused a wide dispersion in the pattern, and the consequent reduction in effectiveness was such as to lose a large percentage of the potential value of the weapon. This dispersion became particularly objectionable at altitudes above fifteen thousand feet.

4. In an attempt to limit this dispersion with the facilities at hand, a method of tying the bombs together by means of a wire or cord was tried. The bombs were connected by a twenty-five or thirty foot length of wire or strong cord, the excess coiled neatly and held by gummed paper tape. On the attack, all bombs were dropped in a close train or salvoed. The result was a group of bombs, each connected to the others by the wire, whose "spread" during the fall was restrained

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to the length of the wire. Controllability was apparently little effected, and even when the wire broke it was usually during the last part of the fall. The resulting pattern was quite compact.

C. CONCLUSIONS:

1. That the above described method was merely a makeshift means to an end. However, it did show the promising results that could be obtained if some means to reduce dispersion were found. It also allowed the effective use of the weapon without radically altering the standard tactics employed. By reducing the inherent dispersion, it could logically be used by a large number of aircraft and allow the accurate placement of the entire pattern. This would allow attacks on such targets as marshalling yards and elongated factory areas down the long dimention, rather than across at some large angle as in the practice with ordinary bombing, and would therefore insure almost one hundred per cent hits rather than the twenty to fifty per cent normally expected in the target area.

D. RECOMMENDATIONS:

1. It is recommended that the following action be taken by the organization designated below:

a. Engineering Division, Materiel Command, Equipment Laboratory:

(1) That VB-1 be further developed with the object of reducing the dispersion noted above. These developments might be in the form of "delayed stabilization," i.e. have the bombs rotate during the first third or half of the bombs fall and then stabilize or some means of making the bombs more uniform and aerodynamically

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similar. This latter is not thought to be practical in production quantities.

Concurrence:

Prepared by PAUL E. HELMICK, Lt. Colonel, A.C.
(Name)

Approved by G. V. HOLLOMAN, Colonel, A.C.
Chief Equipment Laboratory

Approved by F. O. CARROLL, Brig. General, USA
Chief, Engineering Division

Distribution:

Ch., Mat. Div., AC/AS, MM & D
Eval. Branch, Tech. Data Lab.

[redacted]

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IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL: TSENG (TSEPL-314)

xxxxxxxxxxxxxxxx
HEADQUARTERS, AIR TECHNICAL SERVICE COMMAND
Lt.D.M.Baltimore:mep
Ext. 3-5316
Wright Field, Dayton, Ohio
21 December 1944

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Request for Service Test Program for Spazon Bombs.

President,
Army Air Forces Board,
Orlando, Florida.
Attention: Lt. Colonel, E. R. Tash.

1. This office has recently completed drop tests, at Wendover, Utah, of the Spazon Bomb. The Spazon is a modification of the VB-1 bomb, wherein a controlled spin is introduced to the bomb immediately upon release for a given pre-set period. As a result of this spinning characteristic the dispersion introduced by asymmetric properties of gro of bombs is partly cancelled, and the dispersion pattern is reduced considerably.

2. The tests at Wendover were concerned with testing the bombs to determine whether or not the bombs would spin for the desired period and then properly and automatically stabilize themselves at the end of the period. After these actions occurred the bombs were then ready for control in azimuth just as regular VB-1 bombs.

3. The results of these tests were extremely successful. The Spazons did spin for the desired, predetermined period. They did stabilize automatically at the end of the spin period. And the control available after this period was sufficient to move the bombs into the target area. For example, after a 15,000 foot drop, during which the bombs spun for 15 seconds, and 3 seconds were allowed for stabilization, 1,200 feet to 1,500 feet of azimuth control were still obtained.

4. Although not enough bombs were dropped to give a conclusive statement as to the dispersion effects of these bombs, at least a statement as to the tendency to decrease dispersion can be made. Camera pictures and ground measurements showed that the bomb groups remained in very close formation during the spinning period. The larger the spin interval, of course, the less dispersion there would be. Control would be reduced, however, so a compromise arrangement must be made. It is estimated that the bombs maintained spacings of 13 to 20 feet all through the spinning period. Strike photos of drops show dispersions of 70 feet to 300 feet. The best mission accomplished had an azimuth dispersion of 70 feet and a range dispersion 100 feet for a three-bomb drop. The average of the other missions was on the order of 300 feet in range and azimuth.

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
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PROD. CONT.
I. P. S.
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TECH. DATA
CIV. PERS.
OTHERS

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By ____ Signature and Grade MX-593
Date 12-1-48 CENTRAL FILES

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President, AAF Board, Orlando, Florida, Attention: Lt. Colonel, E.H. Nash.
"Request for Service Test Program for Spazon Bombs"
21 December 1944.

5. In the light of these results, it is easily seen that further evaluation of this missile is most desirable. It is requested therefore that a service test project be set up with the Army Air Forces Board at Orlando, Florida to accomplish mass drops with the facilities available there, in order to further evaluate the Spazon bomb with respect to its ability to reduce the pattern dispersion of mass drops of vertical controllable bombs. It is also requested that if this project is accepted, this command be informed as to the quantity of Spazon gyros and standard VB-1 units required for conducting complete tests.

6. It is recommended that this modification be used as a possible improvement with respect to moving patterns in azimuth in project Q-2822.

For the Director:

TECHNICAL STAFF
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Copies to:

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ARMY AIR FORCES
MATERIEL COMMAND

MEMORANDUM REPORT ON

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[illegible]/JRD/mep
Date [illegible] May 1945

SUBJECT: Vertical Controllable Bomb Type [illegible] (Azon).

OFFICE [illegible]

Contract or Order No.

SERIAL No. [illegible]-5-673-16-A-1

Expenditure Order No. 673-21

A. [illegible]

1. [illegible] the development of the Vertical Controllable Bomb Type [illegible] (Azon).

B. FA [illegible]

2. The [illegible] agencies were directly responsible for the development of the [illegible].

a. [illegible] Branch, Engineering Division, Air Technical Service Command, Major [illegible], Project Officer.

b. Section [illegible] of National Defense Research Committee, [illegible] [illegible].

c. Gulf Research & Development Company, contractor to [illegible], [illegible].

3. The purpose of this development was to design a bomb that could be controlled from the carrying aircraft after drop away to correct for the inherent sighting errors common to the best known practices at that time.

4. The project as originally set up [illegible] that a bomb be developed which would be controllable in both range and azimuth from the carrying aircraft. It naturally followed in this development that an attempt be made to control the bomb first in one axis only, azimuth being the [illegible] coordinate. Thus evolved the Vertical Controllable Bomb [illegible] which consists of a 1,000 pound general purpose bomb to which is attached, in place of the standard tail fin, a special Controllable Bomb Tail [illegible] A-1 with movable surfaces to control the trajectory in azimuth only.

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Memorandum Report No. [illegible]-73-16-[illegible]
5 May 1945

Confidential

Within the [illegible] are [illegible] equipment, servo motor mechanism for the [illegible] of the control surfaces, and radio receiver apparatus. [illegible] this device is visually tracked from a control air[illegible] in azimuth [illegible] by means of radio signals [illegible]. [illegible] are available [illegible] Technical Data Library, [illegible] Technical Service Command.

[illegible]

a. [illegible] compiled by the Historical Office, Air [illegible] Technical Service Command, [illegible] 1944.

b. For [illegible] see Appendix [illegible].

[illegible]

a. That the development of the [illegible] controllable bomb [illegible] 21 April 1945.

b. [illegible] is satisfactory [illegible].

[illegible]

a. It is recommended that the following action be taken by the organization [illegible]:

(a) [illegible] Technical Service Command, Equipment Laboratory.

(1) That Expenditure Order Number 673-21 be closed out.
(Action [illegible])

This Memorandum Report Closes out E. O. No. 673-21

Distribution: [illegible]

Prepared by
[illegible], Major, Air Corps

Approved by
[illegible], Lt. Col. A.C.
Special Weapons Branch

Approved by
[illegible], Colonel, A.C.
Chief, Equipment Laboratory
[illegible] Subdivisor

Concurrence: Engineering Division

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4. Any further information desired may be obtained through NDRC, Division [illegible] or through the Special Projects Section of the Office of the Air Communications Officer.

For the Commanding General, Army Air Forces:

R. M. McCLELLAND
Brig. Gen. US Army
Air Communications Officer

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C [illegible] C O P Y 1854 [redacted]

Secret by authority of
CG
10 Nov 44 WCT
Date Initials

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[illegible] Gross/ez/[illegible]
[illegible] November 1944

MEMORANDUM FOR THE CHIEF OF AIR STAFF:

Subject: Bazon Bombs

I. Purpose: To furnish information on the above subject as per your request made during a recent conference in General Arnold's office.

II. Discussion:

1. There are two types of Bazon bombs; the VB-3 and the VB-4.

a. The VB-3 is a thousand pound high angle bomb, controllable in both range and azimuth by means of direct control. A flare is used for visual perception. The tail surfaces and servo equipments are installed on the rear of a standard one thousand pound bomb. The development of this bomb is being conducted by NDRC and flight tests by the Materiel Command. Actual tests are being run at Tonopah, Nevada. The following resulted from eleven VB-3 drops:

	AZIMUTH	RANGE
Mean Point of Impact	0.3 mils	[illegible] mils
Probable error	[illegible] mils	[illegible] mils

Eleven drops are insufficient to fully evaluate the VB-3. However, the very greatly increased accuracy over the uncontrolled bombs [illegible] simultaneously with the VB-3 is most encouraging and as a [illegible] the Twentieth Air Force has made a request for [illegible].

b. The VB-4 is a two thousand pound high angle bomb which functions identically to the VB-3 described above, with the exception of the weight difference. This equipment is a development of NDRC and as yet, no experimental models have been constructed. Design work is temporarily suspended pending the results of the VB-3 test program.

[illegible] By letter dated [illegible] September 1944, signed by Deputy Chief of Air Staff, Brigadier General Hall, the AGC was charged with full responsibility for all phases of the controlled missile program to include requirements, developments, experiments, and procurement relating thereto. By paragraph 11, AAF Regulation 20-46, [illegible] October 1944, the Special Consultant to the Commanding General, Army Air Forces (Dr. Bowles) is granted directional authority over the AGC.

[illegible] Military Characteristics for guided missiles, including Bazon, have been established through mutual coordination of AGC, AC/AS, OC&R,

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Special Assistant for Antiaircraft, and AC/AS, MM&D. The military requirement for any special and specific article and the quantity procurement thereof must depend upon the relative value operationally of the article as compared to standard and more conventional types, etc. A[illegible] accuracy of the Razon type of missile may be offset by the [illegible] in bomb load per airplane and the additional operational [illegible] certain targets, incapable of being hit by the more conventional [illegible] will demand special types of missiles having a high degree of [illegible] unconventional trajectories, irrespective of any sacrifice in bomb load which must be made. Pending demonstration of the operational [illegible] of the Razon bomb, no quantity requirement has yet been established. The VB-4 being an adaptation to the two thousand pound bomb of the controlled equipment for the VB-[illegible], procurement of the VB-4 will follow immediately the establishment of the operational suitability of the VB-[illegible].

III. Recommendations:

Because of the great potential value of a bomb which can be controlled in azimuth and range in reducing the number of airplanes per target required and the recent encouraging results of tests, it is recommended that:

a. The procurement of [illegible] VB-4 tail assemblies be initiated immediately.

b. The initial procurement of [illegible] VB-4's be adjusted in quantity as necessary to provide for adequate tests and as may subsequently appear to be consistent with the results thereof.

/s/
[illegible]NALD WILSON
Brigadier General, U. S. Army
Asst. Chief of Air Staff
Operations, Commitments & Re[illegible]

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[redacted] [15 Feb. 1945]

B. PITTSBURGH PROJECT

(1) Summary of Work Previously Reported. The original objective of this project was the development of a high-angle bomb, transportable in existing standard bomb racks, and sufficiently controllable to convert present "near misses" into hits. Earlier research work under contract with M. I. T. and Gulf Research & Development Co. has now been concentrated at Gulf, with production engineering handled by Union Switch & Signal Co. as covered in Part 7 of this report.

Emphasis has been on tail assemblies which could be attached to standard general purpose bombs by the existing fin mounting threads. The simplest version, known as "Azon", consists of a tail with four fins, each of which contains a control flap. The horizontal pair of flaps are gyro controlled to prevent rolling, while the vertical pair are operated by radio from the dropping plane to steer the bomb in azimuth only. The bombardier uses a standard sight for range, and then lines up target and missile by visually following the path of a flare in the Azon tail.

This weapon exists in models for attachment to 1000 or 2000-lb. standard GP bombs, the complete units being known as Army VB-1 and VB-2 respectively. VB-1 is now in production on an Army order, and has already played a part in the campaigns in Italy and Normandy. The Section has made two men available as field technicians and cooperates on any engineering difficulties which develop. VB-2 has performed successfully in tests and is now being engineered for production as a Division headquarters project. 260

As a result of combat and test experience, work is in progress to reduce VB-1 dispersion when dropped in train. Encouraging results have been obtained by the AAF in releasing bombs simultaneously from several airplanes by automatic radio control. The entire salvo was then controlled by one operator, who attempted to steer the center of gravity of the pattern to the center of the target. A Gulf modification of VB-1, known as "Spazon", also shows promise. In this unit the bomb is forced to rotate continuously for approximately the first 20 seconds of its flight. Rotation is then stopped and control proceeds in the standard Azon manner.

A second version of the missile, known as "Razon", is controllable in both range and azimuth. In order to provide stability in this model, it has been found necessary to make the tail assembly octagonal in shape. Flaps in the horizontal and vertical surfaces of the octagon act respectively as elevators and rudders to steer the bomb, while ailerons on the 45° struts are gyro controlled to prevent rolling. Control is the same as with Azon except that a special bomb sight is necessary. A modification of the Norden sight, known as

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"Crab I", has been constructed by Section 5.5 in cooperation with Section 7.2, and has performed satisfactorily.

Initial drop tests using "Crab I" have been made of the Razon tail assembly attached to a 1000-lb standard GP bomb, the complete unit being known as Army VB-3. Results were quite encouraging, but it was believed that the design should be re-engineered to increase maneuverability. Accordingly a new model is being designed with an additional octagonal shroud about 8" long and without control surfaces mounted forward of the regular tail. Design of a larger version, identified as Army VB-4 when attached to a 2000-lb. standard GP bomb, is pending on the results of tests with the new VB-3.

The Razon type tail is also used on two target-seeking versions of the high angle bomb. The first, known as Army VB-5, consisted of a 1000-lb. bomb in a special shell housing a light-sensitive or photo-electric homing device. These units as tested also had a cylindrical stationary fin or shroud around the body of the bomb to improve stability. Results were quite successful, but this model to date has only been used for experimental purposes.

The other target-seeking model, "Felix" or Army VB-6, comprises a 1000-lb. standard GP bomb with attached Razon type tail and also a special nose assembly housing a heat-sensitive homing control. This device is furnished by Section 5.5 and is therefore more fully covered under Part E of this report. At the request of the Services a "crash program" was instituted to produce a considerable number of VB-6s for a special target. This program is discussed under Part E.

Razon type tails, together with the body shroud previously mentioned have also been used on bombs controlled by radio from target information furnished by television equipment mounted in the missile. These are designated in 1000 and 2000-lb. sizes as Army VB-7 and VB-8 respectively. Results were encouraging, but it is believed that wind-stream operated vanes or "ears" should be employed to aim the television camera into the direction in which the bomb is going. If so equipped the Section considers the missile is probably practical.

(2) <u>Progress Since Previous Report (12/15/44)</u>. The Section has continued to cooperate with the AAF Board at Orlando in the latter's tests to determine the characteristics of VB-1 at high altitudes and when mass-dropped in pattern. An analysis of the results of early tests with this missile is now in progress at Gulf and will be made available to the Board.

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(b) Progress Since Previous Report (12/15/44). Bendix continues to give good service in supplying modulators for ROC radio controls. Various minor troubles showing up during drop tests have been met by modifications as needed. Figs. 9 and 10 show two views of the amplifier and Fig. 11 a schematic diagram. Details of the power unit are shown in Figs. 12 and 13.

(3) Heat Homing

(a) Summary of Work Previously Reported. This Section has sponsored four heat-homing devices. One, developed at M.I.T. under Contract NDCrc-180, uses a rotary scanner which fits inside a false nose. This nose and a tail for control purposes are attached to a standard 1000-lb. GP bomb, the combination being known as "Felix", or Army VB-6. The Felix project had originally the status of a "crash" program, with forty units built for a comprehensive testing schedule.

Tests carried out jointly by Gulf and MIT at Tonopah demonstrated that the most satisfactory air frame for Felix was a model with single octagonal tail structure similar to the Mark I VB-3 Razon but with increased rudder and elevator surfaces. Early drops were largely unsuccessful due to mechanical and electrical difficulties rather than fundamental troubles. Minor alterations subsequently produced very satisfactory results, indicating an average error of about 100 feet for bombs released properly and in working order. Quite extensive target surveys are being made under this contract using an exact duplicate of the latest Felix scanner as used in the actual missile. The minimum detectable signal with this apparatus as measured in the laboratory is 0.4 erg/cm^2/sec., and should not be greater than 1 erg in flight.

The second heat homing device, using a to-and-fro scanner developed by Electro-Mechanical Research, Inc., has as yet no specific application. It has been proposed that this type be utilized in glide bombs or drones under radio control, with repeat-back of information from the vehicle to the control plane. Recent tests have aroused Army interest in its possible applications and further trials are now in progress at Wright Field. In the meantime, EMR is concentrating on the construction and improvement of bolometers for Felix.

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The third, under development by the Polaroid Corporation, is unique in that it operates only on the rate of change of the error angle, rather than on the error signal itself. It proposes to reduce this rate to a constant, of such a value that a collision course must ensue, resulting in a more satisfactory flight from many points of view than using a pursuit course. A grid rotated in front of the bolometer interrupts the signal, with the result that the frequency of the output is a measure of the rate of change of the error angle. This eye, planned eventually to be attached to the Douglas [illegible], has given moderate satisfaction in laboratory tests. Preliminary flight trials of a much-simplified version known as Model [illegible] are now in progress. A signal of [illegible] ergs/cm²/sec. is indicated as necessary for its operation, but a new Model [illegible] under construction is expected to reduce this figure to 1 erg.

The fourth is an adaptation of the Fairchild scanning system for service as a heat-sensitive eye to give proportional control to Felix.

The General Electric Company has developed a much simplified design and manufacturing process for Felix bolometers, and Cambridge Thermionic Corp. is now setting up for quantity production by this method.

(b) Progress Since Previous Report (12/15/[illegible]). Approximately [illegible] of the 150 hundreds Felixes have been completed. Production engineering for the group of [illegible] is nearly complete and fabrication of some parts has started. The test program [illegible] has been [illegible] for by [illegible]. The procedure simulates combat conditions as closely as possible. Assembly and ground check are [illegible] by [illegible] men in a partially roofed hangar and missions are run by [illegible] from [illegible] with an [illegible] [illegible] as observer.

Among the first [illegible] the 50 [illegible] tested [illegible] there was a very large proportion of failures. The reasons for these failures appear to have been discovered and corrected although this is not yet conclusively proved. The causes fall into two groups, insufficient protection against the high humidity prevailing at [illegible],

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and inadequate factory inspection procedures. The majority of the bombs which worked properly registered close hits, i.e., within 200 feet of the thermal center of the target. Those which worked properly internally but did not register close hits apparently were affected by the dispersed pattern of thermal radiation from the target.

The particular arrangement used was chosen to simulate an actual combat target which often extends over a large area and contains a number of individual heat sources. Fig. 15 shows an airplane view of this target. It was expected that by lighting only one set of burners a point target would result which would be satisfactory for tests requiring essentially a point source of radiation. The heat surveys and results of the drops did not bear this out, so that none of the drops so far have been made against a truly unique heat target. Work is in progress to establish a satisfactory point source target at the same location. NDRC's part of the program will continue until it is felt that all of the difficulties within the bomb itself have been corrected and that the nature of the target under all weather conditions is known. When these factors have been well established, the balance of available Felix bombs will be turned over to AAFTAC.

During the past two months the target survey instrument has been tied up most of the time on the Orlando program. A small number of surveys have been made, however, in the Boston area. The few factories which were surveyed gave bigger signals under prevailing

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winter conditions than they did during October. Surveys were made with snow on the ground. Analysis of all of the October survey data by the Applied Mathematics Panel is now complete and a report is partly written. The preliminary report on this analysis has been issued as AMP report No. 127.5R. Figs. 1[illegible] and 1[illegible] show the Felix survey instrument, described in the October 1[illegible] report, with which this work was done.

More work has been done by the Electro-Mechanical Research Group on fundamental improvement of their bolometers. They have determined that sensitivity is not lost at low ambient temperatures. Tests of substitute metals have been fruitless. Formvar was finally made to yield supporting films which will withstand elevated temperatures much better than cellulose nitrate.

This contract is being allowed to expire with the completion of this work. The Army has asked that the contractor submit a proposal for building more of his heat seeking controls for glide-bombs under a direct purchase order. It is believed that the development work under Section 5.5 has produced a device which should be of use to the Army.

Polaroid is engaged in [illegible] the Type II Model F ever mentioned in the last report. The major change has been to increase the scanning rate to [illegible] revolutions per second. Microwave [illegible] and [illegible] continue to [illegible] this program, but [illegible] held out [illegible] early completion of Model F with all its associated equipment for flight testing. Drop tests are still scheduled for

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F. GENERAL PROJECTS

(1) Summary of Work Previously Reported. As the weapons developed by Division 5 have approached closer to combat use, projects have been instituted to engineer the various devices for production. These projects are administered by Division headquarters personnel in conjunction with engineers made available under contract with M.I.T. The work is carried on in close cooperation with the Sections in which the development originated and with the OSRD Transition Office to cover the necessary modifications between a working laboratory model and a design suitable for quantity production. This procedure was followed for VB-1 and is now in operation for VB-2, VB-3 and VB-6.

Under this program a tail fuze has been added to VB-2 to supplement the original nose fuze for greater reliability of detonation. A shorter flare has been developed by Army Ordnance which permits loading the missile into the bomb bays of the B-17 and B-24 airplanes. Also, a new battery has been designed with approximately 2-1/2 times the capacity of the existing one and having a much greater shelf life, suitable for VB-1 and VB-3 as well as VB-2. Initial drop tests of the latter missile at Tonopah were quite successful, and the test program is now being continued by the AAF board at Orlando.

Work on the VB-3 1000-lb. Razon has been proceeding at a retarded pace pending tests with a modified design produced under Section 5.2. A total of 150 units will be constructed, part of which will be tested by NDRC at Wendover and the balance by the AAF board at Orlando. At the request of the AAF, the Division has instituted a crash program for the production of 1000 VB-3s pending the preparation of formal Air Force specifications. It is understood that this contract will be taken over by the AAF as soon as is practicable.

Successful tests of VB-6 at Tonopah resulted in a similar request by the AAF for 1000 of these missiles, and a contract has been instituted on the same basis as for VB-3. Tests of handmade prototypes of the production design constructed under another NDRC contract will be made at Orlando.

[redacted]

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OFFICE FOR EMERGENCY MANAGEMENT

OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

1530 P STREET NW.

WASHINGTON 25, D. C.

May 10, 1945

Dr. Robert L. Stearns, Chief
Operations Analysis Section, 20th Air Force
Army Air Forces Headquarters
The Pentagon
Washington 25, D. C.

Dear Dr. Stearns:

In accordance with our conversation on Tuesday I have prepared the following material and collected some inclosures covering the three guided missiles available or about to become available for combat use. This information will, I think, be of interest to your personnel with the 21st Bomber Command.

VB-1 (1000 lb. Azon)

This missile has been comprehensibly described in a report of the Air Forces Board of 2 March 1945, No. 4386-[illegible]-471.6 entitled, "Preliminary Report on Test VB-1 (1000 lb. Azon Bomb)." In addition, reports of its use in combat have been made by Mr. David Mayer, Operations Analysis Section of the 10th Air Force, and motion pictures of its use by that Air Force have been widely circulated. I believe the headquarters of the 21st Bomber Command has a copy.

This bomb is designed for operation against important targets which are relatively long and narrow. A flare on the tail makes the bomb visible throughout its flight and it is guided in the azimuth direction by remote radio control. The results from the first 459 bombs used by the 10th Air Force resulted in the destruction of 27 bridges, an expenditure of 17 bombs per bridge.

In using this bomb it is necessary for the airplane to continue its flight over the target. A moderate climb or a dive is permissible, however, for the purpose of evading opposition. As the following table shows, the most striking benefit from the use of this weapon occurs when they are dropped singly and individually guided. This has been the general practice in the 10th Air Force where the targets attacked have been bridges of approximately fourteen feet width. For wider targets the Air Forces Board recommends the use of close trains or salvos if repeated runs are not tactically practicable.

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Bombs Dropped	Effectiveness
Six 1000 lb. GP	1
One VB-1	4-6
One VB-1, plus five 1000 lb. GP in salvo	4.7-6.7
Six VB-1 in salvo	5.2-9.2

This weapon has been in production and is now in moderate production. Requirements of twenty-five hundred per month have been set up by the 10th and 14th Air Forces, and stocks on hand plus the present production will take care of this requirement. Production could be readily expanded.

VB-3 (1000 lb. Razon)

This weapon is similar to the Azon except that it is visually guided in range as well as in azimuth. We are sending herewith a 16 mm sound movie describing this missile. The guiding is done by means of an attachment to the bomb-sight consisting of a small half-silvered mirror which projects the image of the flare on to the field of view of the bomb-sight at the point where the bomb would fall were no further control added. The accuracy in the range direction obtainable with the modified bomb-sight depends upon the accuracy of the estimated time of flight of the bomb. If a radio altimeter is used an average range error of 10 mils should be feasible.

Thus far the guiding has been done by two operators; one man guiding in azimuth as in Azon, the other guiding in range through the bomb-sight. Tests are now in progress to determine what effect on accuracy will be if the guiding is done by a single operator. Preliminary studies indicate that the effect will probably not be serious.

As in the case with Azon the bombing run must be continued and the test program just referred to will attempt to place limits on the amount of evasive action which can be taken between the point of release and the instant of impact. Preliminary analyses indicate that the turn resulting from a sixty degree bank and/or a ten degree dive or climb will be permissible without serious interference with accuracy.

The Razons tested so far have had a mean error of 150 feet in range and 18 in azimuth, compared with 580 and 354 for standard 1000 lb. bombs released simultaneously from 15,000 feet.

It is expected that the NDRC phase of the testing with this weapon will be complete before the end of May, and that the Air Forces Board will immediately start evaluation. Three thousand units are on order and delivery is expected to start in July.

VB-6 (Felix, 1000 lb. Heat Seeking Bomb)

This bomb contains a thermo-sensitive element in the nose which scans a twenty degree conical field in front of the missile, and through a servo mechanism steers the bomb to the hottest spot in the field of view. We are

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JOINT TARGET GROUP

PHYSICAL VULNERABILITY SECTION

Japanese Targets Suitable for Attack with Razon and Felix. (1)

1. [illegible] Felix is a 1000 lb. GP bomb fitted with an electronic device which causes the bomb to home on a target which is giving off a sufficient quantity of heat. This may be due to internal heat as in the case of blast furnaces, coke ovens, etc. or may be the result of the reradiation of solar heat from large [illegible]. The bomb is dropped by means of a Norden sight in the customary fashion and requires no control from the aircraft after release. Reliable estimates of the accuracy will not be available until current trials at the AAF Board are completed.

2. "Felix" is constructed in a fashion which causes it to home on the center of gravity of the heat radiation which comes into its field of view. The location of this point, known as the "heat center", depends upon the character of the target and its surroundings. If these are very similar from the point of view of their heat radiation, the performance of the bomb will not be reliable. This means that small to medium sized plants located in densely built-up urban areas are not suitable targets. In case the surrounding terrain is not homogeneous and includes substantial quantities of water, plowed fields, mountains, etc. difficulties arise owing to the deflection of the heat center from the target by the irregularities of the heat pattern radiated by the surroundings. In particular, targets along [illegible] a water front are doubtful targets (2) unless they are almost completely surrounded by water, in which case they are excellent targets. Targets located in the middle of a completely burned out urban area are not expected to be suitable because of the reradiation of the surrounding ashes.

3. [illegible] statements can be made regarding the size of target against which Felix will have the greatest comparative advantage over standard bombs. Small targets (without intense internal heat) will be unsatisfactory because they will [illegible] little heat to control the bomb. Against very large targets the comparative advantage of Felix will tend to be less because a higher proportion of hits will be scored with standard bombs. It is, however, possible that Felix will seek out buildings in large targets, in which case it would have an advantage even though all standard bombs can be placed in the target site area.

4. According to present information, eight Felix bombs can be stowed in a B-29. It is therefore necessary for Felix to be about twice as effective as standard bombs before any advantage accrues from its use unless standard bombs can be stowed in other stations. (3)

5. An analysis of the more important target systems in Japan leads to the following remarks concerning the possible use of Felix in that theater:

a. Aircraft. All important aircraft plants are excellent targets except those near waterfronts. Of targets on which JTG Target Information Sheets have been prepared, only 90.20-[illegible] is ruled out on this account. Most of the new plants are located in outlying regions and constitute ideal targets for "Felix". The older plants located in the cities are sufficiently large and concentrated to be good targets in spite of the urban background. Firebreaks cut by the Japanese around these plants increase their value as a target for Felix.

c. Power. Since all steam plants are located on water, they are not recommended for "Felix" on the basis of present knowledge. A heat survey of some [illegible] steam plants will be carried out to obtain more precise information regarding this system. Hydro plants are located in mountainous regions which causes them to be excluded.

d. Arsenals. The quality of arsenals as a target depends almost entirely on their location; those in cities are generally poor targets, and those [illegible] are good targets. Some, however, are so large and so well [illegible] that the relative effectiveness of Felix could not be great. By way of [illegible]

Good	Doubtful to bad	
	[illegible]	surroundings too closely built-up
[illegible]	84.[illegible]	bad background
[illegible]	90.27-522	too near water
[illegible]	90.[illegible]	bad background
[illegible]		

d. Navy Yards. Coverage is available only on the Yokosuka Navy Yard. Because they are almost surrounded by water, the concentrations of buildings centered around buildings [illegible] respectively are excellent daytime targets.

e. Steel. In general steel plants are good targets because of the large amount of internal heat present. A high concentration of hits could be expected on blast furnaces, and coke ovens. This makes them especially good targets [illegible] those in Japan and Manchuria, all are good except 90.31-16[illegible] which [illegible] small and too near the water.

f. [illegible]. These plants are too small and too similar to their surroundings to be good targets.

g. Machine Tools. These behave like Arsenals with regard to "Felix", except that many are too small to radiate sufficient heat. Of those for which photographs are now available in the Air Target System Folder only one, 90.17-[illegible], is considered good. The others are either too near the waterfront, or cannot be distinguished from their background.

h. [illegible]. The known plants are either too small, too similar to their surroundings, or too near water. None are good targets. Others which are suitable targets may be found.

i. [illegible]. No targets of this sort have ever been surveyed, so [illegible]. There are no large roof areas present, and it is not known whether the internal heat is sufficiently intense.

[illegible] Razon, is a 1000 lb. bomb which is guided in both range and deflection toward its target by an observer riding in the aircraft which released [illegible]. In the present state of development only one bomb can be controlled by [illegible], which means that only one Razon can be released in a single pass by one aircraft. If the aircraft can carry eight 1000 lb. standard bombs, for example, this means that the accuracy of Razon against a given target must be at least eight times that of standard bombs before there is any advantage per aircraft. [illegible] take account the need for a definite advantage on the [illegible] before it can be recommended, this means that Razon should be used [illegible]

[illegible] against only those targets on which [illegible] is expected to be [illegible] than the percentage [illegible] standard bombs. On the basis of present information, this will be true if the target lies within a square whose side is less than 500 feet. This figure, however, is subject to variation with the type of aircraft to be used and the accuracy of bombing. It should therefore be regarded as an order of magnitude rather than a precise figure.

[illegible] Targets suitable for attack with [illegible] include the following:

a. Any target suitable for [illegible]. Targets included here are bridges, causeways, roads, and railroad lines. The improvement over [illegible] will be [illegible] except for short bridges and [illegible] less than [illegible], but there are many important bridges of this size in the [illegible] Islands.

b. Power plants. These all fall within the [illegible] square mentioned above, and consequently are [illegible] for [illegible] attack. In fact [illegible] is the only weapon which appears to be efficient against power plants when dropped from high altitude.

c. [illegible] ovens, blower houses, [illegible] houses, rectifier buildings in aluminum industry and similar small but critical components of larger plants are [illegible] targets.

d. Electronics industry. The [illegible] in this industry are [illegible] target size for [illegible], but would require numerous [illegible] with [illegible] [illegible] the [illegible] and are all in heavily defended areas.

[illegible]

[illegible] targets.

[illegible]

[illegible] This report is [illegible] on preliminary [illegible], and should be evaluated as [illegible].

[illegible] Target Group

This analysis [illegible] targets [illegible] within [illegible] of a [illegible] are [illegible] targets [illegible]. The surveys have shown [illegible] target [illegible] to [illegible] but covers a [illegible] area [illegible] most important [illegible] from the [illegible].

[illegible]

[illegible] from [illegible] for [illegible] dropped [illegible] in addition.

[illegible]

HEADQUARTERS ARMY AIR FORCES

1627

ROUTING AND RECORD SHEET

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TALLY NO	RDB
FILE NO	(4)

SUBJECT: Controlled Missiles

TO: AC/AS, OCR, Requirements Division

DATE 29 Mar 45

COMMENT No. 5

Lt Col Norvell/jo/

FROM: Air Communications Officer, Equipment Division

1. Reference is made to paragraph 4, Comment 4, requesting the status on projects VB-3, VB-4, VB-6 and JB-2.

a. VB-3 - It is expected that the first tests of the production models will be made at Wendover beginning 15 April. Operational use cannot be contemplated before about 1 June, after Army Air Forces Board tests at Orlando.

b. VB-4 - No action will be considered for production of VB-4 until VB-3 tests are completed.

c. VB-6 - Is still being tested by NDRC and upon completion of their tests, the Army Air Forces Board will conduct their portion of the tests on the equipment. Recent drops indicate that the equipment is functioning fairly well. However, a more exhaustive study of targets applicable for Felix use is necessary. NDRC [redacted] already made a preliminary target survey and plan to use the month of April fo[redacted] a complete analysis of suitable targets. At the present time, it is estimated that Felix may be in operational use, at the earliest, by July '45.

d. Electronic control for the JB-2 buzz bomb - A quantity of 2,050 experimental models of the AN/APW-1 are now on procurement and the first three models have been delivered to Wright Field and an additional order has been initiated for the production of 10,000 beacons which will be patterned after the AN/APW-1 but will include many improvements such as coding and operation in both "S" and "X" bands. The AN/APW-1 type of control beacon for use with the JB-2 should be ready as soon as the other components are delivered for operational use.

2. Summarizing the above future plans for these projects insofar as Air Communications Officer is concerned include only the developmental and experimental work and will not extend into the operational field. It is indicated that the primary functions of Air Communications Officer on Felix will be completed by July 1945; Razon, September 1945; electronic components for JB-2 and other missiles, continuing into 1946.

AFACO-E/SP
AFACO-E

R. A. Mondell
Colonel, Air Corps

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

MEMORANDUM REPORT ON

AN:ms:54

SUBJECT: Testing Light and Heat Responsive Devices.

Date December 9, 1941

SECTION.....Experimental Engineering

SERIAL No. EXP-M-54-673-68.

Contract No. ....
Expenditure Order No. 673-1-15
Purchase Order No. ....

DATE
CHF. DIV.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
PROD. ENG.
CONTRACT
INSP.
F. S. S.
I. P. S.
OTHERS

A. Purpose.

To report on the necessary means and conditions for testing light and heat responsive devices being developed on project MX-109.

B. Factual Data.

1. A number of preliminary tests on a Weston light responsive device and on an Eppley thermopile - Offner amplifier combination as a heat responsive device have been made on land and water targets.

2. The variations of light over land referred to as "background" are in general considerably in excess of the effect of targets except for relatively short distances (about 2000 feet or less) and large objects (factory building) in open country.

3. The variations of heat over land is large both in daytime and at night and will require considerable exploration to determine conditions under which heat responsive devices could operate.

4. The tests show considerable promise for successful use of both light and heat devices for over-water operation. The light responsive device can possibly be used in daytime while heat devices could be used at night.

5. Additional testing is needed to determine the following factors:

a. The weather conditions most suitable for operating light and heat responsive devices.

b. The correcting elements (such as light filters) most suitable to permit the use of light responsive devices.

c. The effectiveness of different types of circuits and devices in balancing out the "background" effects.

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Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-68
December 9, 1941

d. Comparative effectiveness of different types of devices under standardized test conditions.

e. Comparative effectiveness of different types of devices under working conditions of "background".

f. Comparative effectiveness of different types of devices under actual operating conditions.

g. The limitations and possibilities of various systems of light and heat responsive devices at night or in the daytime.

6. The following methods of testing have been considered:

a. Laboratory tests including a set up of uniform background conditions (constant temperature wall for heat tests and constant illumination screen for light tests) for standardized targets and for checks of apparatus on motion pictures of actual operating conditions. These tests will provide information on factors outlined in paragraphs 5 c and 5 d above and possibly 5 g.

b. Fixed location outdoor tests. The location for such tests should provide high elevation over water background - preferably a skyscraper or tower overlooking a large body of water. The elevation is needed to secure the correct downward angle to a distance of one or two miles. The large body of water is needed to determine the effect of sunlight and sky coloring in different directions. A sufficient frequency of targets such as large boats must be present. Such a location will permit exhaustive study of the operation of devices under conditions similar to actual operating conditions yet with means of checking test results and observing the effects of corrections. It will also be possible to set up automatic recording devices to register the variations of day and night "background" to determine the most suitable operating periods. These tests will provide information on factors outlined in paragraphs 5 a, 5 b, 5 c, 5 e and 5 g. The following alternative locations have been considered:

(1) Federal Building, New York.
(2) Cape Henry lighthouse
(3) Room in some Chicago or Detroit skyscraper.
(4) A tower to be erected near the St Clair river.
(5) Golden Gate Bridge in San Francisco.

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All except (3) and (4) have the disadvantage of being quite far away. The Federal Building in New York overlooks the Hudson River only and would give quite limited background information. The Cape Henry lighthouse is somewhat too far from the traffic lanes of ships. The erection of a 300 foot tower near the mouth of the St. Clair river would give ideal test conditions but would involve delay and expense. An office in a Chicago or Detroit skyscraper, overlooking the Lake near the point of entry of cargo ships would meet all the requirements of background, elevation and ship traffic needed for these tests.

c. Airplane tests: These tests include gliding at different types of targets and recording the operation of relays. They include also night tests on the possibility of illuminating targets by invisible light and operating suitable infra-red or ultra-violet responsive devices. These tests will provide information on factors outlined in paragraphs 5 f and 5 g as well as a check on the results of other tests.

C. Conclusions.

1. That light and heat responsive devices show considerable promise in the preliminary tests.

2. That the limiting factor is the variation in "background" radiations.

3. That over-water operation should receive intensive study and testing.

4. That contemplated laboratory facilities are needed but they will not give sufficient information on actual operating conditions.

5. That fixed location outdoor testing of working conditions and operating devices is needed.

6. That although airplane testing is essential, it is suitable neither for continuous testing of "background" conditions nor for the study of correcting devices such as balancing circuits and radiation filters.

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December 9, 1941.

D. Recommendations.

1. That a fixed location test station be established as early as feasible in a high building overlooking the Detroit water front.

2. That means be provided at this fixed location for automatically recording the "background" radiation conditions.

A. NYMAN, Major, A. C.

RANDOLPH P. WILLIAMS, Lt.Col., A.C.
Equipment Laboratory

FOC
F. O. CARROLL, Lt. Colonel, A. C.
Chief, Exper. Engineering Section

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MX-109

Chief, Mat. Div., Att: Exec.
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ARMY AIR FORCES
MATERIEL CENTER

MEMORANDUM REPORT ON RWH:hle:54:1759

Date July 31, 1942

SUBJECT: Heat Sensitive Device.

SECTION Experimental Engineering

SERIAL No. EXP-M-54-673-5-I-1

Contract No. ....
Expenditure Order No. 673-13
Purchase Order No. 42-2254

A. Purpose:

To report the results of tests on the third model of Offner heat sensitive device at 18 West Street, New York City.

B. Factual Data:

1. Tests were carried out on July 7th and 8th on the third model of Offner heat sensitive device.

2. Present during these tests were:

Materiel Center:
Lt. Col. A. Nyman
Mr. R. W. Hommel

Offner Electronics
Dr. Franklin Offner

Eastern Procurement District
Capt. E. B. Sundburg

National Defense Research
Dr. Grondahl
Dr. Molnar
Mr. Wyckoff

3. A series of tests were carried out with this model of heat sensitive device. The tests were conducted at the test station on the 35th floor of 18 West Street, New York City. The device was set up on a tripod, the head of which was controlled by two servo-motors. These servo-motors respond to impulses from the heat sensitive device to keep it pointing at the target. Ships on the Hudson River were used as targets.

4. This device was first tested during the late afternoon of July 7. The device centered on the reflection of the sun from the

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Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-5-I-1
July 31, 1942

river and not on the moving targets. After sunset the device worked very satisfactorily following ships of various size. A pliofilm sheet was tried as a protecting cover. With this cover the device would not follow a target accurately.

5. On the morning of July 8 further tests were made with this device. Good results were obtained until the sun got to such an angle as to give a bright spot on the river. From then on the device centered on the spot.

6. The weather conditions during these tests were as follows:

(a) Sun with slight haze during daylight hours.
(b) Clear, no moon during night.

7. The representatives of N.D.R.C. expressed interest in the device in regard to testing it on a falling bomb. The following conditions were specified:

(a) Device to give ten correcting impulses per second.
(b) The model to be mounted in gimbals.
(c) The length not to exceed twelve inches.
(d) A rock salt window to be used to protect the thermopile from the air stream.

Dr. Offner agreed to meet these conditions; the rock salt window to be furnished by the Materiel Center. To observe the action of this device when directed toward a marine target, the following test was evolved:

> Place this device in a gimbal mounting. Provide servo-motors to control the movement of the device. Install this set up in a test airplane. Fly over water and observe whether this device would follow a marine target.

C. Conclusions:

1. That Dr. Offner has in this model a workable heat sensitive device.

2. That a pliofilm cover reduces the sensitivity of the device.

3. That this device can be used by N.D.R.C. for tests in connection with their high angle bomb project AC-36.

4. That tests from an airplane would determine the suitability of this device for high angle bomb.

[redacted]

MDAC-266-WF-6-27-41-60M sets of 2

AC-36
7-3/3P
NDRC

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Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-5-1-1
July 31, 1942

D. Recommendations:

1. That the Offner Electronic Company complete this model using a rock salt window as a protecting cover and provide gimbal mounting.

2. That facilities be provided to test this device when completed in a test airplane. (Action to be taken by the Materiel Center).

3. That slight changes in design be carried out on future models by Offner Electronic Company to adopt this device to the N.D.R.C. requirements for their high angle bomb.

Prepared by R. W. HOMMEL (Name)

W. P. Lester
1st Lieutenant Air Corps
Equipment Laboratory

Approved by ~~G. V. HOLLOMAN, Col. A.C.~~ for W P Lester
Chief, Equipment Laboratory

Concurrence:

Approved by F. O. CARROLL, Col. A.C. Simmons, Maj A.C.
Chief, Exp. Engrg. Section

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MX-109

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EX6037

Reference:A:ms:4

August 20, 1942

MX-109

Gulf Research and Development Company,
Pittsburgh, Pennsylvania.

Gentlemen:

Reference is made to a suggestion by Mr. Wyckoff and Dr. Grondahl of your Company that experiments may be conducted on controllable bombs being developed by your Company for the National Defense Research Committee utilizing heat sensitive devices.

Such a device, manufactured by Offner Electronics, was demonstrated to your representatives at the Materiel Center Test Station in New York City on July 7, 1942. Subsequently this device was tested on an airplane. It was mounted to follow heat emitting targets below the flying airplane. The device operated satisfactorily over marine targets on Lake Erie at elevations up to 10,000 ft.

It is the opinion of the Materiel Center that the device as at present available, protected with a rock salt window, could be tried out on your bomb.

It is suggested that aerodynamic tests be conducted through your Company on the rotating thermopile and mirror without the rock salt window. These parts mounted for test can be furnished at request by Offner Electronics, 1133 East 63rd Street, Chicago, Illinois. The tests could be carried out at Langley Field either on the 750 m.p.h. 24" high speed tunnel or in the 550 m.p.h., 8' high speed tunnel. These tests are important in view of the difficulties encountered when manufacturing rock salt windows of the size required.

It is requested that the Materiel Center be informed with respect to any action you may take on this subject.

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MX-109

PROJECT NO. ......

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DATE
CHF. DIV.
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Gulf Research and Development Company,
August 20, 1942.

It is also requested that in case your organization can utilize the Offner heat sensitive device, that the subject of mounting this device in the bomb receive immediate consideration by your Company and that its details be worked out in cooperation with Materiel Center personnel.

Very truly yours,

F. O. CARROLL,
Colonel, Air Corps,
Chief, Experimental
Engineering Section.

[redacted]

PROJECT NO. MX-109

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The following extract from NDRC PROGRESS REPORT—FELIX, dated 1 June 1944, is quoted to show the early phases of the development prior to the Army Air Forces' interest in the project:

"The development of the bomb itself started under Contract OEMsr-240 at the Massachusetts Institute of Technology and continued under Contract NDCrc-183 at Gulf Research and Development Company. The combination of M.I.T. heat-homing control and Gulf high-angle bomb has been given the name "Felix." This type of bomb can be carried in the bomb bays of standard bombers and is ordinarily dropped with the use of a bombsight in the same manner as a free falling bomb. Its aerodynamic surfaces are small, and consequently it is less maneuverable than most other types of guided missiles. However, due to the accuracy of aim at time of release and to the short time of fall, great maneuverability seems unnecessary.

*** *** ***

"By May, 1943, sufficient promise was indicated to justify starting design for actual drop tests. It was decided that six units would be enough for a satisfactory initial test. Gulf Research was to make the bomb structures and we (Div. 5 of NDRC, MIT) were to provide the internal gadgetry.

*** *** ***

"By September, 1943, one of the detecting units designed and built for actual bomb control was flight-tested, and this initial test was followed by several more flights over land targets in a search for a particular type of land target which would be suitable.... During these preliminary flights over land the gadget showed promise for actual combat use on certain types of land targets. The six heat-homing bombs were completed December 15, 1943, and went to Eglin Field for test."

[redacted]

Felix
33-(10-1944)
Central File
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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON (AFDMA-2C)

SUBJECT: Procurement of VB-6 "Felix" Equipments for 1000 lb. Bombs.

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

ATTN: Office, Chief of Administration (TSTEX)

Commanding General
Air Forces
10 NOV. 1944 MCD
Date Initials

1. A requirement for one thousand (1000) VB-6 "Felix" equipments for 1000 lb. bombs has been received by this office.

2. It is directed that the Air Technical Service Command take the following action:

a. The assignment of sufficient funds to the National Defense Research Committee to procure one thousand (1000) VB-6 "Felix" equipments for 1000 lb. bombs. This procedure is necessary since testing, and possibly development, of this item are not complete and it is necessary to make available at the earliest possible date sufficient VB-6 equipments for AAF Board tests, tests by the Navy, and the start of service tests in the theaters. A request to the N.D.R.C. for this procurement of one thousand (1000) VB-6s has been initiated by this office through the War Department Liaison Officer for the N.D.R.C.

b. The preparation by the Air Technical Service Command for prompt procurement of further quantities of the VB-6 "Felix" equipments, in case further requirements become apparent for this device.

3. The following conditions are to apply to the A.T.S.C. preparation for procurement:

a. The determination of N.D.R.C. delivery schedules and the potential deliveries that could be secured, without further expansion of facilities, after the completion of the N.D.R.C. order.

b. The securing of drawings and specifications, necessary for further procurement, of all items involved in the VB-6 "Felix" equipment.

4. The A.T.S.C. is to take necessary action to insure that components and materials from the cancellation of the VB-1 Azon tail procurement are to be used as much as can be considered practical in the N.D.R.C. procurement.

5. It is further directed that prompt information be forwarded to this

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or changed to
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By CO-356
Signature and Grade
Date V-1-45

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To "Restricted"
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Subj: Procurement of VB-6 "Felix" Equipments for 1000 lb. Bombs. (Cont'd)

office on the following:

a. The schedule for the 1000 VB-6 and the potential follow-on schedule that could be secured.

b. The spares considered necessary.

c. The test equipment and tools considered necessary for the use of the VB-6 "Felix" equipment.

By command of General ARNOLD:

J. F. Phillips

J. F. PHILLIPS
Colonel, Air Corps
Chief, Materiel Division,
Office, Asst. Chief of Air Staff
Materiel and Services

[redacted]

Y-88188

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ATSC Form No. 00-606 (1 NOV 44)

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AUTH Air Tech Svc Cmd
DATE 11/18/44
INITIALS HFM

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

HFM:cjt:TSTEX

mx225

TECHNICAL INSTRUCTIONS

Wright Field, Dayton, Ohio
18 November 1944

Serial No.: TI-2003, Add #510

Subject: Procurement of VB-6 "Felix" Equipments for 1000 lb. Bombs

To: Procurement Division
Engineering Division
Supply Division

MX-225

1. Problem Presented:

a. To transfer sufficient funds to the National Defense Research Committee to cover procurement of 1000 VB-6 "Felix" equipment for 1000 lb. bombs.

2. Factual Data:

a. A requirement for 1000 VB-6 "Felix" equipments for 1000 lb. bombs has been received by the Office, Assistant Chief of Air Staff, Materiel and Services.

b. The assignment of sufficient funds to the National Defense Research Committee to procure 1000 VB-6 "Felix" equipments for 1000 lb. bombs is necessary since testing and possibly development of this item is not complete and it is necessary to make available at the earliest possible date sufficient VB-6 equipments for AAF Board tests, test by the Navy, and the start of service tests in the theaters. A request to the N.D.R.C. for this procurement of 1000 VB-6's has been initiated by the Office, Assistant Chief of Air Staff, Materiel and Services, through the War Department Liaison Officer for the N.D.R.C.

c. This Command is to plan and make the necessary preparation for prompt procurement of further quantities of the VB-6 "Felix" equipment in case further requirements are established for this device.

d. The following conditions are to apply to the planning and preparation for possible future procurement:

(1) Determination of N.D.R.C. delivery schedules and the potential deliveries that could be secured without further expansion of facilities after the completion of the N.D.R.C. order.

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Date 11-1-45

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1605 —

H cjt:TSTEX
Wright Field, Dayton, Ohio
18 November 1944

Serial No.: TI-2003, Add #5

Subject: Procurement of VB-6 "Felix" Equipments for 1000 lb. Bombs

To: Procurement Division
Engineering Division
Supply Division

(2) Obtain drawings and specifications, necessary for further procurement of all items involved in the VB-6 "Felix" equipment.

e. Components and materials from the cancellation of the [illegible]-1 azon tail procurement are to be made available and used as much as considered practical in the N.D.R.C. procurement.

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 10 November 1944, subject as above, from, Chief, Materiel Division, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Engineering Division take the necessary action to cooperate with the N.D.R.C. on the development of the VB-6 "Felix" equipment and obtain and furnish to the Procurement Division all drawings and engineering data that may be required by the Procurement Division in the event further procurement of subject equipment is directed. In addition the Engineering Division will furnish to the Supply Division all information necessary to enable the Supply Division to determine spare requirements and the testing equipment and tools considered necessary for use of the VB-6 "Felix" equipment.

b. That the Procurement Division take the necessary action to plan and make preparations for prompt procurement of additional quantities of the VB-6 "Felix" equipment in case additional requirements are established. In addition the Procurement Division will determine the delivery schedule for the 1000 VB-6 equipments and the potential follow-on schedule that could be secured and forward this information through this office to the Office, Assistant Chief of Air Staff, Materiel and Services.

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HFM:cjt:TSTEX
Wright Field, Dayton, Ohio
18 November 1944

Serial No.: TI-2003, Add #5

Subject: Procurement of VB-6 "Felix" Equipments for 1000 It. ...s

To: Procurement Division
Engineering Division
Supply Division

c. ... that the Supply Division take necessary action to determine spare requirements and test equipment and tools considered necessary for the use of VB-6 "Felix" equipment and furnish this information through this Office to the Office, Assistant Chief of Air Staff, Materiel and Services.

By Command of Lt. General KNUDSEN;

HF Mullins Insp AC
for T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Maintenance Division

Incl.
Orig. Hqs. Wash. ltr. dtd. 10 Nov. subj. as above.

By CD-353
Signature and Grade
Date 11-1-45

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C. LOS ANGELES PROJECT

(1) Summary of Work Previously Reported. This project began and is now under contract with the Douglas Aircraft Company to develop a radar-homing bomb. The design is unusual, having three or four symmetrically arranged wings of known section and a correspondingly finned tail, the fins of which may be either co-planar with the wings or spaced midway between them. Four designs are possible: Xx, X+, Yy, and Yλ. Wind tunnel tests on full scale models show all are feasible but slightly favor Yλ.

Fuselage and wings are both of hollow cast magnesium, measuring over-all about 77 in. diameter by 100 in. long. The structure is designed to contain either a 12 in., 1100 lb. or a 14 in., 1600 lb. armor-piercing bomb, with space forward for the radar-homing device and aft for power supply. Servo motors actuated by the homing device are mounted in the wings and drive full-length controlling surfaces thereon. The tail has no elevators or rudders, but has flaps attached to the fins which act as a brake to hold the maximum velocity to 800 ft. per second. Carried outboard, a single bomb imposes a burden of 30 h.p. on the airplane engine at 300 m.p.h.

This appears to be the only vehicle which can successfully employ any type of homing device and is considered most promising. The glide bomb flies at such flat path that it is ill-adapted to photo-electric or infra-red homing, due to the distraction of the horizon. The high-angle bomb has so steep a flight path that radar is hardly likely to become applicable. The intermediate angle utilized by the Douglas bomb (adjustable between 30 and 60 degrees) makes possible the use of all homing devices so far known. Inherent stability of the design should diminish roll sufficiently not to interfere with homing, and it is expected that a hit could be obtained on evasive targets with target speeds up to at least 60 miles per hour. At the Division meeting on February 3, 1943, an extension of the Douglas contract was voted in the amount of $100,000 to August 31 to cover the construction and tests of experimental bombs in the field. Under this extension the contractor is producing ten test vehicles equipped with photo-electric homing devices. These test bombs will be dropped in California during the summer.

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(2) Progress Since Previous Report (6/15/43). The schedule worked out with the contractor called for the completion and testing of 10 trial vehicles during the month of July, 1943. This was an extremely close schedule and allowed but little time for contingencies. It contemplated the use of a simple but undeveloped photo-electric target-seeking device which would be adequate to test the homing properties of the vehicle without making any pretense to having combat value.

The photo-sensitive element of the system is a caesium photo-cell with four 90-degree sector-shaped cathodes. This cell was reported to be developed and in moderate production for the Army. The delivery on these items has been extremely slow so that the development of the pre-amplifier was seriously retarded. Furthermore, two shipments have been required, since the first lot was so seriously below specifications as to be unusable. The second lot is somewhat better but the irregularities in the end of the glass envelope so distort the image of the target that the signal output of the cell is too unreliable for test.

Steps are being taken to:

(a) Secure adequate four-cathode photo-cells which will permit the use of the homing system developed for this project;

(b) Change the optical system so that a standard single-cathode cell can be used;

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(c) Apply other homing systems of test or combat suitability.

Aside from the scanning system the test vehicles are complete and ready for trial. Fig. 2 shows a dummy test bomb on test rack under a C-47 airplane, and Fig. 3 another bomb after impact in a dummy drop test.

Wind tunnel trials have been completed on a test vehicle complete with its power amplifier and roll stabilizing gyro. These tests confirmed the theory on which the design was based and showed that the control system is adequate to protect the vehicle against excessive roll. At 205 miles per hour wind velocity asymmetry was deliberately introduced to produce a roll of 30 revolutions per minute with the gyro operating but the circuit to the control servos open. Upon application of power to the servos the roll was completely suppressed after 3 or 4 seconds during which rotation continued for about 3/4 of a revolution.

The field tests are fully arranged and will occupy a period of some four weeks, starting as soon as a suitable scanning system can be assembled.

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SUBJECT: Guided Missile Project "[illegible]"

TO: [illegible], Research & Liaison Section, Attn: Col. Brown   Date [illegible] Feb 44

FROM: Air Communications Officer   Gen. McClelland/[illegible]

1. Division [illegible] of [illegible] has a guided missile under development known as "[illegible]". This project has until now been carried on as an independent [illegible] project without our sponsorship. It is requested that the "[illegible]" project be sponsored by the Army Air Forces and that Colonel [illegible] Wright be named as the liaison officer.

2. It is also requested that Division [illegible] of [illegible] be requested to accelerate the development of "[illegible]" and that development include both radar homing and heat homing, with emphasis on the latter.

/s/ H. [illegible] McClelland
[illegible]
Brig. Gen., [illegible]

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AUTH: F.C. CARROLL
BRIG. GEN., U.S.A.

DATE: 12 May 1944
INITIALS: TJF

ARMY AIR FORCES

MATERIEL COMMAND
ENGINEERING DIVISION

MEMORANDUM REPORT ON

AM-rea-54

SUBJECT: Television and "Roc"

Date 12 May 1944

SECTION: Equipment Laboratory

SERIAL No. [illegible]

Contract No.
Expenditure Order No. 573-1
Purchase Order No.

A. Purpose.

1. To report on conference at the Douglas Aircraft Corporation, concerning the possible use of "Roc" controllable missile against land targets.

B. Factual Data.

1. A conference was held on 24 April 1944 at the Douglas Aircraft Corporation in Santa Monica, California at which Lt. Col. A. Hyman of the Materiel Command and Dr. Frank Colbohm of the Douglas Aircraft Corp. were present.

2. A second conference was held on 25 April 1944 at which the following personnel were present:

Materiel Command	Douglas Aircraft Corp.
Lt. Col. A. Hyman	Dr. P. Klemperer
Capt. [illegible]	Mr. Kingdon Kerr
	Mr. [illegible]
	Mr. R. Shavell
	Mr. [illegible]

3. The "Roc" X-1000 (see Appendix 1) consists of a shell built around a 1000 pound general purpose bomb and carrying four wings at right angle relation and a similar tail. The control is exercised by wing flaps with balancing tabs. Each wing flap has its own servo motor. The present design envisages the use of a homing radar device of the type R.H.B.

4. The Douglas Aircraft Corporation has carried out test flights on a prototype model of this vehicle under a N.D.R.C. contract demonstrating its ability to be guided by target seeking means.

5. An alternative design has been laid out called Roc 00-1000 (see Appendix 2) using a cylindrical shroud instead of the four wings. This shroud is mounted on pivots to permit steering in two orientations at right angles to each other (corresponding to azimuth and elevation). The design is entirely symmetrical so that either control may become azimuth or elevation. A cylindrical tail acts only as a brake and has no controls.

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Engin. Div. Memo. Report No. [illegible]
12 [illegible] 1944

[illegible]. Preliminary aerodynamic tests demonstrated the effectiveness of this aerodynamic structure to be practically equivalent to the type [illegible]. It has the advantage of smaller cross sectional dimension which would permit its installation in the B-29 bomb bay.

[illegible]. [illegible] design [illegible] has demonstrated the following aerodynamic features:

a. No variation in angle of attack of the bomb axis for varying lift trims.

b. Operational and interchangeable functioning of azimuth and elevation control (resulting in minimum time delay).

c. [illegible] low power needed for flap control (1/30 h.p. motors are being used).

d. Ability to fly at speeds of the order of [illegible] m.p.h.

e. Very low drag permitting maximum jet propulsion range.

f. Design suitable for large scale production.

[illegible]. The suitability of this design was considered with respect to the following types of control:

a. Television [illegible] with Hammond radio control: A layout as shown in Appendix [illegible] indicates considerable increase of length to accommodate all the equipment. This length is prohibitive for internal carrying even in B-29. The stability factor with the increased length would have to be carefully established. The Hammond controls would have to be modified to introduce proportionality of the control and of its deviation as required by this type of bomb.

b. Television type "Mimo" (miniature image orthicon now being developed by R.C.A. on an [illegible] contract). The layout is illustrated in Appendix [illegible]. This layout is slightly shorter than [illegible] illustrated in Appendix [illegible] and can be mounted in the bomb bay of B-29. This layout would have the following advantages:

(1) Stability equal to the present design.

(2) Control designed as integral part of Mimo to give the required proportionality.

(3) Adaptability of the same layout to the use of heat and radar target seeking devices without additional aerodynamic studies.

(4) Possibility of internal mounting in B-29 bombers.

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c. The use of heat target seekers. A layout such as Appendix 1, Appendix 2 or Appendix 4 would be suitable for this purpose. The target seeker would have to include a control factor proportional to angular deviation. This can be secured in two alternative ways:

(1) By the use of orienting target seeker such as M.I.T. bolometer type (used on high angle bomb Felix) furnished with gimbals and proportional pick-offs

(2) A target seeker designed around Dr. Golay's heat detector including rotational scanning with about [illegible] total viewing angle and a proportionate response derived from the shape of the heat detecting element. This design has been discussed with Dr. Golay and could be apparently carried out within a few months time by the use of available elements of design. Mr. Fl[illegible] favored the latter alternative as the most likely to produce suitable operating characteristics.

d. The use of [illegible] as a plane released, antiaircraft, jet propelled, television-radio controlled weapon. It appears that the prototype design, which has already been tested, is most suitable for this purpose. Since the pay load need not exceed 100 pounds, the weight and size of this model is most readily adapted to the use of jet propulsion. The size is quite sufficient to carry the "Mimo" television and control equipment. The jet propulsion charge would include the following elements to accomplish the desired function:

(1) An accelerating charge of short duration and high thrust to raise the speed from about [illegible] m.p.h. to [illegible] m.p.h. considered sufficient for attack purposes. Eventually even higher speeds could be achieved with the avail-able design. The possibility of ground launching should also be considered.

(2) A sustaining charge of long duration and low thrust to sustain the flight during the attack period and to permit full maneuverability even in the upward direction. At least five minutes operation is considered practical.

9. The facilities of the research staff of the Douglas Aircraft Corporation are limited. They are at present directed to the completion of the layout shown in Appendix 2. It was indicated to the Materiel Command representative that the design of Appendix 4 could be readily carried out provided full cooperation of R.C.A. could be obtained to provide suitable design of "Mimo" elements. A conference with Dr. Zworkin of R.C.A. was arranged by telephone to take place in Princeton, New Jersey, early in May. Completion of a bomb of this type suitable for production could be achieved in eight months.

10. The Douglas Aircraft Corporation also expressed keen interest in the heat target seeking application and the antiaircraft application.

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... of the ... Laboratory ... the
... been initiated.

H V...

Prepared by A. ..., Lt. Colonel, A.C.

Approved by C. ..., Colonel, A.C.
... Equipment Laboratory
Engineering Division.

Approved by F. O. CARROLL, Brig. Gen. U. S. A.
Chief, Engineering Division.

Distribution:
Materiel Div. ..., ...,
N. ...; Div. 5 NDRC;
ARL; Air Com. Officer;
Eval Br. Tech Data Lab.

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AAFMC 743-WF-5-5-43-500M

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AUTH: ... CARROLL
BRIG GEN, USA
DATE 5/29/44
INITIALS [illegible]

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ARMY AIR FORCES
MATERIEL ~~CENTER~~ COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

ARmeo:54

Date 29 May 1944

SUBJECT: Roc - Television.

~~SECTION~~ Equipment Laboratory

SERIAL No ENG-54-673-4-F-2

Contract No.
Expenditure Order No. 673-12
Purchase Order No.

A. Purpose.

1. To report on a conference at R.C.A. Laboratories concerning the development of miniature television and a vehicle for operation against point land targets.

B. Factual Data.

1. Directing a controllable missile to point land targets appears to be possible by the use of a vehicle such as "Roc" in which the angle of attack is zero at all times and the oscillations around all axes are reduced to a minimum.

2. Previous report, serial number ENG-54-673-33 covered the conference with Douglas Aircraft Company concerning the suitability of "Roc" for this purpose. Two types of control were mentioned: television radio link and heat target seekers. A conference was held at R.C.A. Laboratories, Princeton, New Jersey on 16 May 1944 to discuss the available devices for the first type of control.

3. Present at the conference were:

R.C.A.

Mr. R. Thalner
Mr. R. D. Kel
Dr. V. K. Zworykin
Dr. E. W. Engstrom
Mr. H. Rhea
Mr. G. C. Szikla

Douglas Aircraft Co.

Dr. W. B. Klemperer

Materiel Command

Lt. Col. A. Nyman

Signal Corps

Lt. L. Katz

N.D.R.C. Divn. 5

Mr. H. Spencer
Mr. R. E. Shelby

4. Consideration was given to the possibility of the use of Block III equipment, the image orthicon camera (ML15) and the miniature image orthicon camera (Mimo). The Block III camera and transmitter appear to be excessively large for "Roc". The ML15 compact camera demonstrated by a mockup could be fitted into "Roc" by extending the nose of "Roc" about 18".

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The Mimo camera and transmitter demonstrated by mockup could be fitted into the "Roc" design known as MOO-1000.

5. Consideration was also given the prospective production schedule on MI15 and Mimo respectively. MI15 tubes are on order now and deliveries are proceeding at the rate of 30 a month. However, the compact camera must still be developed. The Mimo tube will be ready for 30 a month production in September. The engineering staff available could devote its energies either to the design of a compact camera for MI15 tube or of a smaller design for Mimo tube as directed.

6. With regard to the radio link it was suggested that the five channel receiver known as GVT3, using RC164 transmitter be employed. This design is available at the Aircraft Radio Laboratory.

7. Mr. Spencer of Division 5 of N.D.R.C. suggested that the Douglas staff and R.C.A. staff study the problem of introducing the Mimo device into Roc and meet early in June to permit N.D.R.C. to arrive at a decision with regard to this development.

8. A check of television operation of "Roc" was also suggested by the use of Block III equipment. The discussion revealed that such a test, requiring squeezing of Block III equipment into the "Roc" by removing the pay load, would involve considerable engineering effort which could be used to much better effect by applying its energies to adapting "Mimo" equipment to the same purpose.

9. A demonstration was given of the operation of MI15 tube. The image was clear for illumination of a darkened room insufficient for reading. Resolution of 450 lines was observed on a test set up. The Mimo tube was shown but its operation not demonstrated.

10. A demonstration was given of a navigation device depending on a weathervane and adjustable crosshair on the viewing instrument. An improvement in guiding the carriage representing the missile could be observed.

C. Conclusions.

1. That miniature image orthicon (Mimo) appears to be a practical possibility in about three months.

2. That a camera and transmitter design for Mimo tube appears to be of a size suitable for "Roc" vehicle for high angle land target operations.

D. Recommendations.

1. It is recommended that the following action be taken by the organizations designated below:

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Concurrence:

Prepared by: [illegible], Lt. Colonel, A.C.

Approved by: [illegible], Colonel, A.C.

Distribution:

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completed and the resultant products are too slow and too expensive in comparison to other potential missiles. There will be none ordered and project will be closed out shortly. Priority is 3C. Classification is IV.

i. Campbell: Remote controlled explosive-carrying boats, both target and rescue types being used. Development has been completed. Assistance is still being given to OSS on their present theatre project. No further target-boats are on order. Priority is 1A. Classification is I.

2. GLIDE BOMBS (All carry a 2000 lb. Bomb)

a. GB-1 Preset: Approximately 3000 in stock. Have been used by U.K. but further extensive use is doubtful. Development is complete.

b. GT-1 Glide Torpedo: Kit to use GB-1 airframe with torpedo. Approximately 500 in stock. GT-1 equipments and B-25s for carrying are in Hawaii now, but any extended use is doubtful. Development is complete.

c. GB-4 Television: One thousand are complete except for television. Controls considered successful but television pictures have been uncertain, and it is almost impossible to navigate to a target at high speeds by television means unless terrain has readily identifiable characteristics. The AAF Board tests and a limited theatre tests were considered unsuccessful. Television will only be completed for approximately 100 and further development will be curtailed. Priority cut to 3A. Classification is III.

d. GB-5A Light Contrast Seeker: Only recommended for marine targets without armored sides. Use in this war doubtful. Priority is 3A. Classification is III.

e. GB-5D Flare Seeker: Development is nearly complete. [illegible] any left over from 20 experimental [illegible] special targets. Priority is 1A. Classification is I.

f. GB-6A Heat Seeker: Development is nearly complete and test drops are being made. Could be used in this war, if requirements are established. Priority is 1A. Classification is I.

g. GB-7A (RMB) and 7B (SRB) Radar Seekers: Development is nearly complete on the 7A and approximately 50% complete on the 7B. Use in theatres is doubtful, however, as the LAB radar low-altitude bombing planes are already being used against similar targets. Priority has been reduced to 3A.

h. GB-7C (Moth) Radar Seekers: Device to home on enemy radar antenna. This project was unsuccessful and development has been discontinued.

i. GB-8A Visual: 1000 have been completed. AAF Board test considered unsuccessful. Controls are good, but visual steering to a target from long distances has not proved accurate. A small number were taken to U.K.

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but never used. Extensive use is doubtful unless has become necessary against heavily protected locations. Further development will be curtailed. Priority cut to 3A. Classification IV.

j. GB-9 Ground Skimmer: This project requires a great deal of further development and has been dropped due to the general loss of interest in visually sighted glide bombs.

k. GB-10 Television: Proceeding on low priority [illegible] to use other types of television than the Block III.

3. VERTICAL BOMBS (All are AGRC developments. All except [illegible] carried in Bomb Bay.)

a. VB-1 Azon: Tail added to standard 1000 lb. bomb to permit radio control right or left. Has been used in Italy and France and [illegible] CBI. Procurement requirement reduced from 110,000 to approximately [illegible]. Further development continuing on reducing dispersion when dropped [illegible] and controlled by single transmitter. Reduced in priority to 2A. Classification is I.

b. VB-2 Azon: Tail for 2000 lb. bombs now ready for AAF Board tests. Doubtful whether any production orders will be placed. Priority is [illegible] until AAF Board tests are completed. Classification is I.

c. VB-3 Razon: Tail for standard 1000 lb. bomb to permit radio control in range and azimuth. Development nearly complete. 2000 ordered for AAF Board and Navy tests and Air Force use (particularly for [illegible] Air Force). Priority is 1A. Classification is I.

d. VB-4 Razon: Razon tail for 2000 lb. bomb. Development just starting. Might be made available for this war. Priority is 2A, and may be bettered. Classification is I.

e. VB-5 Light Seeker: Razon type tail with light seeker in nose. Development has been stopped. May be started again if OC&R check with theatre finds there is a theatre requirement.

f. VB-6 Seeker "Felix": Razon type tail with heat seeker in nose. Development nearly complete. 1000 ordered for AAF Board and Navy tests and possible theatre tests. Priority is 1A. Classification is I.

g. VB-7 and VB-8 Television Type: Razon tail with television in nose. Development has been stopped after poor tests.

h. VB-9 ROC Medium Angle Radar Seeker: Development has been discontinued due to unsuccessfully surveys on radar seekers approaching at this comparatively high angle.

i. VB-10 ROC, Television, VB-11 ROC Heat Seeker, VB-12 Visually Guided: ROC is a basically different airframe used for a medium to high angle approach.

[redacted]

[redacted]

for use against [illegible] targets. Airframe is in early test phases. Seekers available in early 1945. Doubtful if available for this war unless expedited. Priority is 2A. Classification is II.

4. SUMMARY OF [illegible] THAT MIGHT BE USED IN THIS WAR:

a. Will be used: Willie, Campbell, VB-1 Azon, VB-3 Razon, VB-6 Felix, GB-1 Preset.

b. Can be Used if Required: JB-2 (Chinese Copy), GT-1 Glide Torpedo, GB-4 Glide Bomb, [illegible] Light Seeker, GB-6 Heat Seeker, [illegible]-7A Radar Seeker, [illegible] Visually [illegible], VB-2 Azon 2000 lb., VB-4 Razon 2000 lb.

c. May be Available: JB-1 Northrop Jet Bomb, JB-3 Air-to-Air Jet Bomb, [illegible] Radar Seeker, [illegible]-5 Light Seeker, [illegible] VB-10 Television, [illegible] Heat Seeker and VB-12 Visual.

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HqATSC Form No. MC 507 (20 Jan 45)
(Old AAFMC-266)

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File ROC
JAE

ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND

MEMORANDUM REPORT ON

Date 2 April 1945

SUBJECT: Visit of Lt. Col. George L. Haller and Dr. E. M. Williams to Douglas Aircraft on 14 and 16 March 1945, and to Bendix Aviation, North Hollywood, California, on 14 March.

OFFICE Special Projects Laboratory Contract or Order No.

SERIAL No. TSERR2C-7 Expenditure Order No.

A. PURPOSE:

1. To investigate status of radio controls for NDRC ROC project and to coordinate work under ATSC contract with RCA on miniature television with ROC requirements.

B. FACTUAL DATA:

1. Douglas Aircraft has a NDRC Division 5 contract for the development of the ROC missile. Radio control for this missile is being developed under NDRC contract by Bendix Aviation Ltd., in North Hollywood. The Mimo television was developed under NDRC contract with RCA at Princeton, New Jersey.

2. A number of flight tests have been made without the television equipment. On the one flight with television the television picture failed after a short time. No reason has been found for this failure.

3. On a number of drops the photographic instrumentation employed by Douglas has recorded failure of the radio control system during the latter part of the test. The failure is tentatively attributed by Douglas to the Bendix radio control system; however, since there has been no failure in the laboratory the Bendix engineers attribute the anomalous results to failure of the Douglas instrumentation. Douglas has stated its interest in assuming responsibility for the radio control system; this is opposed by the Bendix engineers who feel that this is a reflection on their work and that they would receive rather arbitrary treatment under Douglas administration. This situation is an excellent example of the coordinating difficulty arising in the development of a new guided missile when the responsibility for the development of all components is not placed in one contractor's hands. Fortunately, for the Special Projects Laboratory in this case, the resolution of the contractors' squabble is an NDRC problem.

4. The Mimo television equipment was demonstrated. Some difficulty is arising because the additional Mimo units needed on ROC tests are being purchased by ATSC from RCA. RCA is finding it necessary to make changes in dimensions on which, to date, Douglas has no reliable information and cannot, therefore, freeze the space available for Mimo in all the ROC "birds" being constructed. Arrangements are required for more direct RCA-Douglas coordination.

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TSERR2C-7
2 April 1945

5. The Bendix radio proportional control system was demonstrated. Douglas has reported trouble with zero control drift and thyratron tube special selection. The Bendix engineers attribute all difficulties to their system of modification of the RC-186 control transmitter to allow proportional control. They were advised to make a new modification of the RC-186 to eliminate this difficulty even if involved changes in wiring of the set are required.

C. CONCLUSIONS:

1. The Bendix proportional control appears to be an excellent equipment but somewhat more bulky and elaborate than is justified for the present requirements of the ROC. The Mimo television development is still incomplete.

D. RECOMMENDATIONS:

None.

Distribution:
TSESE-20
TSEPL-3I
TSERR-2A2
Attn: Lt. Col. Eaton
TSERR
Attn: Col. Yeager

Prepared by Everard M. Williams
EVERARD M. WILLIAMS
Engineer, Radio

Approved by George L. Haller
GEORGE L. HALLER, Lt. Col., A. C.,
Chief, Special Projects Laboratory

Approved by Wayne G. Eaton, Lt Col AC
for
T. H. BAXTER, Col., A. C.,
Chief, Aircraft Radio Laboratories,
Radio and Radar Subdivision,
Engineering Division.

Concurrence:

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HqATSC Form No. 80-807 (20 Jan 48)
(Old AAFMC-366)

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AUTH: DIR., ATSC
INITIALS
DATE

ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND

No. of pages - 17.

MEMORANDUM REPORT ON TSEPL-314/WAG/mcw

Date 25 June 1945

SUBJECT: ROC Project (VB-10)

OFFICE TSEPL-314

SERIAL No. TSEPL-3-673-68

Contract or Order No.

Expenditure Order No. 673-59

A. PURPOSE:

1. This report briefly describes and outlines the chacteristics and functions of a guided missile known as ROC. It also summarizes the developmental tests conducted by Douglas Aircraft Company, Santa Monica, California, from September, 1944, to 1 July 1945.

B. FACTUAL DATA:

2. Personnel present at various times were:

ATSC

Lt. Colonel C. O. French, Jr.
Lt. Colonel G. L. Heller
Lt. Colonel A. Nyman
Captain M. E. White
Lt. J. D. Jones
Lt. W. A. Gervais
Mr. C. L. Paulus

AC/AS, OC&R

Colonel Fix
Colonel J. L. Travis

NDRC

Dr. J. C. Boyce
Mr. W. H. Nichols
Mr. H. H. Spencer

RCA

Mr. R. R. Thalner
Mr. I. W. Stanton

NBC

Mr. A. E. Jackson

Douglas Aircraft Company

Mr. E. P. Wheaton
Dr. W. B. Klemperer

Bell Aircraft Corporation

Dr. Mertz

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Memorandum Report No. TSEPL-3-673-68
25 June 1945

3. Five types of intelligence have been proposed for use with ROC, as follows:

Item	Intelligence	Control	VB-No.	MX-No.
1	Direct Sight	Radio Link	VB-10	MX-601
2	Television (Mimo)	Radio Link	VB-10	MX-601
3	Radar	Homing	VB-9	MX-602
4	Heat	Homing	VB-11	MX-604
5	Light	Homing	VB-12	MX-603

Development only of the first two types was carried on during the period covered by this report. The basic airframe is common to items 1 and 2, above, the only difference being the addition of a Mimo intelligence device in item 2.

4. Description:

a. The VB-10 is a high-angle, air-to-ground, unpropelled, guided missile, known as ROC, carrying a standard AN-M 1000-pound general purpose bomb (See Appendix 1). It flies at zero angle of attack and does not have to bank in order to turn. Aerodynamic deflection in range and azimuth is provided by movement of a circular wing surrounding and gimbally mounted about the airframe. This wing is controlled by two electrically-operated actuators whose servo motors are energized by radio link equipment remotely-controlled by the bombardier in the parent airplane during the missile's fall to the target. The whole fuselage, including the wing, is attached to the bomb's tail fin attaching collar. Airframe characteristics and component weights are included as Appendix 2.

5. Aerodynamic Control:

a. The VB-10 is equipped with a circular wing, angular movement of which deflects the missile's trajectory in range and azimuth. The wing is controlled remotely by radio link equipment (See Appendices 3 and 4) and installed in the parent airplane. Change of wing incidence is accomplished by two actuators, one located in the fuselage which moves the wing in yaw, the other located in the wing itself to move the wing in pitch. Power to drive the actuators is obtained from an electronic-controlled amplifier developed for Division 5, NDRC, by the Radio Research Section of the Bendix Corporation. The amplifier receives its signals from a radio link receiver. The actuators have been designed to move the wing from neutral to full over (±13°) in approximately 1.6 seconds under

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a maximum applied air load hinge moment of 1[illegible] inch/pounds determined from wind tunnel tests and based upon a maximum speed of [illegible] mph indicated airspeed. At a wing incidence of 13° in both pitch and yaw, the wing is effectively rotated 1[illegible]° about an axis midway between the pitch and yaw axes. At a gross weight of 160[illegible] pounds, 13 degrees of wing incidence gives the missile a turning radius of 750[illegible] feet.

b. Roll stabilization is effected by a gyro system which controls a four-aileron empennage (See Appendix 5). A circular, perforated ring is also mounted behind the empennage and serves both as a brake to reduce the speed of the missile and as a radio link receiving antenna.

c. The VB-1[illegible] can be controlled to hit approximately 6000 feet from the target either in range or azimuth when dropped from a height of 15,[illegible] feet. The recommended flight path is any angle above 45 degrees. The anticipated hit accuracy is ± 2[illegible] feet; however, this figure has not yet been realized. In fact, one missile hit 82 feet from the target, one other hit approximately 1[illegible] feet from the target, and all remaining hits were progressively farther from the target. Several hits were made at [illegible] feet while the remaining missiles fell several thousand feet away.

d. A [illegible] of the results of development test is included as Appendix 6.

6. Intelligence Data:

a. The VB-[illegible] is "stick" guided from the parent airplane by observing on a television receiver, the target image transmitted by the Mimo television camera installed in the nose of the missile (See Appendix 7). The necessary corrections to guide the bomb to the target are transmitted to the missile by means of audio modulated radio frequency signals. The radio receiver in the bomb activates the servo mechanism to steer the bomb.

b. The Mimo television equipment consists of a television camera, transmitter, power supply, and antenna. The television camera uses the newly developed Miniature IMage Orthocon tube, type IMS15, incorporating electro-magnetic deflection and focusing, and an electronic multiplier output section. The Mimo camera is supported by the nose fuze flange on the bomb.

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25 June 1945

c. Scanning consists of a 350-line, 40 frame/second, non-interlaced pattern system. The present transmitter operates on Block III frequencies and is capable of an output of from 6 to 8 watts. This type of intelligence has all the limitations of any television system; notably, it cannot operate during poor visibility or overcast and requires targets of satisfactory contrast. The equipment weighs approximately 5 pounds.

d. The parent airplane must be modified by installing a radio control transmitter and antenna, a television receiver, a guiding scope, a television receiving antenna, and a special carrying rack (for each missile).

e. While suspension of the VB-10 under an airplane could lead to identification of the missile beforehand, Block 18 equipment, which is contemplated for combat use, should reduce the possibility of jamming. From 15,000 feet, the duration of the missile's fall is 34 seconds.

6. Fusing and Arming:

a. Both a nose and tail fuse will be employed. A standard type tail fuse is proposed and the nose fuse will be similar to that used on VB-6 (Felix). It is presently planned to air arm both fuses by use of a small air turbine developed by the L. N. Schwien Engineering Corporation, Los Angeles. A standard arming wire "safety" is employed.

7. Targets and Limitations:

a. The VB-10 is specifically adapted to pinpoint targets but is limited to targets having sufficient ground contrast to permit the missile's television equipment to satisfactorily view the objective.

b. Television intelligence is susceptible to loss by (1) jamming, (2) cloudiness, (3) poor visibility, and (4) angle of view of the television camera.

c. Use of the present VB-10 is limited by its size. (See Appendix 8) The missile is 147.9 inches long, has a 48-inch circular wing and a tail brake 30.6 inches in diamber. Internal carriage is not possible in the bomb bays of a B-29 airplane.

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d. Some performance (speed) loss of the parent airplane will result due to drag where the VB-10 is externally suspended. (See Appendix 9)

9. Development Agency and Priority:

a. The VB-10 is being developed by Douglas Aircraft Company, Santa Monica, California, under NDRC Contract OEMsr-127 (See Appendix 10). In addition, responsibility has been assigned by Division 5, NDRC, to Bendix Aviation Corporation Research Laboratories for developing radio control equipment and to the Radio Corporation of America, Camden, New Jersey, for developing Mimo television equipment. The existing priority for the VB-10 project is 3B.

C. CONCLUSIONS:

10. The VB-10 has not yet been able to successfully demonstrate its ability to score hits sufficiently near to a target to justify its size, cost, or complicated mechanism.

11. Failure during the six Mimo television drops has been characterized by (1) lack of dependable image on the television receiver scope in the parent airplane and (2) outbreak of interference patterns on the receiver scope during test drops which blur reception.

D. RECOMMENDATIONS:

12. It is recommended that the following action be taken by the organization designated below:

a. Engineering Division, Air Technical Service Command, Equipment Laboratory:

(1) That definite pronouncement regarding this project be withheld until after the evaluation of results of July tests, at which

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(Old AAFMC-266)

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Memorandum Report No. [illegible]-3-673-68
25 June 1945

time a supplementary memorandum report will be submitted to Higher headquarters on the merits of the entire project with a view to deciding on its prospects for eventually fulfilling tactical requirements of the Army Air Forces.

Distribution:
AC/AS, M & S (5)
TSEAL-6D, Tech. Data Lab.
TSEPL-313, Equip. Lab.
TSEPL-31[illegible], Equip. Lab.
TSEPL-314, Equip. Lab. [illegible]
TSESE-2G, Airc.Proj.Sect.
TSERR-2C, Proc.Proj.[illegible]

Prepared by [illegible] G[illegible], [illegible] Lt., A.C.
(Name)

Approved by [illegible], Jr., Lt.Col., A.C.
Chief, Special Weapons Branch

Approved by T. B. [illegible], Colonel, A.C.
Chief, Equipment Laboratory
Propulsion and Accessories Subdivision

Concurrence: Engineering Division

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Memorandum Report No. TSEI-3-[illegible]-68
25 June 1945

APPENDIX [illegible].

AIRFRAME CHARACTERISTICS

Weight Complete (lbs.)	[illegible]
Payload (lbs.)	[illegible]
Turning Radius (ft.)	[illegible]
Wing Loading (lbs/sq in)	[illegible]
Wing Dimensions (in.)	[illegible]
Max. Lift Coef. of Airfoil	.7[illegible]
Wing Area (sq.in.)	[illegible]
Terminal Velocity (mph)	[illegible]
Response Time to Obtain Full Lift (sec.)	[illegible]
Overall Length (in.)	[illegible]
Max. Fuselage Diameter (in.)	[illegible]
Max. Brake Diameter (in.)	[illegible]
Max. Wing Incidence (degrees)	[illegible]

[illegible] (lbs.)

Fuselage	[illegible]
Wing	[illegible]
[illegible]	[illegible]
Boom	[illegible]
Tail Section	[illegible]
Fuse Arming	[illegible]
Wiring	5.
[illegible]	[illegible]
[illegible]	[illegible]
Nose Ballast	[illegible]
Camera Mounting Plate	[illegible]
Total	[illegible]

[redacted]

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Memorandum Report No. [illegible]
25 June 1945

APPENDIX [illegible]

1. The first [illegible] drops ([illegible] Model) were conducted at the Naval Ordnance Test Station, Inyokern, California, commencing on 21 September 1944 and ending on 19 April 1945. Succeeding drops continued at the Special Weapons Test Unit, Wendover Army Air Field, Utah, starting [illegible] April 1945. The 26th test drop was made on [illegible] May 1945. All of these drops were made from external racks mounted underneath each wing of a B-17G airplane.

2. In the initial four (4) drops, the wing of the missile was pre-set in pitch and yaw and released from the parent airplane to observe aerodynamic properties. In the next thirteen (13) drops, each missile was released by a Norden bombsight and the missile was then visually guided by radio to the target using so-called "CARP Sight Technique" (sail-dive program). Early in March, it was decided that no further missiles would be expended using the CARP bombsight attachment unless the device were greatly improved and checks made on dummy bomb beforehand.

3. In the succeeding three (3) drops, no attempt was made to hit the target but merely to test the maneuverability of the modified VB-1[illegible] having four ailerons for roll stabilization. Some evidence of oscillation in pitch is now being investigated.

4. In the present series of drops, the VB-1[illegible] has been equipped with a Mimo television camera which transmits to the bombardier's television receiver in the parent airplane a view of the approaching target so as to permit necessary corrections to be made by remote control to steer the missile to the target.

5. Six (6) test drops of VB-1[illegible] using television intelligence have been made up to 24 May 1945. While pictures obtained on the airplane television receiver have been satisfactory over downtown Los Angeles, actual target drops have been characterized by loss of, or interference with, the television screen pattern during all of these six (6) drops. As a result, the guider in the control airplane has been handicapped in steering the bomb to the target.

6. The [illegible]th [illegible] test drop of the [illegible]-model and the [illegible]th in the series of television (Mimo) equipped missiles was made at Wendover on [illegible] May. The point of impact was approximately [illegible] feet short in range and over 300 feet to the left in azimuth.

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Memorandum Report No. TSEPL-3-673-68
25 June 1945
Appendix 6

7. Evaluation of film records indicates loss of Mimo intelligence after the initial few seconds of drop. It was further noted that multi-path effects produced an interference pattern on the scope sufficient to obliterate any possible image. As a result, it was decided to cancel all further drops using Mimo until RCA could improve its basic performance.

8. The four (4) Mimo units which remain on hand will probably be dropped about the middle of July to test improvements in Mimo receiving equipment as well as a new type directive antenna. Thereafter, a lull will exist in project activity and further tests will be held in abeyance until after 1 September pending receipt of new mimo units.

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Memorandum Report No. TSEPL-3-673-68
25 June 1945

APPENDIX 10.

1. History of Project:

May 1942 - Research and development of basic airframe initiated.
Jul 1943 - 1st test drop of X Model.
Jun 1944 - 12th test drop of X Model.
Dec 1943 - Redesign for increased payload (1000-pound bomb) started.
Sep 1944 - 1st test drop of 00 Model - Preset.
Nov 1944 - 1st test drop of 00 Model - Direct-Sight Intelligence.
Mar 1945 - 1st test drop of 00 Model - Television Intelligence.
May 1945 - 20th test drop of 00 Model - Direct-Sight Intelligence.
May 1945 - 6th test drop of 00 Model - Television Intelligence.

2. Homing Versions of ROC:

a. The VB-9 (closed out) was intended to be a Radar Homing version.

b. The VB-11 (work not initiated) is intended to be a Heat Homing version.

c. The VB-12 (inactive) is a Light Homing version.

3. Cost:

a. The initial lot of twenty (20) missiles (00 Model) was constructed on a small-scale production basis. The last of these was expended on 25 April 1945 at an estimated cost of $20,000 each.

b. A contract was drawn for a second lot of 100 missiles (00 Model) of which an initial thirty-five (35) were to be constructed immediately. Construction of these is now practically completed.

c. The estimated production cost based on the initial delivery of 100 missiles is $13,000 each. This figure roughly comprises (1) cost of basic airframe $7500 each; (2) cost of television equipment $5000 each; and (3) cost of radio link $500 each.

4. It is estimated that the cost of a second lot of 100 missiles (production, not experimental) could be reduced to approximately $8000 each.

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NAVY DEPARTMENT
Washington 25, D. C.

Forward to Air Wester
WhS.

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12 Aug 1944

Dr. Irvin Stewart, Executive Secretary
Office of Scientific Research and Development
1530 P Street, N. W.
Washington 25, D. C.

Dear Dr. Stewart:

The guided missile ROC is being sponsored by the Army under Project AC-36. Although this project is primarily the cognizance of the Army, it is further understood that the development of ROC will be directed to meet the Navy requirements insofar as possible. In this connection the Navy Department has agreed to supply materiel and assistance wherever necessary to expedite the development of ROC as rapidly as possible.

The requirements of the Navy Department for ROC are outlined in the enclosed copy of the joing letter from the Bureau of Aeronautics and Ordnance under date of 19 July 1944. It should be noted that sub-paragraph (a) of paragraph 5 designated specific aircraft types for which ROC is intended. Although the requirements of the Army and Navy may not be similar in every detail, it is requested that wherever practicable ROC and the components and test equipment therefor be designed in accordance with the basic Army-Navy specifications.

The following are named as liaison officers for the Navy Department on Project AC-36:

Comdr. D. G. Donaho, USN, DCNO(A), Op31-21, Ext. 3422
Comdr. Grayson Merrill, USN, BuAer, Special Design Sect., Engineering Div., Ext. 2062
Lt. T. C. Merkle, USNR, BuOrd (Re4g), Ext. 4760, 62066

Sincerely yours,

J. A. FURER, Rear Admiral, U.S.N.
Coordinator of Research and Development

Encl. (HW) BuAer & BuOrd
ltr to Coord,
with 1st Enc.
by DCNO(A)

CC:
DCNO(A)
BuAer(Spec.Design)
BuOrd (Re4g)
WDLO w/NDRC (w/encl.)
Chief, Div. 5, NDRC (w/encl.)

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(SC) F41-6
[illegible]

[illegible]

To: Deputy Chief of Naval Operations (Air)

Subj: [illegible] - Project "[illegible]".

Ref: (a) [illegible]
24 Feb [illegible]
(b) [illegible]
[illegible]
(c) [illegible]
[illegible] 22 Sept [illegible]

1. [illegible]

2. [illegible]

3. [illegible]

4. [illegible]

[illegible]

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NAVY DEPARTMENT
BUREAU OF AERONAUTICS
and
BUREAU OF ORDNANCE

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BuAer
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BuOrd
Re4C
005272

19 JUL 1944

JOINT LETTER

From: Chief, BuAer
Chief, BuOrd

To: The Co[illegible] of Research and Development

Via: The [illegible] Naval Operations

Subj: Project [illegible] - [illegible] Requirements for.

Ref: (a) [illegible] Secret serial [illegible] dated 13 May 1944.
(b) [illegible] secret serial 0103731 dated 20 May 1944
(c) [illegible] secret serial R[illegible] dated [illegible] May 1944.

1. Reference (a) [illegible] certain [illegible] requirements for Project ADC and designated Lieut. [illegible] Marble, Jr., USNR, as BuOrd liaison officer on the project.

2. Reference (b) [illegible] reference (a) to BuOrd and directed that such [illegible] joint Chief, BuOrd-Chief, BuAer letters.

3. Reference (c) [illegible] Comdr. Grayson Merrill, USN, as BuAer liaison officer on the project.

4. The [illegible] understanding is that this project is under the [illegible] the Army, but that this development will be directed [illegible] requirements insofar as may be practicable. It is further understood that the Army will supply material and assistance as [illegible].

5. It is [illegible] that the [illegible] meet the following requirements:

(a) It should be capable of being carried on carrier based types of aircraft. Specifically, the [illegible], [illegible], SB2C, TBM, and F?F should be investigated. This requirement includes carrier [illegible] as well as cat[illegible]-offs and normal take-offs.

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(b) It should be capable of carrying and being controlled by each of the following: blind homing equipments; radio direction used in conjunction with other intelligence means.

(c) It should have a terminal velocity of not less than 800 feet per second.

(d) It should be capable of making 1000 yard corrections in either range or deflection when dropped from 1[illegible],000 feet.

(e) It should be designed to carry either a 1000 pound G.P. bomb or a 1000 pound S.A.P. bomb.

(f) All pre-flight adjustments and checks should be easily performed when the ROC is mounted on the aircraft.

(g) Special consideration should be given to problems of shipboard handling and stowage of ROC.

(h) Components of ROC that require periodic service of maintenance should be readily removable from the airframe.

(i) Test equipment should be designed and its fabrication carried forward concurrently with the missile design and fabrication.

(j) ROC, its components, and its test equipment should be designed, wherever practicable, in accordance with applicable Army-Navy specifications.

[illegible]. It is requested that the CNO forward the foregoing requirements to the [illegible].

[illegible]. The originating Bureaus will be governed by reference (b) insofar as liaison and activity on this project is concerned.

cc
[illegible] N.A.Fi[illegible], Jr.
Acting

L. A. Richardson
Rear Admiral, U.S.N.
Assistant Chief of Bureau

[redacted]

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2-3/6 SECRET 7-46F

Target Seeking Device for Future Large Bombs.

General Echols DATE: 6 Jan 1945

General Wilson COMMENT NO. 1

1. At this morning's (5 Jan) New Developments Committee meeting, the question of obtaining a high percent of hits with our future very large bombs was discussed at considerable length. It has been apparent to me, that as we get into the field of bombs weighing 20 and 40,000 pounds, against targets heavily protected by concrete and earth, we shall have to find a means of obtaining accuracy far beyond that possible today. It was my thought that in attacking the dug-in targets of tomorrow we may not be able to utilize such controls for our missiles as depend upon heat, light or magnetism. It would appear that the target seeking device which will make our future very large bomb, in effect, a highly accurate guided missile, must be capable of "seeing" through clouds and darkness, and must further be capable of finding a target which from the air is almost homogeneous in character with its surroundings.

2. I suggested to the Committee representatives, including Colonel Phillips of your Office, that there might be merit in investigating the possibility of devising a radar control mechanism which would match the radar picture on its 'scope with a radar photograph of the specific target prepared beforehand for the purpose. A device of this nature, which corrected the trajectory of the bomb by its continuing efforts to synchronize two pictures, would satisfy the difficult problem I have indicated above.

3. It was the consensus of the Committee that a guided missile capable, within reasonable limits, of reaching any type target through its own integral controls under any conditions of visibility represents an ultimate toward which we must strive. However, in view of the complexity of the problem and the diversion of NDRC talent which would result from assigning such a project high priority, it was agreed that the problem should be presented to NDRC with the request that this agency study the implications and give its recommendations as to action which might be taken, together with an indication of the interference which such a project might cause to other important projects. It is accordingly requested that your Office take the necessary steps to submit this matter for NDRC consideration.

/s/ DONALD WILSON
/t/ DONALD WILSON
Brigadier General, U. S. Army
Asst. Chief of Air Staff
Operations, Commitments & Requirements

SECRET

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ARMY AIR FORCES

AIR TECHNICAL ~~XXXXXXXXXXXXXX~~ SERVICE COMMAND

ENGINEERING DIVISION

MEMORANDUM REPORT ON

Date 17 March 1945

SUBJECT: Conference on Equipping the British 12,000# "Tallboy" Bomb with Radio Control.

SECTION TSESE-2

SERIAL No. TSESE-2G-1162, Add. 1

Contract No.

Expenditure Order No.

Purchase Order No.

A. Purpose:

1. To report proceedings of the conference held 14 March at the office of the Chief, Materiel Division, AC/AS, M&S, on the problem of radio control for the British "Tallboy".

B. Factual Data:

1. The conference was held on 14 March 1945 in the office of Chief, Materiel Division, AC/AS, M&S, with the following people present:

Brig. General J. F. Phillips, AC/AS, M&S, Washington, D. C.
Lt. Colonel V. A. Stace, AC/AS, M&S, Washington, D. C.
Major E. Kotcher, Pilotless Aircraft Br. Wright Field.

2. During the conference it was decided that in view of established liaison existing between NDRC and Gulf Research and Development Company that faster development of the controlled bomb would result if use were made of this liaison. In view of this, it was decided that NDRC shoud have complete responsibility for the development of this project.

3. This reverses the decision of the 10 March conference for the Army to contact Gulf Research and Development Company directly.

C. Conclusions:

1. None

D. Recommendations:

1. None

Prepared by John A. Dilworth, Capt. A.C.

Approved by Ezra Kotcher, Major, A.C.
Chief, Pilotless Aircraft Br.

Approved by M. S. ROTH, COLONEL, A.C.
Chief, Aircraft Projects Sect.

Distribution:
AC/AS, M&S (3cys.)
Propulsion & Accessories Sect.
Equipment Laboratory
Aircraft Radio & Radar Sect.
Ordnance Office
Bombardment Br.
Production Section
Aircraft Laboratory
Armament Laboratory
General Carroll
Pilotless Aircraft Br.

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IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL:
TSENG (TSESE-4I)

HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TSESE-4I:JPA:pjg

MX-627

21 March 1945

NDRC Project Entitled "Development of a Radio Control for the 12,000-lb. British 'Tallboy' Bomb"

X-334.8-NDRC-Project

Conf'd.

Commanding General
Army Air Forces
Washington, D. C.

Attention: AAF Liaison Officer with NDRC
Colonel Wm. G. Brown
Room 5D 915 Pentagon Building

[redacted]
AUTH: DIR, ATSC
INITIALS
DATE 3-21-45

1. It is requested that a project be initiated with the National Defense Research Committee for the development of a radio control for the 12,000-lb. British "Tallboy" bomb. The control mechanism desired should operate to give control in range and azimuth. This project will be entitled "Development of a Radio Control for the 12,000-lb British 'Tallboy' Bomb". The code name will be "Tarzon".

2. It was originally believed by the Air Technical Service Command that the control equipment developed under the project "Razon" could be used to control this new bomb. However, further investigation has revealed that the control forces and the velocity at which the controls must operate are much greater than those encountered in "Razon". This indicated that new development must be accomplished in order to solve the control problem, and it is therefore desired to utilize, if possible, the facilities of the NDRC in developing the control mechanisms. Preliminary discussions have been held with members of Division 5, NDRC, and with representatives of the Gulf Research and Development Company, at which time the general problem was reviewed.

3. There is inclosed herewith Drawing No. X20-89001, giving the general arrangement of a "Tallboy" installation in the B-29 airplane. This is forwarded for information of the NDRC on the installation limiting dimensions.

4. The classification of the project is "Secret". The project officer will be Captain J. A. Dilworth and the liaison officer will be Major J. P. AuWerter.

COM. GEN.
TECH. EXC.
ADM. EXC.
E. O.
PROD. OFF.
EXP. ENG. J. P. AuWerter
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
F. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS

Classified [redacted]
or changed to
AUTH: CD-356
BY [redacted]
Signature and Grade
Date 10-1-45

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CENTRAL FILES

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AAF Liaison Officer with NDRC
NDRC Project Entitled "Development of a Radio Control for the 12,000-lb. British 'Tallboy' Bomb"
21 March 1945

5. Due to the urgent use of the equipment, it is requested that the development be completed by 15 September 1945.

For the Director:

L. C. CRAIGIE,
Brig. Gen., U. S. A.,
Deputy Chief,
Engineering Division.

Incl:
Drawing

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Date 10-1-45

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VELOPE TO ATTENTION OF
FOLLOWING OFFICE SYMBOL:
TSESE-4I

HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND TSESE-4I:JPA:pjg

MX-627

23 March 1945

NDRC Project Entitled "Development of a Radio Control for the 12,000-lb British "Tallboy" Bomb"

SECRET
AUTH: DIR., ATSC
DATE 3-29-45

To: Air Technical Service Command Liaison Officer
at the NACA Laboratory
Langley Field, Virginia

1. The Air Technical Service Command has initiated a project with the National Defense Research Committee to apply radio control to the 12,000-lb. British "Tallboy" bomb. A copy of the letter requesting this project with the NDRC is inclosed. In addition there is inclosed two drawings of the bomb, one of the "Tallboy" itself and the other of an installation in the B-29 airplane.

2. It is anticipated that aerodynamic problems will arise in the application of control surfaces to this bomb. The bomb without controls, i.e. with fixed stabilizing fins, travels at supersonic velocities. However, with control surfaces installed on the fins, it is anticipated that the bomb will fall in the transonic velocity region.

3. The type of control surfaces to be applied to the bomb have not been decided upon as yet and it is desired that representatives of the NDRC discuss the problem with the NACA at Langley Field. It is requested that a conference be arranged with appropriate personnel from Langley Field on 30 March 1945 to discuss the aerodynamic problems with the following NDRC and Wright Field personnel:

Dr. L. O. Grondahl, NDRC
Dr. R. D. Wyckoff, NDRC
Mr. J. W. Fitzwilliams, NDRC
Capt. J. A. Dilworth, ATSC

This project has been given to the Air Technical Service Command with high priority and must be completed by 15 September 1945.

By Command of Lieut. General Knudsen:

J. P. ARMERIER
Major, Air Corps
Chief, Research
Projects Branch

H. Y. SMITH
Colonel, Air Corps
Chief, Engineering Standards Section
Service Engineering Subdivision
[redacted]ering Division

3 Incls.
1. ltr 3/21/45
2. Drwg. 54B16875
3. Drwg. X20-89001

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By CD.356
Signature and Grade
Date 10-1-45

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CONTRACT
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TECH. DATA
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OTHERS

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AAFMC-196-WF-5-20-42-2 MU.

CENTRAL FILES

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12000 LB HIGH ANGLE RAZON CONTROLLED BOMB (TALLBOY)

1. DESCRIPTION: The British-design, 12,000 lb. semi-armor-piercing bomb, modified to be controlled in range and azimuth. Length 21.0 feet, diameter of case 38 inches, diameter of shroud 54 inches (around center of gravity), Octagonal tail. Specially modified B-29 carries one. British carry one in specially modified Lancaster.

2. CHARACTERISTICS: Prospective control in range and azimuth probably on the order of 100 mils. Case of S.A.P. construction and special shape to achieve maximum penetration, carrying 6,000 lbs. explosive load. Original British bomb of rotating design without control; when dropped from 35,000 ft is estimated to have 1,250 to 1,300 ft per second impact velocity. Controlled bomb will probably strike with approximately 1,000 ft per second impact velocity.

3. TRAINING: VB-1 and VB-2 personnel can be used for Tallboy. Certain field training will probably be necessary to adapt VB-1 and VB-2 experience to Tallboy, and to acquaint armorers and airplane mechanics with the techniques of handling very large bombs and the specially modified aircraft. Tallboy will probably require more intensive training due to the fact that less control is available than for VB-1 and VB-2. British experience has indicated desirability of special training preparation for each tactical operation.

4. COMMENTS: This bomb is primarily designed for deep penetration of heavily fortified targets; U-boat and E-boat pens, underground factories, V-sites and other special military structures being examples. The bomb case and tail cone are so streamlined that effective control necessitates the addition of aerodynamic surfaces forward of the tail, so that the total amount of control will be determined by allowable sacrifice in performance. The 54" diameter 20" chord shroud around the C.G. presently planned (will give approximately 1/3 the controllability of the VB-3), will have approximately 4 times the drag of the bomb and will reduce impact velocity to approximately 1,000 ft per second. NACA assistance has been asked for aerodynamics, particularly in view of transsonic experience of NACA. In order to provide a missile with supersonic speed and greater penetrating power, NACA has agreed to recommend a design of bomb to achieve approximately 1,250 ft per second and greater controllability than is obtainable with the present plan. The development project will be carried on by NDRC Division 5, which is contracting the work with Gulf Research Corporation.

5. AVAILABILITY: Development is estimated to be completed in six to nine months from 26 February 1945, when work started at ATSC. Tallboy requirements at present are 10 live bombs per month for last six months of 1945. These will be used uncontrolled until controlled models become available.

C5-8579,AF

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(5 April 1945) 283

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AIR TECHNICAL ~~XXXXXXXXXX~~ SERVICE COMMAND
ARMY AIR FORCES
ENGINEERING DIVISION

MEMORANDUM REPORT ON — JAS:hic
5 April 1945

SUBJECT: Conference on Radio Controlled 12,000 Pound Bomb.

OFFICE: TSESE-2G

SERIAL NO. TSESE-2G-1170

A. PURPOSE:

1. To report proceedings of the conference held at Langley Field, Virginia, 30 March 1945 on the problem of a radio controlled 12,000 pound bomb.

B. FACTUAL DATA:

1. Personnel present were:

Air Technical Service Command

Captain J. H. Evans
Captain R. H. Vandenberg
Captain J. A. Dilworth

N.A.C.A., Langley Field

Mr. T. Thompson
Mr. E. Buckley
Mr. E. A. Soule
Mr. R. T. Jones
Mr. John Stark
Mr. T. J. Bailey
Mr. J. A. Roche
Colonel K. T. Green
Captain W. P. Carl

Hq., AAF, Washington

Mr. V. S. Roddy

Division 5, N.D.R.C.

Dr. H. H. Spencer
Dr. L. C. Grondahl
Mr. R. D. Wyckoff
Mr. J. S. Fitzwilliam

2. The Gulf Research & Development Company has developed a modification to the Tall-boy consisting of a fixed lifting shroud about the center of gravity with a razon type tail for control. A model of this modification has been tested in a wind tunnel at [illegible] mph. Gulf Research & Development Company believes control of ±1000 feet is possible from 15,000 feet after a fall of 1[illegible] seconds with no control.

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Memorandum Report No. TSESE-2G-117
5 April 1945

N.A.C.A. roughly estimated that the striking velocity would be 1000 ft/second maximum from any altitude and that estimates of control by the standard razon method were on the whole correct.

3. The meeting was in agreement that bombs such as proposed by the Gulf Research & Development Company be made and dropped as soon as possible.

4. N.A.C.A. believes that by the use of a triangular planform surface they can (1) achieve more control than is possible with the Gulf proposal (2) obtain a bomb with a striking velocity of about 1250 ft/second that is relatively free of shock wave phenomena in the transonic range. N.A.C.A. will be requested to design the bomb they recommend for test by Gulf Research & Development Company.

C. CONCLUSIONS:

1. That the bomb proposed by the Gulf Research & Development Company is satisfactory as a start toward a solution of the problem.

2. That the proposal of N.A.C.A. is basically sound and should be given consideration.

D. RECOMMENDATIONS:

1. It is recommended that the following action be taken by the organizations designated below:

a. Gulf Research & Development Company

(1) That bombs as designed by the Gulf Research & Development Company be built and dropped.

b. N.A.C.A., Langley Field, Virginia

(1) That N.A.C.A. design the bomb they recommend.

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(2) That as early completion date as possible be expedited for the program.

J. A. DILWORTH, Captain, A.C.

VICTOR R. HAUGEN, Colonel, A.C.
Aircraft Projects Section

F. O. CARROLL, Brig. Gen., U.S.A.
Chief, Engineering Division.

Mat. Div., AC/AS, M&S (5)
Division 5, N.D.R.C.
N.A.C.A., Langley Field, Va.
TSPAL-6D
TSEPL-3
TSORE

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Memorandum Report No. TSESE-2G-1170
5 April 1945

APPENDIX 1

The bomb proposed by Gulf Research & Development Company is the standard British Tall-boy with a fixed shroud of 20 inch chord and 54 inched diameter placed about the C.G. The razon tail unit has an octagon shape with a 20 inch chord and 54 inch maximum outside dimension placed with the leading edge 136.8 inches from the center of gravity.

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AFDMA-1B Maj McPewers/[redacted]/73344

By Authority of
The Commanding General
Army Air Forces

Date Initials

24 April 1945

NDRC Project Entitled "Development of a Radio Control for the 12,000-lb British "Tallboy' Bomb."

War Department Liaison Officer for NDRC
Headquarters, Army Service Forces
Room 4E-637, The Pentagon.

1. It is requested that a project be initiated with the NDRC, as an amendment to AC-36 "Controlled Trajectory Bombs," for the development of a radio control for the 12,000-lb British "Tallboy" bomb. The control mechanism desired should operate to give control in range and azimuth. This project will be entitled "Development of a Radio Control for the 12,000-lb British 'Tallboy' Bomb." The code name will be "Tarzon"

2. It was originally believed by the Air Technical Service Command that the control equipment developed under the project "Razon" could be used to control this new bomb. However, further investigation has revealed that the control forces and the velocity at which the controls must operate are much greater than those encountered in "Razon." This indicated that new development must be accomplished in order to solve the control problem, and it is, therefore, desired to utilize, if possible, the facilities of the NDRC in developing the control mechanisms. Preliminary discussions have been held with members of Division 5, NDRC, and with representatives of the Gulf Research and Development Company, at which time the general problem was reviewed.

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3. There is inclosed herewith Drawing No. X20-89001, giving the general arrangement of a "Tallboy" installation in the B-29 airplane. This is forwarded for information of the NDRC on the installation limiting dimensions.

4. The classification of the project will be SECRET.

5. This project is considered of sufficient urgency to warrant the deferment of personnel in the age group 22 through 25.

6. The project officer will be Captain J. A. Dilworth of of Air Technical Service Command and the following will be liaison officers:

Major J. P. Auferter - Air Technical Service Command.

AFDMA-1B Lt. Col. V. A. Shaco - AC/AS, MM&D.

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WDLO/NDRC
NDRC Project Entitled "Development of a Radio Control for the 12,000-lb British "Tallboy' Bomb."
24 April 1945

7. Due to the urgent use of the equipment, it is requested that the development be completed by 15 September 1945.

For the Commanding General, Army Air Forces:

J. F. PHILLIPS
Brig. General, U.S.A.
AAF Liaison Officer for NDRC

Incl.
Drawing.

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Mr Roddy/mjr/2100

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HEADQUARTERS ARMY AIR FORCES
Office, Asst. Chief of Air Staff, Materiel & Services

Inter-Desk Memorandum

MEMORANDUM FOR BRIGADIER GENERAL J. F. PHILLIPS DATE 7 June 1945

SUBJECT: Razon Control for Tallboy

1. At a conference on 26 May 1945, a representative of AC/AS, OC&R, stated that there is no requirement for control for Tallboy bombs for this war, and that there is a requirement for a long-term program on control of large bombs, up to 100,000 lbs, but only as a post-war project. This has since been confirmed by the attached R&R.

2. The reasons for the "no requirements" part of the above statement are:

a. Reported accuracies without control of 3 to 4 mils from British operational use and better than this, from Eglin Field drops. NDRC indicates about 1 1/2 mils in azimuth and 3 mils in range as the best that can be expected of Razon.

b. The intention of OC&R to use hand picked and specially trained crews for Tallboy operations, in order to obtain better accuracy.

c. Only one squadron - approximately 15 B-29's - is scheduled to be used, so that requirements in any case would be small.

d. Requirements are being calculated on a fifteen month war; controls for Tallboy may not be ready in time.

e. Personnel can be better used for introduction of Razon into the Pacific Theatre.

3. Other factors, apparently not fully considered by AC/AS, OC&R, are:

a. American operational experience has reduced the reputed "pickle barrel" accuracy of various bombing methods in the past.

b. Razon is intended to correct for bombardier's mistakes and other unknown factors not appearing under ideal conditions.

c. British training for Tallboy operations has been very intensive. American practice in the past has not tended toward this sort of very thorough preparation. The availability to the Pacific Theater of properly qualified men, such as the Pathfinder men used by the British for Tallboy operations, is questionable.

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d. The limited number (11) of drops made at Eglin Field upon which the OC&R decision was partly based have all been made by one exceptionally good bombardier under ideal conditions. The danger of drawing general conclusions from such data is obvious.

e. The use of only one squadron means that production quantities of control will be small; these can be turned out as laboratory models and thus cut production time considerably, making equipment available for this war. According to NDRC, this will cut 6 to 9 months from production time and make equipment available for this war.

f. Design of the control equipment is complete; the amount of effort to complete trial drops should be relatively small, and can be done without affecting the theatre introduction of Razon.

g. Air Technical Service Command has been criticized in the past for dropping projects half-done; this job has gone from 1A priority to "no requirements" in three months.

h. We still have the long term control requirement. This cannot properly be attacked by starting with 100,000 lb. bombs, but should be extrapolated by degrees from something we now have. Tallboy is a logical step in this process. For this reason alone [illegible] should continue. Yes [illegible]

i. The British are developing a form of azimuth control for their own Tallboys in spite of the operational experience.

4. The Pilotless Aircraft Branch at ATSC has expressed concurrence that the Tallboy control project should be continued for the reasons given above and further because they feel that all research and development should be pushed as far as possible toward operational experience in this war.

5. It is recommended that NDRC Division 5 be requested to proceed with the Tallboy control project regardless of the "no requirements" statement, and that if this is undesirable to NDRC, that active development be carried out at Air Technical Service Command. It is believed that if this development proceeds at high priority, it will very probably be successful, and if successful, it will probably be used in this war.

Bruce [illegible] Col AC

FRED. R. DENT, Jr.
Colonel, Air Corps
Chief, Engr. Br. Mat. Div.

1 Att:
ER/1 dtd 1 Jun 45

OK except [illegible] development [illegible]

[redacted]

Note: I talked to [illegible] Phillips on this on 18 June, and he said [illegible]

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SRM

Azon-Razon Controls for "Tallboy" and "Grandslam" bombs

AC/AS, MSS, Materiel Division, Engineering Branch — 1 JUN 1945

AC/AS, OC&R, Requirements Division — Maj Weinbrenner/dr/72485

1. Based on the operational experience of the Royal Air Force, and the preliminary tests at Eglin Field with "Tallboy" bombs, it is expected that the Army Air Forces will achieve bombing accuracy of the magnitude of four mils in proposed large bomb missions employing normal sighting technique. The problem of applying Azon or Razon controls to Tallboys and Grandslams was discussed at a meeting on 26 May attended by representatives of N.D.R.C., AC/AS, MSS, AC/AS, OC&R, and the Office of the Chief of Ordnance. It was pointed out by the N.D.R.C. representative that any radio control to these bombs would result in a loss in terminal velocity. Also, it was brought out at this meeting that even with Azon or Razon controls on these large bombs, there was no indication that the accuracy obtainable would be greater than that possible from normal sighting operations.

2. It therefore seems apparent that there is no justification for N.D.R.C. continuing with the development of Azon or Razon controls for Tallboys and Grandslams with the view of getting them into the present war. It is believed more desirable for N.D.R.C. to direct efforts towards the improvement of the present VB-3.

3. Controls are still desired for large bombs, but in order to justify the added equipment and training, it is necessary that the accuracy obtainable with controls be materially greater than that obtainable through normal bombsighting technique. It is believed that in order to obtain a series of really satisfactory large controlled bombs it will be necessary to design a new bomb shape, incorporating new designs of control surfaces. This office is now studying this problem, and a statement of military characteristics for large controlled bombs will be submitted you shortly.

LESLIE O. PETERSON
Colonel, Air Corps
Acting Chief

Bomb Br __________

Org Sec __________

____

AFHRQ/M __________

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ATSC Form No. [illegible] OCT 44

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL:
TSESE-2A

WRIGHT FIELD, DAYTON, OHIO
6 April 1945

SUBJECT: Large Bombs

[redacted]
AUTH: DIR., ATSC
INITIALS [illegible]
DATE 6 April 1945

TO: Commanding General,
Army Air Forces,
Washington 25, D.C.

Attn: AC/AS, Materiel & Services
Development Engineering Branch.

1. A conference on large bombs was held in Washington on 29 March 1945, and was attended by representatives of the Air Technical Service Command, AC/AS, M & S Armament Branch, AC/AS OC & R, and Air Ordnance. Courses of action which were decided upon in that conference have considerable bearing upon the bomb bay design of bombardment aircraft, and it is therefore requested that liaison be maintained with Air Ordnance so that confirmations of action and changes involving the conference decisions may be made available to this office.

2. Col. R. G. Butler agreed that the following action would be taken by Air Ordnance:

a. The 22,000 pound "Grand Slam" bomb as supplied for use in all USAAF Aircraft would be 18 inches shorter than the current British design, making a length of 287 inches overall. The change was to be accomplished by substituting a two inch rounded tail cap for the 20 inch tail cone which is located aft of the stabilizing fins. No dimensional changes ahead of the trailing edges of the stabilizing fins would be made.

b. A design would be studied for a 42,000 pound bomb having the following characteristics: Length overall, 322 inches; maximum body diameter, 54 inches; tail box diameter, 50 inches; center of gravity, 100 inches minimum from nose. As a last resort, the overall length would be increased to a maximum of 374 inches, but only if no practicable means of stabilizing the 322 inch type could be found. It was pointed out during the discussion of this bomb that in order to properly balance the B-36 airplane with two 42,000 pound bombs aboard, the bomb length must either be limited to 322 inches, or else the airplane must carry ballast to compensate for nose heaviness. Spacewise, the limiting bomb length is 374 inches.

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By CD-356
Signature and Grade
Date 18-1-45

HQ AAF X-89649

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CG, AAF, Wash. 25, D.C. [redacted] Page 2
Large Bombs
6 April 1945

c. No dimensional changes would be made in the 12,000 pound "tall boy" bomb for use in USAAF aircraft.

d. Five each 12,000 pound and 22,000 pound bombs, inert, would be made available to Air Technical Service Command for use as mock-ups as soon as possible without incurring delay in any operational suitability test programs.

For the Director:

W. S. ROTH,
Colonel, Air Corps,
Chief, Aircraft Projects Section,
Service Engineering Subdivision,
Engineering Division.

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Classification cancelled
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CD-357
Signature and Grade
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HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

REPLY REFER TO:

(AFDMA-2G)
11 August 1945

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

SUBJECT: Controls for Series of Heavy Bombs

13 Aug '45

TO: Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: Office, Chief of Administration (TSTEX)

1. It is directed that a development program be initiated by the Air Technical Service Command to produce for the Army Air Forces a series of very large, deep-penetration, vertical controlled missiles in a complete range of sizes from the 12,000 lb and 22,000 lb now in development up to 100,000 lbs as follows:

12,000	22,000	30,000	42,000	50,000
60,000	70,000	80,000	90,000	100,000

Overall coordination of development will be a responsibility of the Air Technical Service Command, as will the development of those portions of the missile not falling within the basic technical ability of the Ordnance Department. The Air Technical Service Command will assign to the Ordnance Department the development of warheads, fuzes and other components in which Ordnance is considered to have the "basic technical ability in research" referred to by the directive of the Deputy Chief of Staff of 2 October 1944, copy attached. The Air Technical Service Command, however, will be responsible that the bomb warhead design is such that control can be satisfactorily applied.

2. Special emphasis should be given to the 12,000, 22,000 42,000 and 70,000 lb sizes, since there are now aircraft in development for carrying these bombs. The Army Service Forces have been requested to initiate engineering studies on a series of bombs to give the range of sizes quoted above. The 12,000 lb and 22,000 lb bombs are already available, and control studies have been started by the Air Technical Service Command on these sizes. The 42,000 lb bomb is now being engineered.

3. The attached statement of Military Characteristics is ~~forwarded~~ for guidance in the prosecution of this project. A statement of the es-

[redacted]

ADDRESS REPLY TO: COMMANDING GENERAL, ARMY AIR FORCES, WASHINGTON 25, D. C.

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timated time schedule of these developments is desired in this office by 10 September 1945.

4. A 3A priority is assigned to this project.

By Command of General ARNOLD:

B G Bunker

B.G. BUNKER
Colonel, Air Corps
Actg Chief, Materiel Division
Office, Asst. Chief of Air Staff
Materiel and Services

2 Incls
Incl 1 - Statement of Mil. Req.
Incl 2 - Memo of 2 Oct 44

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Major Jon H. Ober
ced/TSTEX (5-6147)
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Auth: CG, ATSC
Date: 8/24/45
Init: JHO

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Wright Field, Dayton, Ohio
24 August 1945

SERIAL NO: TI-2003, Addendum No. 47

SUBJECT: Controls for Series of Heavy Bombs

TO: Engineering Division

1. Problem Presented:

a. To develop a series of very large, deep-penetrating, vertically-controlled missiles.

2. Factual Data:

a. Overall coordination of development will be a responsibility of the Air Technical Service Command, as will the development of those portions of the missile not falling within the basic technical ability of the Ordnance Department. The Air Technical Service Command will assign to the Ordnance Department the development of warheads, fuses and other components in which Ordnance is considered to have the "basic technical ability in research" referred to by the directive of the Deputy Chief of Staff of 2 October 1944, copy attached. The Air Technical Service Command, however, will be responsible that the bomb warhead design is such that control can be satisfactorily applied.

b. Special emphasis should be given to the 12,000, 22,000, 42,000, and 70,000 lb sizes, since there are now aircraft in development for carrying these bombs. The Army Service Forces have been requested to initiate engineering studies on a series of bombs to give the range of sizes quoted above. The 12,000 lb and 22,000 lb bombs are already available, and control studies have been started by the Air Technical Service Command on these sizes. The 42,000 lb bomb is now being engineered.

c. The attached statement of Military Characteristics is for guidance in the prosecution of this project.

3. Authority:

a. CG, AAF. By letter dated 11 August 1945, subject as above, received from AFDMA-2G, Acting Chief, Materiel Division, AC/AS, M&S.

471.63 - Bomb

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SERIAL NO: TI-2003, Addendum No. 47

SUBJECT: Controls for Series of Heavy Bombs

4. Action Desired:

a. That the Engineering Division develop a series of very large, deep-penetrating, vertically-controlled missiles, in a complete range of sizes from the 12,000 lb and 22,000 lb now in development up to 100,000 lbs as follows:

12,000	22,000	30,000	42,000	50,000
60,000	70,000	80,000	90,000	100,000

(1) The Chief, Materiel Division, is to be furnished with an estimated time table for the above developments by 10 September.

b. This project carries a 3-A priority.

c. This TI is approved for post-VJ-Day compliance.

By command of Major General KNERR:

for H O Bentley Maj AC

K. H. BITTING
Colonel, Air Corps
Chief of Administration

2 Incls:
#1 Directive frm CG,AAF
#2 Statement of Mil.Char.

cc: Procurement Division
Supply Division
Maintenance Division
Tech Liaison Office
Flight Test Division

[redacted] W-32799-A-

Control for Series of Heavy Bombs

Research & Engineering Division AC/AS-4 — 15 FEB [illegible]

2

Guided Missiles Division AC/[illegible] — Lt. Col. Thorne/eh/72435

1. The requirement for a series of very large, deep-penetration, vertical controlled missiles continues to exist. The advent of bombs of great blast effect makes the requirement for penetration bombs more firm. The enemy may be expected to place his most vital targets underground. These installations will also be of very heavy construction quite similar to those constructed by the Germans during this war. The present 1[illegible],000 lb bomb is proven to be ineffective against these targets in tests now being conducted in Europe.

2. Agree with Comment 2a above. However, the directive to Air Technical Service Command invites such thinking. Even though paragraph 1 of this directive directs the designing of warheads, fuzes and other components that will permit satisfactory control, paragraph 2 calls attention to aircraft being developed to carry standard conventional bombs and directs emphasis be placed on control of those bombs for which aircraft are being developed.

3. It is recommended that the directive be rewritten clarifying the desires of this Headquarters.

(a) Continue to investigate the possibility of applying satisfactory control to conventional bombs of the large sizes.

(b) If it is determined that control can not be applied satisfactorily to conventional bombs, action must be taken to design warheads, fuzes and components that will permit the desired control.

(c) If it is determined that aircraft now in development are unsatisfactory for carrying the newly designed bomb, steps should be taken to develop a suitable aircraft for that purpose. Thought should be given to expendable and towed aircraft with a cheap power unit to assist in take off and to provide greater speed on the target run after release.

2 Incl.
r/c

WILLIAM L. RICHARDSON
Brigadier General, U.S.A.
Chief, Guided Missiles Division

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[redacted]
Auth: C.G. AMC
Initials: CMT
Date: 14 JUNE 1946

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App. B, VOL. III

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Auth: C.G. AMC
Initials: CWT
14 JUNE 1946

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THE DEVELOPMENT OF GUIDED MISSILES

APPENDIX C

Navy and Ordnance Documents

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[redacted] ... IS RETURNED
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... THE AAF
HISTORICAL OFFICE

FILE NO. 201-48

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... C.G. AMC
... Cunt
... 14 June 1946

Downgraded to Unclassified in accordance with letter from AMC, dated 17 Nov 59, subj: "Declassification of Histories (U)"

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C.G. AMC
Chief
14 June 1946

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Auth: C.G. AMC
Initials: Cu-T
Date: 14 June 1946

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[illegible] by [illegible] of [illegible] missiles [illegible] and [illegible] by the enemy [illegible]

[illegible] available [illegible] project designated [illegible] which has been [illegible] employ only presently available components. This [illegible] on [illegible] March 1945.

[illegible] features and the [illegible] of the foregoing [illegible] are given in greater detail in the attached [illegible] of the specific missiles.

The [illegible] program of the Bureau of Aeronautics may be stated [illegible] completion of the three ship-to-air missiles [illegible] above, the continuation and expansion of the present programs of development of component phases of the missile design [illegible], and the laying down of the design of more advanced ship-to-air missiles as military requirements and the state of the art may require.

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3. To give the missile a high speed so as to be less vulnerable to anti-aircraft fire or fighters.

4. To give the missile an acceleration and continued thrust as it comes out of its dive at a low level, in order that it may have increased range in level flight at low altitude (skimming).

5. To give the missile an acceleration prior to impact with the target, in order that it may strike with armor-piercing (A.P.) velocity.

6. In the case of long-range artillery or ground-launched missiles, to provide the principal power for high-velocity flight.

7. Under conditions of low [illegible] gliding missile [illegible] by A.A. fire.

The principal types [illegible] described below in order [illegible] propulsion may be considered [illegible] [illegible] propulsion [illegible].

[illegible] control.

[illegible]

[illegible] control system.

[illegible] with conventional [illegible]

[illegible] controlled 1000-lb. or 2000 lb. bomb [illegible] control only.

[illegible] bomb in 1000- and 2000-lb. sizes having [illegible] range and azimuth control.

[illegible] winged anti-aircraft or anti-light ship missile, launched from and controlled by a parent aircraft. Type A is to be propelled by a rocket and Type B by a turbo-jet. The frame is of the "Canard" design.

[illegible] Similar to Gorgon II, but with frame of conventional aircraft design. Types A and B will employ rocket and turbo-jet propulsion, respectively.

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[illegible]

The fuel is not known, but it must be a [illegible] since the space for the second fluid is insufficient to [illegible] appreciable oxygen and this second liquid must be a catalyst. The heat of explosion must be low or there must be a diluent, since the burning temperature is so low.

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made with 3 to 4 aircraft flying past the ships [illegible] and releasing the gliders when the line of sight [illegible] to the target. [illegible] proceed for a few seconds [illegible] craft before [illegible] the direction of attack. [illegible] dence that the Hs-293 [illegible] the target. About [illegible] fail to function properly.

There has been some confusion between the Hs-293 and the F.X. since the latter has large frontal [illegible] wings. [illegible] He-177 [illegible] at [illegible] The [illegible] of being [illegible] air-to-air bombing.

The P.C. 1400 F.X. (Fritz or [illegible]) [illegible] both about 3-1/2 ft. long and [illegible] 22 inches [illegible] have not [illegible] with jet-propulsion.

The German P.C.R.R. rocket bombs (14) are [illegible] not [illegible]. These are 440 to 2000 kg. A.P. bombs [illegible] attack on capital ships. A single rocket [illegible] rocket candles (or [illegible]) is fitted [illegible]. The burning time is about [illegible] seconds.

b. Aircraft Propulsion

Reports of German technical developments are [illegible] and confusing, so it is possible to obtain only a broad general picture of the probable developments. It seems evident, however, that the Germans have developed and flown airplanes powered by turbo-jets and by ram-jets.

The Heinkel 280 is reported to have no propellers [illegible] powered by two axial-flow turbo-jets of the [illegible] type. The latter has a maximum thrust of 1700 lbs. at sea level. The competing Junkers turbo-jet Jumo-004 (JuTL) has a thrust of 2100 lbs. at sea level. High temperature alloys for turbine blades have presented a serious problem, since the requirements are difficult to meet and Germany lacks some of the special metals used in such alloys. Special blade designs have been developed to improve cooling. The best combination appears to be a [illegible] airplane with the Jumo turbo-jet power plant. This is a single-seater with a finely-pointed fuselage and a low weight per h.p. It is said to have an endurance of one hour, a top speed of [illegible] m.p.hr., and a landing speed of 110-125 m.p.hr. One report is that large production of these planes did not go ahead (in [illegible] 1943) because the large fuel requirements could not be provided. Another report is that these planes will be in service in 1944.

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subject of intense study in

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not be described in detail. Although much information is avail- able concerning the launching installations along the [illegible] Coast, very little is known about the missiles to be [illegible]. There appear to be two [illegible] different developments. One, probably a very large high altitude rocket, without wings, [illegible] rocket and propelled by rockets. The probable [illegible] this device is outlined in Section [illegible]. The other is probably [illegible] pilotless aircraft since the launching [illegible] [illegible] short and set at [illegible] to the horizontal [illegible].

[illegible]

[illegible] oxygen is [illegible]

d. Submarines

[illegible] No information is available [illegible] agency, but it [illegible] for speed-boost.

At 15 knots each 1000 [illegible] lbs. With a specific impulse [illegible] thrust at a fuel rate of [illegible] lbs. [illegible] even a small submarine would require [illegible] fuel to obtain a speed-[illegible] for [illegible] minutes.

At least one report refers to a German development of a jet- propelled underwater torpedo. The Italians are [illegible] have ex- perimented with jet-propulsion for torpedoes.

e. Assisted Take-Off

1. Reports are available indicating that the German [illegible]

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ENCLOSURE "B"

DRAFT

MEMORANDUM FOR THE JOINT POST-WAR COMMITTEE:

SUBJECT: Capabilities and Development Trends of Guided Missiles and Other New Developments in relation to Permanent Seacoast Defense Fortifications for Postwar Military Bases.

REFERENCES: a. J.C.S. 1096
b. Memorandum to JCS from Joint Post-war Committee dated 6 November 1944.

1. In the reference b [illegible] memorandum the Joint Committee on New Weapons and Equipment was requested to advise the Joint Post-war Committee on this subject. The current capabilities and probable trends of development of guided missiles and other new weapons and equipment in relation to [illegible] have been reviewed in response to the request of the Joint Post-war Committee. The problem has been interpreted as relating primarily to [illegible] defense against seaborne or airborne attack. The following [illegible] in accordance with the questions contained in the inquiry [illegible] November 1944:

"It is requested that the Joint Committee on New Weapons and Equipment furnish to the Joint Post-War Committee, in connection with the study presently being conducted in compliance with the reference:

a. A summary of the current capabilities of guided missiles, and the probable trends in their development, as may be related to the problem under consideration."

"(1) For the period of five years through 1950."

2.

a. The probable development of various guided (and homing) missiles for coast defense and for attacks on coast defense installations is tabulated in Appendix "A". Some details concerning the various missiles are set forth in Appendix "B".

b. In general, many of the developments of guided missiles may be utilized by the attacking as well as by the defending forces. The defending forces will generally have the advantage of opportunity for more elaborate launching equipment, greater capacity for storage and perhaps

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more precise navigational methods, but will [illegible] ing unable to take avoiding action.

c. Long-range guided missiles (over [illegible] mi.) are already [illegible] effective against such large targets as [illegible] but they cannot yet be controlled with sufficient precision and in sufficient numbers for conclusive action against such small targets as coastal installations or attacking ships. With five years of [illegible] development the requisite precision of observation and control can be expected.

d. One can speak of three main periods in the development of the [illegible] of coast defence and attack. The first period is characterized [illegible] rently available refinements and aids to present tactical [illegible] period, significant diminution in the importance of [illegible] equipment is indicated. The second period, two to three years [illegible] will be marked by an extension of the range of bombardment [illegible] and shore fire against ships, to forty or fifty miles, [illegible] ment of guided or homing missiles of the V-1 type. The [illegible] sents the foreseeable limit, under ordinary circumstances, of [illegible] vision of target and missile. Such a development will make [illegible] coastal artillery inadequate for defense against such attacks. In the third period, beginning, say, five years from now, the situation may be entirely altered by the possibility of very long-range attack and defense.

e. Predictions as to availability of new missiles can be made with fair assurance relating to items listed for the next two or three years, on the basis of current laboratory results. The predictions for four or five years assume a vigorous and integrated program of development of supersonic missiles.

3. "(2) Probable indicated trends subsequent to that period

a. Probable indicated trends subsequent to 1949 (again assuming a vigorous and well integrated program of development) suggest that accurately controlled supersonic missiles should be available between 1949 and 1954. In various forms they should be available for the different

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[illegible]

[illegible] ... under development, the [illegible] the [illegible] be inaccurate in range.

"Trends and [illegible] for future development"

[illegible] years the trend will be to powered supersonic missiles, [illegible] powered supersonic missiles. [illegible] greater the missiles will become less vulnerable to countermeasures but will require increasing perfection of control. They will still have missile identification problems when guided and target identification problems when homing. The longer the range of control the more important [illegible] methods become for the final approach to the target. [illegible] will

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[illegible] with [illegible] of [illegible]

[illegible]

"[illegible] defense weapons, of [illegible] and other [illegible] new weapons."

Present fixed armament coast [illegible] of major caliber may [illegible] be [illegible] limited to what will [illegible] range [illegible] [illegible] and hence of less moment [illegible] the time between [illegible] and [illegible] whenever large quantities of accurate [illegible] long range missiles become available. Fixed permanent [illegible] defense of extended [illegible] may only force an invading force [illegible] over beaches rather than by seizing ports. [illegible] installations would preclude their use except [illegible] It is assumed that where such installations are [illegible] will [illegible] designed as to [illegible] naval and air [illegible] Modern [illegible] antiaircraft fire with radar tracking and [illegible] will lose much effectiveness when [illegible] type missiles fly at high altitude and follow a jinking course. Against such [illegible] the AA defense would have to be so dense as to be prohibitive [illegible] for any but the most vital targets. Against supersonic high-trajectory missiles conventional antiaircraft fire is entirely ineffective.

d. "The effect of the employment of guided missiles or other new weapons against fixed installations:

(1) Of the current types.

Guided missiles should be effective against current types of coast defense installations, whenever the precise location of these installations is known to the remote operator.

(2) "Consisting predominantly of installations for guided missiles or other new weapons."

The guided missiles for defense of a base would be stored in underground magazines invulnerable to air and naval bombardment and would be carried by mobile launchers to prepared sites or to any level ground for launching. They would thus be less vulnerable than present installations. Air-launched missiles have, of course, the vulnerability of their carrier pla[illegible]

Enclosure "[illegible]"

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e. "Countermeasures, available and trends in development, against guided missiles or other new weapons which may be related to the problem, when such new weapons are employed."

Possible countermeasures to guided missiles, apart from present antiaircraft fire against winged versions, include electronic jamming of the guiding link and obscuration or confusion of the target area. Against homing missiles obscuration or confusion of the target area or the use of decoys must be relied upon. As a defense against air-launched missiles, an increased range of attack by fighters upon the launching airplane would be an effective countermeasure. The guided AA projectile should also become an important defense.

(1) "By seacoast defenses."

When visually supervised guided missiles are used by the defenses, smoke screens may have some value in protecting the attacking forces. If the missiles are radar supervised, the usual [illegible] methods come into play. In both cases attempts would be made to jam the radio control link. When homing missiles are used, [illegible] confusion and decoys would be expected.

(2) "Against seacoast defenses of fixed [illegible] and current types."

When guided missiles are used against current seacoast defenses the above methods of jamming are to be expected, but the defending forces should place great emphasis on camouflage or underground [illegible] and on mobile defense installations having no permanent location, since a guided missile can only be effectively directed against a located target.

(3) "Against seacoast defenses consisting predominantly of new types of weapons."

These types of seacoast defenses would be expected to be dispersed and, hence, somewhat less vulnerable, but all of the above precautions should be taken.

[redacted]

[redacted]

APPENDIX "A" TO ENCLOSURE "B"

DRAFT

PROBABLE DEVELOPMENT OF GUIDED MISSILES

1. 1945

a. For defense of coast.

(1) Air Launched

High Angle Bombs
FX (visual observation, radio control)
Azon (visual observation, radio control)
Razon (visual observation, radio control)
Felix (heat homing)

Glide Bombs
HS293 (visual observation, radio control)
Pelican (homing on reflected radar)
Some GB's (television or direct sight, radio controlled)

(2) Special Torpedoes, homing, which may be launched from air, from surface craft, or from submarine.

For attack on Coastal Installations

High Angle Bombs
FX

Azon

Razon

Glide Bombs
HS293

Some GB's

b. High angle bombs and glide bombs do not materially alter tactics nor make existing devices obsolete. They merely increase the precision of high angle bombing or permit attack from outside the range of present antiaircraft defenses.

c. Special torpedoes are also a refinement and call for no major change in planning.

d. In general, it can be stated that both guided and homing missiles are apt to be useful against attacking ships and planes, but that, because of the lesser contrast between coast defense installations and the surrounding terrain, the attacking forces will be limited to guided missiles.

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2. 1946 or 1947

a. For defense of coast. — For Attack on Coastal Installations

(1) Air Launched Missiles

As in 1945 plus Bat (homing on reflections of its own radar) and Roc (televison or heat-homing)

Plus television Roc as in 1945

(2) Ground Launched V-1 and V-2 Types

Accurately guided (or homing for V-1) to ranges of 40 mi.

(3) Ship Launched

V-1 type, accurately guided.

(4) Ground Launched Subsonic

Guided antiaircraft projectile.

(5) Torpedoes (shore launched and also radio guided) as in 1945, plus longer range.

b. Accurate guiding implies sufficient accuracy to hit a destroyer or larger ship or land installations of corresponding size.

3. 1948 or 1949

a. For defense of coast — For Attack on Coastal installations

(1) Ground LaunchedV-1 and V-2

Accurately guided (and homed) to ranges of 300 mi.

(2) Ground Launched supersonic

Guided antiaircraft projectile.

(3) Ship Launched V-2 Type

Accurately guided, but probably of shorter range than shore-launched missiles

(4) Ram jet missiles for general purposes, ground, ship, and air launched

Accurately guided.

b. By this time ground launched missiles will have sufficient speed to attack aircraft. The limited number of missiles that can be carried on an aircraft for air launching will tend to give advantage to shore installations. Even ships will be at a disadvantage because of limited storage space.

4. When the general class of accurately guided supersonic missiles are avialable in large quantities, perhaps by 1954, many of the present types of weapons will become obsolete.

[redacted] Appendix "A" to Enclosure "B"

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APPENDIX "B" TO ENCLOSURE "B"

DRAFT

SUMMARY OF GUIDED MISSILES

1. Non-powered missiles.

a. In considering coast defense and other immediate applications of guided missiles which may become effective in 1945 or 1946, a very brief review of the state of the art may be in order. Consider first those missiles which are primarily powered by gravity. Among high angle guided bombs two have seen combat use, the German FX and our Azon.* Each has had its notable early success but each has been used less extensively than might first have been expected. In the case of FX a special maneuver of the bombing plane is necessary immediately after releasing its bomb. This requires special training and coordination of pilot and bombardier. Also, the bomb is very large (2800 lbs.) and must be carried on a wing rack. In the case of Azon the operational data are very meager, and opinions differ as to its effectiveness. The 8th and 15th Air Forces, after some few months of the use of Azon, abandoned it. An Azon squadron has gone to the 10th Air Force, but no operational reports have yet been received. Production of the Azon tails has now ceased but a considerable number are understood to be in stock. Because of the early availability of Razon, Azon will probably shortly become obsolete.

b. Two more high-angle guided bombs should shortly become available, Razon and Felix.** A special attachment for the Norden bombsight frees Razon of one limitation of the German FX, the necessity for a difficult maneuver after release of the bomb. The Razon bomb is smaller (1000 lb.) and goes inside the bomb bay. It is believed that Razon can be made to hit large ships from an altitude of [illegible],000 ft., whether or not the ship is taking evasive action, as well as [illegible] targets requiring high precision.

* FX is a high-angle bomb, radio-controlled in range and azimuth. Azon ([illegible]) is a high-angle bomb, radio-controlled in azimuth only.

** Razon ([illegible]-Gulf) is an American development of a high-angle bomb, radio-controlled in both azimuth and range. Felix ([illegible]) is controlled by a heat-seeking device in the nose of the bomb.

[redacted]

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[redacted] [redacted]

c. Felix is shortly to be tested at Orlando, following good results [illegible] at Tonopah. If these tests are satisfactory, it may go into early [illegible] use in limited quantities. The importance of a heat-seeking missile will depend, of course, on the degree of success attained in selecting proper targets.

d. Roc and Dove*** still need more development work. [illegible] as a vehicle of triple application. Its greater maneuverability will permit visual co-linear control in attacking very small targets, thus eliminating the source of error present when Razon is used with the [illegible] sight. Its ability to turn without banking and its nearly constant angle of attack lend themselves to the proposed television application and [illegible] heat homing. The design of Dove contains many refinements. It should be better than Felix against moving targets.

e. Three types of glide bombs have seen combat use, the German HS-293 (with some variants) and our GB1 and GB4*. HS-293 is really a gravity-powered missile, although it has initial jet propulsion to get it up to flying speed and out in front of the air plane which carries it. [illegible] this weapon has not lived up to its initial successes, although this may be due to decreasing opportunities for its use as Allied air power has increased, as well as to jamming operations. GB-1 (pre-set) and GB-4 (television) have had very minor operational use and it is understood that no further operational use is contemplated, either for these or for other

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***Roc is a more elaborate high-angle bomb, built around a 1000 lb. payload. It is to be steered by tilting a ring-shroud located near the center of [illegible] of the missile. This shroud can be tilted about either of two axes to give control in both azimuth and range. Dove (BuOrd-Polaroid) is an advanced design of heat-seeking bomb. All of the controls are to be located in a special nose to be attached to a standard bomb. The bomb is to be steered by yawing it by the action of lift-spoilers to be protruded from the nose of the bomb. The nose is to be roll stabilized by inertial reaction against the remainder of the bomb. A modified tail is needed for stability but it has no control function. The heat-seeking "eye" (NDRC-Polaroid) is to be gyro-stabilized. Measurement of target angular rate will allow computation of collision courses against moving targets.

* The German HS-293 is a radio-controlled glider built around its bomb. The glider carries a large flare which can be seen for several miles. The glider is steered by radio so as to keep the target eclipsed by the flare. The weapon has not been particularly accurate in combat use. The GB family of glide bombs have been developed by Wright Field. With minor variations the air frame is common to the group. It is a very simple structure, easily transported, and is assembled on two beams strapped to the bomb. Simple gyro-stabilization is provided. In the simplest form GB1, the direction of flight is pre-set into the gyro system and there is no other control. GB[illegible] is steered by radio and observed by a flare similar to HS-293. GB4 and GB[illegible] are two variants adapted for television. GB5 is a light-seeker, GB[illegible] a heat-seeker and GB7 used radar for homing. [illegible]

[redacted] [redacted]

members of the very numerous GB family. Other GB's under development include one for direct radio control and others with homing controls utilizing light, heat, and radar. These had all achieved some small measure of experimental success, but the GB program undoubtedly suffered much from its diversity.

(c) After many difficulties Pelican* tests are now about 40% successful against ship targets but the Navy has decided that there is no operational requirement for this type of weapon. Bat is still under development and it remains to be seen if the advantage of providing its own radar illumination will offset the added cost and weight of the transmitter. This answer should be forthcoming within 1944. In addition to the GB family of glide bombs (Army Air Forces) and the Pelican-Bat type (NDRC-BuOrd), there is also the Glomb (BuAero). It is an explosive laden glider to be towed to target behind a bomber and then to be directed against its target by remote guiding or homing or by a combination of these two methods. It is understood that Glomb now has a rather low priority.

4. Radar-guided powered missiles.

a. The application of radar control to powered missiles is already in progress. The Willie projects** may be regarded as the forerunners of this general development. The possibilities of this type of control are suggested by recent tests of elements of the Willie system. By the use of plotting-board techniques, together with SCR-584 and responder-beacon location of the aircraft, it is expected that a plane can be directed with an accuracy in range and azimuth of the order of 0.1% of the total range. (Altitude is regulated by a local altimeter in the aircraft.) In preliminary tests a B-17 has been directed to a point 32 mi. distant with an error of 100 yards. The overall bombing error is expected to be approximately twice the tracking error. Certain general features of this type of control may be noted: (a) Directions are relayed to the aircraft by the radar beam itself; (b) the necessary electrical apparatus in the

*Pelican (NDRC-Bureau of Standards) is a glide-bomb on reflected radar. The target must be kept constantly illuminated from the bombing plane during the flight of the Missile. Bat (BuOrd-Bell Telephone Labs) contains its own transmitter but is otherwise generally similar to Pelican.
**Remotely-controlled, unmanned, conventional aircraft (often a "war-weary").

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aircraft (exclusive of servo motors) would weigh about 50 lbs.; (c) range is limited by line-of-sight; (d) available beacon coding and decoding techniques allow a very high degree of security to be built into the system if desired.

b. The Willie type of control system is applicable directly to V-1. There is every reason to believe that a radar guided V-1 can become an important weapon in more than one field of warfare in the rather near future.

c. The guiding of V-2 presents a rather different problem. One does not yet know how V-2 can be controlled aerodynamically in the non-powered phase of its flight. In order to effect a significant increase in accuracy, it presumably must be controlled over some latter portion of its trajectory, during which period it would be brought on to a trajectory passing through the target. It can be said that the tracking of V-2 in range azimuth, and elevation offers no difficulty with responder-beacon techniques and that, if suitable steering over the latter part of the trajectory could be achieved, the point of impact could be very accurately controlled. The design of the complete servo-loop may present some new problems and, in any case, will be drastically affected by the nature of the steerability of the missile.

3. Guided antiaircraft missiles.

a. The probability of hitting an enemy aircraft by current, predicted antiaircraft fire becomes small for ranges greater than about 10,000 yds. If the hostile aircraft can "jink" or maneuver out of the lethal region of the burst in less than the time of flight of the projectile, the aircraft is relatively safe. As a result, land and seacoast installations, surface ships, etc may become unable to defend themselves against bombing from high altitude or against missiles launched from "mother" aircraft outside the effective range of the antiaircraft defense. Consequently, the use of fighter planes or, better, of guided antiaircraft missiles, is necessary for protection. For a guided antiaircraft missile to be completely effective, it must first travel faster than the enemy aircraft;

[redacted] Appendix "B" to Enclosure "B" [redacted] [redacted] [redacted]

second, it should be guided on a path to its target which does not require excessive maneuverability of the missile; and, third, the missile should not be vulnerable to fire from the enemy aircraft. These conditions are partially satisfied by the subsonic guided missile, whose velocity is just below the trans-sonic range, and should be completely met by the supersonic guided missile. The first of the above conditions dictates that both of the missiles should be jet propelled because of the inefficiency of the standard aeroplane propeller in this velocity range and at high altitude.

b. The subsonic guided antiaircraft missile.

(1) At the present time it should be possible to construct a satisfactory subsonic missile. Data are available for the design of the aerodynamical surfaces and reliable controls. Efficient turbo jet engines or aero-pulse (buzz bomb) engines are now developed to the point where they can be used for driving the missile. Experience with the radar and radio control of glide bombs, pilotless standard airplanes, etc., together with an assessment of the present state of this type of control in general, indicates that a satisfactory mechanism for guiding the subsonic missile to its target can be developed within a year.

(2) The principal disadvantages of the subsonic antiaircraft guided missile is its vulnerability to gun and rocket fire from the enemy planes and its long overtaking range. Its advantages are that it can be launched from rest. It should be an effective weapon and could be ready for use in a comparatively short time.

c. The supersonic guide antiaircraft missile.

(1) At the present time experimental data for the aerodynamic control of aircraft at supersonic speed are very meager and are not sufficient for design purposes. Also, except for the inefficient rocket motor, which is practical for this use only for short range, no tested power plant exists which is suitable for driving a supersonic guided antiaircraft missile. However, a very promising method of propelling the supersonic missile, called the ramjet or athodyd, has been proposed but, as yet, the experimental data necessary for

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calculating its performance are not available. Recently, some investigations of this have been started both in the United States and in England.

(2) The radio or radar and servo control for a missile attacking at supersonic speed a maneuvering target must be worked out. This system problem calls for no basically new developments, but it is difficult enough so that we cannot now foresee the form its solution will take. In view of the fundamental nature and difficulty in carrying out some of the necessary experiments, it may require from three to five years before a satisfactory long range, supersonic antiaircraft guided missile can be produced even with intense effort. Progress throughthe trans-sonic range of speeds may involve serious problems of stability.

(3) The disadvantages of this weapon are that it has to be launched and the probable long time required for its development. Its advantages, however, are its very great defensive and offensive value and that it is not vulnerable to the enemy's defenses.

(4) Small, short-range antiaircraft guided missiles such as the British "Ben" , which are propelled by ordinary rocket motors, are practicable but considerable time may be required for the development of the controls.

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WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON, D.C.

AFRDB

27 August 194[illegible]

SUBJECT: Navy "Bat" Project

Commanding General
Army Air Forces Center
Orlando, Florida

Attn: AAF Board

1. The U.S. Navy made limited operational use in the war against Japan of a missile designated as SWOD Mark 9. This missile is known by the code word "Bat". Lt. Colonel Richard Craig of the Army Air Forces Board was placed on temporary duty with the Navy to serve as AAF Liaison officer of "Bat" operations in the Pacific. This officer submitted periodic reports of his activities directly to this Headquarters. These reports were well written and of great interest to personnel concerned with the field of guided missiles.

2. Lt. Colonel Craig has completed his temporary duty with the Navy and has returned to the Army Air Forces Board. In order to bring all available information on this project together in one document, it is desired that a final report be prepared on Lt. Colonel Craig's period of temporary duty with the U. S. Navy.

3. A <u>2-C</u> priority is assigned this project.

BY COMMAND OF GENERAL ARNOLD:

HOYT S. VANDENBERG
Lt. General, U.S.A.
Assistant Chief of Air
Staff - 3

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Summaries on Navy GM Program GM Br. ac/ad-4
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[20 Nov. 1945]

Bureau of Ordnance Guided Missile Policy

1. To concentrate initial effort to develop ship launched supersonic guided missiles with priority as follows:

   (a) Ship to aircraft
   (b) Ship to Ship
   (c) Ship to ground
   (d) Ship to guided missile

2. At the propitious time proceed with development of the Bee family and such other types of guided missiles as may be appropriate.

3. To continue development of air to ship subsonic guided missiles with underwater payloads.

4. To provide funds for continuing program in approximately same order as now provided. i.e. about 1/5 to 1/4 of Re funds.

5. To foster general civilian scientific support of all guided missile programs.

6. To maintain extensive liaison with all other agencies developing guided missiles and pilotless aircraft by maintaining technical personnel in the laboratories and test stations working on guided missiles, so as to avoid unnecessary duplication of effort and to maintain a constant ar complete interchange of information.

7. To permit all other United States agencies developing guided missiles and pilotless aircraft to have free access to all data and information attained from BuOrd projects.

8. To support the mutual use of all test facilities by all agencies developing guided missiles and pilotless aircraft to the limit of the capability of those facilities and to utilize test facilities of other agencies.

9. To coordinate BuOrd research projects with those of other agencies to prevent undesirable duplication of effort.

10. To foster an extensive educational program for Naval officers and selected civilians in the scientific fields required for guided missiles to increase the supply of professional talent to meet demands of research, development, production and use of guided missiles.

11. To promote research on countermeasures against all types of guided missiles.

12. To foster close liaison with the agency responsible for development of atomic explosives and propellants so that these fe ures may be utilized in guided missiles when available.

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[illegible] elements [illegible] in [illegible] fields [illegible] which [illegible] to [illegible] recognition [illegible] enemy [illegible] and [illegible] sufficient range to permit launching of guided missiles in time to be effective.

9. To encourage development by other agencies of long range, early warning radar systems.

10. To insure provision for adequate component test facilities in the general vicinity of the laboratories to avoid the long delays which would be required to conduct major tests at stations remote from the laboratories. It is considered that short range East Coast test stations and a long range West Coast station will be adequate for BuOrd purposes.

16. To recognize the inherent characteristics of long range research programs by maintaining sufficient complimentary projects to reduce the chance of total failure which exists when complete reliance is placed in a single item or a single organization. Two groups working to solve the same major problem approaching the problem with different viewpoints and from a different direction are necessary for reasonable assurance of success.

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Program

In order to carry out BuOrd Guided Missile Policy, BuOrd proposes to adopt the following program:

1. To maintain the Bumblebee project at the Applied Physics Laboratory (Johns Hopkins University) at present scale. (About 3/4 BuOrd guided missile research effort.)

2. To establish a complementry project at the Massachusetts Institute of Technology at about 1/4 BuOrd guided missile research effort

3. To continue development of Kingfisher at the National Bureau of Standards

4. To establish a small general research project at Inyokern with primary emphasis on liquid propulsion, launching, and overall guidance systems. Sufficient consideration will also be given to general propulsion and controls, payloads and the other phases of guided missiles in order that the scientific testing personnel can be provided an adequate background on guided missiles and an intimate knowledge of all developments in both APL and MIT. This should insure that adequate test facilities and evaluation of each completed type of missile can be quickly and effectively covered. Along with this research program the Bureau will continue its plan to provide an adequate test laboratory and related facilities at Inyokern for flight testing and overall missile system testing of all types of guided missiles

5. To be prepared to establish a small general research project at NOL with primary emphasis on aerodynamics controls and overall missile design. Sufficient consideration will be given to other phases such as propulsion, launching and guidance to provide adequate background for the scientific staff of NOL in the new field of guided missiles, and liaison with other agencies. The primary field for NOL in guided missiles, however, should be developmental, type testing and component testing which can be done by means of shop tests, as contrasted with flight testing which will be done at Inyokern and the East Coast Test Stations

6. Provide a new short range test station on the Eastern Seaboard and maintain Warren Grove for computer and homing developmental tests where recovery is necessary. Whenever the new station can provide the facilities now available at Warren Grove, Island Beach and Fort Miles, those stations will be closed

[redacted]

7. To stress early provision of large rocket pushers for Bumblebee. Coordinate developments with other agencies.

8. Applied Physics Laboratory, Johns Hopkins Laboratory, Massachusetts Institute of Technology, National Bureau of Standards, and other BuOrd research projects will not compete for securing any outside agency. Each BuOrd project must respect interests of other projects.

9. Provide a program for investigating optimum warhead characteristics.

10. Develop ship board launching equipment and installations by time it is needed for test and evaluation for guided missiles.

11. To complete the current minor development projects for such items as glider targets.

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MISSILE CATALOGUE

COGNIZANCE	MISSILE	TYPE
BuOrd	Bumblebee	Ship to air; ramjet; beam guidance; super-sonic
BuOrd	Meteor	Ship to air; jet propelled, super-sonic, radar homing.
BuOrd	Kingfisher	Air to Ship; subsonic; radar homing; underwater payload.
BuAer	BAT	Air to ground; glider bomb, radar homing; sub-sonic
BuAer	LARK	Ship to air; rocket propelled; shipboard radar plus homing radar; sub-sonic
BuAer	GORGON II A	Air to air; rocket propelled; television plus radio guidance, subsonic
BuAer	GORGON II C	Ship to ground (short & long range); intermittent jet, beacon and radio control, sub-sonic
BuAer	GORGON III A	Air to air; radio guided, television.
BuAer	LOON	Ship launching project for adapting Army JB-2.
BuAer	GARGOYLE	Air to surface; glider bomb; guidance flare, line of sight with radio control, automatic pilot.
BuAer	GLOMB	Air to surface; glider loaded with explosives, radio control
Bu[illegible]r	Little Joe	Ship to air; rocket propelled (to be dropped in flight); radio control; sub-sonic
AAF	CONDOR	Principle of operation similar to "beefed up" Bumblebee
AAF	Glider Projects	Air to ground; glide bombs dropped from parent plane; radio controlled.
AAF	JB-2 (Copy of German V-1)	Ground to ground; impulse duct (Resojet), gyro control, sub-sonic; radio controlled in flight
AAF	JB-3	Air to air; solid fuel rocket; radar homing; sub-sonic.
AAF	JB-10	Ground to ground; impulse duct, guidance under study; sub-sonic.
AAF	AZON	High angle 1000# G P. (and 2000#) bomb radio controlled in azimuth only
AAF	RAZON	Same as AZON with control in range as well as azimuth.
AAF	ABUSIVE	Development of war weary B-17 and B-24 planes for conversion to guided missiles carrying 18,500 pounds H.E. payload
Army Ord	NIKE	Surface to air; radar guidance, rocket propelled in flight; super-sonic
Army Ord	HERMES	In early study stage by General Electric considering entire guided missile field

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[illegible]	[illegible]	Long range; liquid fuel rocket, gyro stabilized with radio control of deflection vanes in jet stream and air foil.
[illegible]	[illegible]	Intent to develop rocket similar to German V-2.
British	[illegible]	[illegible] one ramjet and other liquid fuel; radar control
British	[illegible]	Air to air; solid fuel rocket propulsion; guidance radar line of sight control; 2000 ft/sec velocity
British	[illegible]	Ground to air; solid fuel rocket propulsion; radar line of sight control; velocity 1500 ft/sec.
German	V-1	Ground to ground; Ramjet; preset compass with pneumatic servo control of rudders; sub-sonic
German	V-2	Ground to ground; liquid fuel rocket propulsion; radio control; supersonic; [illegible] V-2 integrating accelerometer control.
German	[illegible] (Schmetterling)	Ground to air; liquid rocket propulsion; gyro-stabilized, optical tracking of missiles and target; subsonic
German	C-2 (Wasserfall)	Ground to air, liquid rocket propulsion; gyro stabilized and infra-red optical homing; supersonic.
German	Rheintochter	Ground to air; liquid fuel rocket propulsion; radar guidance; supersonic
German	Enzian	Ground to air; liquid fuel rocket propulsion; radar tracking; subsonic
German	X-4	Air to air; liquid fuel rocket propulsion; guidance visual by observation of wing tip flares; acoustic homing; subsonic.
German	HS-298	Air to air; solid fuel long burning rocket propellant; gyro stabilized for roll; radio control; subsonic.
German	X-7	Ground to air; solid fuel rocket propellant; wire controlled; subsonic

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ORGANIZATION

A Bumblebee

Prime Contractor - APL, JHU, Silver Spring, Maryland.
Naval Ordnance Development Unit - Officers & enlisted men - Assists APL in development & test work

(1) Principal Associated Contractors -

(a) For Lone Star Laboratory

Consolidated-Vultee Aircraft Corp	(Operation)
Elliott Co.	(Compressor)
Koch and Fowler of Dallas, Texas.	(Architect-Engineers)
Lone Star Steel Co. of Daingerfield, Texas	(Facilities)
Pittsburgh-DesMoines Steel Co	(Construction)

(b) Other Contractors

Bendix Aviation	(Guidance, Servo gyros, radar computers electronics consultants)
Bendix Products Division	(Fuel metering)
Bowen and Co.	(Pilot production of experimental models and parts)
Bureau of Standards	(Fuel and burner)
Carter Oil Co	(Gyro)
Consolidated-Vultee Corporation	(Overall problems with emphasis on aero-dynamic problems, composite design; also operation of Lone Star Laboratory)
Curtis-Wright Corp	(Overall problem with emphasis on the ramjet, aero-dynamics, flight tests and full size model)
Elliott Co	(Consultants on Fuels)
Erwood Co	(Pilot production of experimental models and parts)
Ethyl Gas Corp	(Consultants on Fuels)

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Experiment, Inc.	(Consultants and testing of fuels and burners)
Farnsworth Television and Radio Corp	(Airborne radar)

(b) Other Contractors (continued):

Hercules Powder Co	(Electric detonators and power delay mechanism)
Princeton University	(Chemistry of fuels, telemetering, guidance)
Standard Oil Development Co. (Esso)	(Test station for ramjet burners; program of fuel evaluation, study of fuel metering, burner design)
University of Illinois	(Aerodynamics)
University of Michigan	(Aerodynamics)
University of New Mexico	(Photography of shock waves on models in free flight testing of burst patterns)
University of Texas	(Aerodynamics and guidance)
University of Virginia	(Test Station for ramjet burners; development of complete burner for ramjet)
University of Washington	(Fuze and warhead)
Wilmotte Manufacturing Co.	(Pilot production of experimental models and parts)

B. METEOR

Prime Contractor M.I.T.
Supplementary contracts with commercial firms for development and design, services, models, shop work, etc as necessary for the project.

C. KINGFISHER

Prime Contractor National Bureau of Standards project under direction of Dr. H. L. Dryden associated groups

(1) NAMU, Johnsville, Pa. conducts airborne tests of the Kingfisher and supplies aircraft for airborne research.

(2) BuOrd Experimental Unit at the National Bureau of Standards, consisting

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of BuOrd officers and enlisted men, assists National Bureau of Standard personnel in development and test work.

D. GENERAL

NOTS will perform research in certain fields.
NOL will be requested to work on development and type testing of BuOrd Missiles and research in aerodynamics using the Kochel wind tunnel.
NOL will also provide facilities for tracer development for Bumblebee.

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[illegible]

[illegible]

(1) Ability [illegible]

[illegible]
(b) [illegible] Test Station
[illegible]
[illegible] been requested of the Army?
(d) [illegible]
Wind Tunnel [illegible]

[illegible]

[illegible]

Warren [illegible] Test [illegible]

Subsidiary [illegible] with commercial firms
[illegible] development
and design

[illegible]

Warren [illegible] New [illegible]
Test [illegible]

National Bureau of [illegible]
Laboratories [illegible] electronic and other test equipment

[illegible] target ships grounded on shoals,
together with observation stations. Air operations will be
from [illegible]

GENERAL

(a) Field testing at Inyokern and East Coast Test Range.
(b) Supersonic wind tunnel (Kochel), shop testing, developmental,
and type testing at NOL
(c) General Research in liquid propulsion at Inyokern
(d) General Research in Aerodynamics at NOL.

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ESTIMATED FINANCES

A. BUMBLEBEE -

July 1945 to July 1946	$12,000,000
July 1946 to July 1947	$10,000,000

B. BAT - (BuAer project as of Nov. 1945)

July 1945 to Nov. 1945 (Est.)	$ 250,000

C. KINGFISHER

July 1945 to July 1946 (Est.)	$ 1,000,000
July 1946 to July 1947 (Est.)	$ 300,000

D. METEOR

Nov. 1945 to July 1946	$ 3,750,000
July 1946 to July 1947	5,700,000

E. GLIDER TARGET

July 1945 to July 1946	$ 235,000
July 1946 to July 1947	[illegible]0,000

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BEE SCHEDULE

Table 1

SIZE 1	PAYLOAD (Pounds)	RANGE (Miles)	USE	WEIGHT INCLUDING LAUNCHING BOOSTER (Pounds)	TIME SCALE
Pre Bee	300 Frag	15	Test(AA)	2000	1946
Might Bee	300 Frag	50	AA	[illegible]800	1948
Esso Bee 1	300 Frag	50	A/M	2800	Very diffi-cult

SIZE 2					
Can Bee 1	2000 Frag	50-150	B	7000	1948
Will Bee 1	2000	50-150	A/S	7000	1949
Could Bee 1	2000	300-500	B	8500	?
Will Bee 2	Atomic	150	A/S	8500	?
Esso Bee 2	Atomic	50	A/M	8500	?

SPECIAL SIZES					
				12000	?
Could Bee 2	Atomic	300-500	B	25000	?
Glory Bee 1	Atomic	1000	B	30000	?
Glory Bee 2	Atomic	2500	B		?
Glory Bee 3	Atomic	4000	B	------	------

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NAVY DEPARTMENT

Bureau of Ordnance

Washington D.C.

11 January 1945

From: The Chief of The Bureau of Ordnance
To : The Commanding General, Army Air Forces

Subject: Intensive Program on Guided Jet-Propelled Antiaircraft Missiles.

1. On the basis of technical evaluations and work already in progress, the Commander in Chief, United States Fleet, directed on 4 December 1944 that the Bureau of Ordnance program on the development of guided, jet-propelled antiaircraft missiles is to be carried forward on an urgent basis, and further directed that other Bureaus and agencies of the Navy shall give all possible support and assistance to the Bureau of Ordnance in connection with this program.

2. The broad character of this project, involving new basic research and unusual new engineering problems, especially in the supersonic region, coupled with the fact that various other government agencies and groups in the Armed Services, including the Army Air Forces, are vitally interested in similar problems, has necessitated the handling of this assignment by an unusual method. Dr. M. A. Tuve has been asked to undertake the organization and direction of this program for the Bureau, with the request that it be centralized in an outside agency, under an NOrd research contract of the new "Section T series" of the Bureau of Ordnance. The officials of the Johns Hopkins University have been asked to establish the necessary administrative and technical staff and facilities to serve as this central agency.

3. This special means of handling the project, by assigning the complete problem to a single technical group under a research contract, is proposed for maximum speed and effectiveness, and particularly in order to facilitate arrangements for a high degree of cooperation and actual joint technical work with other interested agencies. The program, although initiated and supported by the Bureau of Ordnance, is to be carried forward as a broad technical project of value to many agencies of the Army and Navy; all interested groups are asked to participate and will be credited with their part in the program. A number of discussions on a technical level have already been held with various men in and out of the Services who are or have been concerned with work of this nature.

4. Tentative plans call for increasing the present central technical group at Johns Hopkins University (Applied Physics Laboratory) to several hundred during the next few months. It is proposed to use

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whatever technical assistance and guidance are made available by the various agencies interested in the general problem, but the central group will be charged with the overall task and must find and develop its own technical men and facilities in cases where other agencies are unable to supply requested help or to carry out needed measurements or coordinated projects. With the full cooperation of the interested five or six major agencies of the Government, and of industrial and university groups, it appears reasonable to expect the necessary basic data within a year to sixteen months, and practical results can be hoped for in roughly two years. Jet and missile developments by our Axis enemies make it important for us to work together and press for the shortest possible time scale.

5. I am asking Captain C. L. Tyler, USN, Director of our Research and Development Division, to make specific suggestions and requests for help from the Army Air Forces, but it is already clear that the assignment of at least two of your officers full time, some assistance from Dr. von Karman and his group, and the part-time help of two or three of the civilian technical staff (Wright Field) will be needed within several months. In addition, clearance to various stations and contractors' activities is desirable, as the work progresses.

6. I look forward with you to activities in this field of very great interest and mutual benefit, I would, of course, be very glad to discuss this with your of Major General Echols personnally when andif you consider it necessary and desirable.

G. F. HUSSEY, JR.

JM

Copy to:
Maj. Gen. OP Echols
Asst. Chief of Air Staff

Coordinator Research & Development

Dr. M. A. Tuve

Chairman, Navy Jet Propelled MissilesBorad (DCNO Air)

Issue -2/182/ed
Guided Jet-Propelled
Aircraft Missiles
28 Jan 1943

c.r.F MIX 416 183

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Col Phillips/ee/71500
Written 26 January 1945
AFDMA-1

(dated 30 Jan 45)

sub - Intensive Program on Guided Jet-Propelled Antiaircraft Missiles.

to - Navy Department
Washington, D. C.

Attention: Chief of the Bureau of Ordnance

already in file -

1. With reference to your letter of 11 January 1945, S78-1(118) concerning the participation of the Army Air Forces in an intensive program on Guided Antiaircraft Missiles, you are assured that the Air Forces will gladly participate to any extent compatible with the necessity for expediting our own Guided Missiles program.

2. The Army Air Forces is primarily concerned with the development of offensive weapons to supplement air power. The defense of ground installations as well as the defense of aircraft, however, demands an active development of the phase of guided missiles of the antiaircraft type.

3. The Army Air Forces are in a position to furnish to the Navy Department several officers qualified in the Aerodynamic, Ordnance, Power Plant, and Antiaircraft aspects of guided Missiles. Civilian technicians can be made available on a consultant basis only. In order that full and complete exchange of information be assured and that the efforts of the Army Air Forces not suffer by the diversion of the above technical talent, it is assumed that the Navy Department will make an equal number of qualified technicians available to the Army Air Forces for the same purposes.

4. Prior to final commitment in the above matter, it is believed appropriate that the contemplated research program referred to in your letter be reviewed by the Guided Missiles Committee which, it is understood, is being formed under the auspices of the Joint Committee on New Weapons and Equipment.

416 Guided Missiles

C.C. Office of Signature, C/AS
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Guided Jet Propelled Missiles
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Lt Col Stace/bja/2908
Written 6 March 1945

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(AFDMA-2G)

9 MAR 1945

SUBJECT: Navy Contract with Johns Hopkins on Anti-aircraft Guided Missiles

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio.

ATTENTION: Chief, Office of Administration (TSTEX)

1. Attached for information is a copy of Navy Bureau of Ordnance Contract NOrd-7386 with the Johns Hopkins University.

2. This is a new type of development contract for the Navy. The Navy considers it particularly important as it represents a form of development contract that the Navy expects to use frequently in the future.

3. This contract also represents a change in procedure as the Navy usually places contracts for a specific device with a commercial company, rather than a research institution. In effect, the Navy is "buying brains" with this contract.

4. This contract is commonly referred to as the "Tuve" project, since Dr. M. A. Tuve will head the project for Johns Hopkins. Preliminary information from Dr. Tuve on the project follows:

a. The Applied Physics Laboratory of Johns Hopkins will work on this project as an expedited "crash" project. They are assembling a central technical group of two hundred (200) to three hundred (300) scientists, and are working toward a goal of securing a usable missile by approximately 1 January 1947.

b. They expect to spend four to six million dollars in the first year, and ten to twenty million dollars in a two year period.

c. The development will involve extensive studies into the development of ram-jet and rocket engines, supersonic airframes, and precise electronic control systems.

d. Overall preliminary general characteristics are:

(1) Speed: 1800 ft/second
(2) Range: Over 20 miles

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Subject: Navy Contract with Johns Hopkins on Anti-aircraft Guided Missiles.

(3) Gross Weight: Approximately 2,000 lbs after launching.
(4) Warhead: Up to 600 lbs explosive.
(5) Altitude: Over 30,000 ft.
(6) Accuracy: A collision course if possible. (Proximity fuzes may be used.)

5. Attached for information also are the following copies of letters:

a. Letter of 11 January 1945 from Navy BuOrd, subject "Intensive Program on Guided Jet-Propelled Antiaircraft Missiles".

b. Letter reply of 30 January 1945 from Chief of Staff, Army Air Forces, to Navy Department, subject "Intensive Program on Guided Jet-Propelled Antiaircraft Missiles".

6. Cooperation with the Navy on this project was discussed with Major General B. E. Meyers and others by Brigadier General J. F. Phillips on 19 January 1945.

7. No reply has been received from the Navy as yet to the letter of 30 January 1945, concerning Army Air Forces participation.

8. It is desired that Air Technical Service Command take aggressive action to secure maximum possible benefit from the extensive basic research and development programs that will be included in the "Tuve" project. It is requested that an adequate liaison program be formulated by the Air Technical Service Command, and recommended to this office prior to 15 March 1945. This recommendation should include:

a. Names of liaison personnel.
b. Estimate of the proportion of each individual's time that will be spent on liaison work.

9. For your information, the Special Assistant for Anti-Aircraft is designating a full time liaison officer. The Chief of Ordnance is designating several full time liaison officers.

10. Attention is called to the stated intention of Johns Hopkins to assemble a large number of personnel qualified in the technical guided missiles field. Any delays in forwarding the Army Air Forces Guided Missiles Program will undoubtedly result in inability to secure adequate technical assistance due to assignment to Ordnance or Navy programs.

By command of General ARNOLD:

(Signed) O. P. Echols

O. P. ECHOLS
Major General, U.S.A.,
Asst. Chief of Air Staff,
Materiel and Services

3 Incls:
Incl 1 - BuOrd Ltr, 11 Jan 45
Incl 2 - C/AS Ltr, 30 Jan 45
Incl 3 - cpy Navy BuOrd contract.

OFFICE SYMBOL
GRADE AND SURNAME OF COORDINATING OFFICERS

[redacted]

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Secret by authority of
CG AAF

7 JUN 1945 SRM
Date Initials

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

In Reply Refer To:
14

AFPDB

MEMORANDUM FOR THE CHIEF OF AIR STAFF:

SUBJECT: Air Force Organization for Guided Missiles

DISCUSSION

1. The United States has found itself to be far behind Germany in research on and the development of certain guided missiles; probably by at least ten years. Efforts in this field so far have not been planned in a manner that will lead to rapid advancement. The Navy "Bumblebee" projects on a ground-to-air missile are, today, probably the most complete and most promising in this field. Army Service Forces as well as the Army Air Forces are now in a position to capitalize on German research since General Eisenhower has offered to send a group of one hundred (100) of the very best rocket research personnel to this country to contiue their work here.

2. General Arnold has repeatedly expressed the desire that the Army Air Forces take the lead in the development of guided missiles and thereby assure the Air Forces a major part in their operational employment. Efforts so far, while resulting in the only successful operational use of a guided missile in this war by the Army (Azon), have not been as productive as is desirable. The failure to make sufficiently rapid progress in this field is believed due in a large part to the lack of a centralized authority within the Army Air Forces having as its only responsibility the implementation and direction of an adequate guided missiles program.

3. It is understood that the Army Ground Forces are planning on the formation of a separate agency whose functions will be to act as a steering and guiding organization in all matters pertaining to guided missiles. This organization will be headed by a general officer. The Navy has formed a Jet Propelled Missiles Committee directly under the Office of Chief of Naval Operations which handles all matters pertaining to guided missiles. This Committee is headed by an officer with the rank of Admiral.

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4. Because of the immediate and long range implications of the guided missile program involving so extensively the future of the Army Air Forces, immediate action must be taken to assure that the Army Air Forces leads in this field.

5. The development of guided missiles along the lines broadly outlined in the military characteristics recently proposed by Requirements Division requires considerable basic research and many new concepts in design. The results of research, assuming capable personnel are employed, have been found to be almost directly proportional to the freedom of investigation allowed under centralized direction. Such freedom is difficult, if not impossible, to attain under the divided authority and direction existing in the large staff organization of Headquarters, Army Air Forces. It is believed that the shortening of staff channels by the establishment of a central agency for guided missiles within the Air Staff would expedite attainment of AAF leadership in this field.

6. Among the advantages of the staff organization recommended in the paragraphs above are:

a. Freedom from conventional thought and methods.

b. Authoritative representation of the AAF in contracts with other agencies such as: WDGS, Navy and civilian research and manufacturing organizations.

c. Expediting the development of guided missiles by elimination of lost time in getting staff decisions.

ACTION RECOMMENDED

1. It is recommended that an office of Assistant For Guided Missiles directly responsible to the Chief of Air Staff be established. This office should be headed by a General Officer with an excellent technical background who is known for his progressive attitude toward new developments in warfare. He should be free to choose, as his assistants, regular army officers of proven technical and staff ability without regard to branch of service. This office should be responsible for the direction of the Army Air Forces guided missiles program up to the point of approval of operational suitability tests. The use of approved weapons would then be handled through normal staff channels.

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Ordnance and Navy Guided Missile Program.

TSEPG TSESA 10 Jan 46 1

1. The following is a brief summary of the existing pilotless aircraft and guided missile activities of the Army Ordnance and Navy.

a. Orcit. Army Ordnance California Institute of Technology development of jet propulsion and large ground-to-ground rockets similar to the German V-2. The largest rocket tested is the "Wac Corporal", a fin stabilized, non-controlled, vertically launched liquid rocket using booster assisted launching. It reaches a maximum velocity of 2100 mph and attains an altitude of 230,000 ft. It weighs approximately 650 lbs., is 16 ft. long and is 1 ft. in diameter. Approximately 8 missiles have been launched successfully. "Corporal F" is a long range (50 to 60 miles) fin stabilized, controlled, liquid fuel rocket intended to provide research data on launching, propulsion, ballistics and control systems. It is 35 ft. in length and 30 in. in diameter and weighs 10,000 lbs. This missile is scheduled for launching in March 1946.

b. "Hermes." Army Ordnance/General Electric Company. Calls for the assembly of a technical organization, a review of German information and equipment and the design and construction of guided missiles. At present the project is preparing about 25 captured V-2 rockets for firing tests at White Sands, New Mexico. The "Hermes" project is also working on a ground-to-air missile and a long range ground-to-ground missile. Both are in the preliminary study stage. Tests have been conducted on liquid rocket engines and additional test stands are under construction.

c. "Nike." Army Ordnance/Bell Telephone Laboratories. The missile is in the early development stages, although subcontractors are working on power plant, aerodynamics etc. Limited by a short range of 12 miles and by the necessity for two ground radar sets and a computer for each missile in the air. This missile will have a maximum velocity of approximately 1000 mph.

d. "Bumblebee." Bureau of Ordnance/John Hopkins University Ground-to-Air Missile. Ramjets have been flown but no check has been made of ramjets at high altitudes. A sub-sonic control test vehicle has been built to test automatic pilot and servo design but not yet been flown successfully. The missile is expected to have a range of about 18 miles and a speed of 1700 mph.

e. "Lark." Bureau of Aeronautics/Ranger/Consolidated Ground-to-Air Guided Missile. Each contractor has completed a prototype which is now ready for launching (670 mph at sea level with a range of 40 miles). The radar seeker is not yet available, nor is a satisfactory system for controlling the "Lark" to within seeker range. The first tests will be flown with radio control and visual observation.

CHARLES H. PRICE
Colonel, Air Corps
Chief, Aircraft Projects Section
Service Engineering Subdivision
Engineering Division

HH/led
36351
Bldg. 126

Copies to:
TSESA
TSESE
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EVALUATION REPORT [illegible] [illegible] 17 [illegible] 46

PERIOD JANUARY - DECEMBER 194[illegible]

SUMMARY

[illegible] objective of the Bumblebee program was the develop[illegible] [illegible] pelled supersonic missile capable of stopping aircraft [illegible] ,[illegible] yards and altitudes up to [illegible],000 ft. The objective [illegible] first year was to determine whether such a missile was feasible. [illegible] course of the year a group of associated contractors has been [illegible], required facilities have been obtained, and new techniques [illegible] developed. The first successful ram-jet powered missile [illegible]. In addition, technical results obtained during the year [illegible] are no insurmountable difficulties in the development of [illegible], and most important, a group of technical people have [illegible] with the problems of guided missiles so that with the [illegible], rapid progress can be made during the next year. [illegible] has been spent; [illegible] dollars on facilities, [illegible] million [illegible] the associated contractors, and [illegible] million dollars at the [illegible] laboratory. [illegible] people are engaged in the work, [illegible] are at the associated contractors.

[illegible]. Introduction

A. [illegible] Problem

[illegible] problem that was considered during the formulation [illegible] program was the defense of ships against guided missiles [illegible] from outside the effective range of gunfire. The desired solu[illegible] defensive guided missile capable of destroying an aircraft [illegible] reach a range of 20,0[illegible] yards. In addition, it was [illegible] that [illegible] defensive guided missile should be capable of over[illegible]taking the attacking aircraft if it turned after the missile is launched. [illegible] problem became a reality with the Japanese use of Baka, but [illegible] these missiles were not used in great enough quantity to [illegible] the course of the war. Following VJ Day the objective of the [illegible] was modified. The new objective became the exploration of [illegible] limitations on guided missiles rather than the immediate pro[illegible] of the first possible guided missile. In the course of following [illegible] objective it is expected that missiles will be developed and [illegible] which undoubtedly can serve as prototypes for service missiles. The [illegible] purpose of these missiles, however, is the testing of the applica[illegible] of our design information.

B. Technical Problem

[illegible] the investigation of possible solutions to the military [illegible], it was recognized that two quite different solutions were possible. [illegible] was a subsonic missile which could be developed by use of existing

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techniques. The second was a supersonic missile which would require major advances in the field of aerodynamics and propulsion and supersonic aerodynamics. It was recognized that it was highly doubtful that any program initiated at such a late date could be carried through to combat use unless enemy developments lengthened the war, but the technical results obtained would be highly valuable to the future of guided missile work whether the war stopped or not. The same considerations influenced the choice between liquid fuel rockets and ram-jets for propulsion. Considerable information was available on liquid rockets and practically none on ram-jets, although the latter seemed far more attractive as it does not carry its own oxygen. In assigning the task to the Johns Hopkins University, the Bureau of Ordnance recognized the value of the technical contributions of the program as well as the development of specific missiles. The Bureau believed, nevertheless, that an immediate attack must be made on this problem, and expected that this would result at the best in the production of an advanced antiaircraft weapon which might be available in the latter stages of the war, and at the least in considerable valuable progress in research and development on jet propulsion techniques, selfguided techniques, and other technical matters of great importance to the future of ordnance.

II. Method of Operation:

It was planned from the beginning that the previous Section T pattern of operation should be followed, utilizing the Applied Physics Laboratory and associated contractors, both university and industrial. It was also recognized that many other agencies were actively engaged in similar development and that close liaison with these other agencies was necessary for the most rapid progress of all programs. This basic policy is stated in the original task assignment. "The work shall include cooperation and joint activity, as may be feasible, with those groups in the Armed Services and other agencies which are actively concerned with the development, testing, production and use of similar or related missiles for the United States Government. The work also may include, on request of the Bureau of Ordnance, supervision and guidance of the technical work under other Navy contracts which may be assigned work related to this task."

III. Organization:

The original organization included groups on aerodynamics, burners, guidance, launching, test models, and facilities. During the course of the year it has been found necessary to add groups on control, wind tunnel, telemetering, analysis, composite design, as well as a liaison office. The details of organization and supervisory personnel are shown in Appendix A.

IV. Facilities:

Major facilities acquired for the program include:

1. Island Beach Proving Ground, New Jersey.
2. Air Supply for the University of Virginia.

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3. Forest Grove Station Laboratory and Air Supply, (near Silver Spring, Maryland).
4. Wind tunnel and air supply at Lone Star Laboratory, Daingerfield, Texas.
5. Air supply for Esso Laboratories.
6. Fort Miles Proving Ground, Ft. Miles, Delaware.

Laboratory personnel participated actively in all of these programs except number 2. Compressors were sought country-wide and finally procured from Shasta Dam and TVA. Proving Grounds ranging from the East Coast to California were investigated.

IV. <u>Techniques:</u>

The program required the development of techniques, some entirely new and others unfamiliar to laboratory personnel. These include:

1. Methods of acquiring performance data in field tests.

    a. Camera tracking
    b. 584 tracking
    c. CW radar (microwave)
    d. CW radar (shortwave)

2. Design and procurement of test missiles:

    a. 6" ram-jet
    b. 6" momentum sustained model for control tests
    c. "Cobra" (6" ram-jet with enlarged annulus for packaging).
    d. 5" rockets for aerodynamics
    e. CTV (Subsonic control test vehicle)
    f. STV (Supersonic control test vehicle)
    g. RTV (18" Ram-jet test vehicle)

3. Launching equipment.

    a. Ramps for all test missiles
    b. Multiple rocket launching carriages for test missiles
    c. 5" long burning rocket for CTV
    d. T10E1 and Mod 36 launching rockets
    e. 17" Aerojet rocket for launching RTV (10" rockets largest previously developed).

4. Laboratory techniques.

    a. Combustion instrumentation
    b. Free supersonic jets for aerodynamic and combustion studies
    c. Simulators of control systems
    d. Flares and tracers for fuel ignition

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. [illegible]
. [illegible]

1. [illegible] photography
2. [illegible]graphy
3. [illegible]
4. [illegible] recording system

[illegible]

a. [illegible] system including [illegible] receivers
. [illegible] modulated audio system, 1-2-and 4 channel
. [illegible]
. [illegible]
. [illegible]
. [illegible]
. [illegible] modulated audio system including
[illegible]
. [illegible] of [illegible] pick-up instruments
. [illegible] systems for missiles.

[illegible] development of these techniques is given in Appendix [illegible].

[illegible]

[illegible] - January 1946.

[illegible] calculations existed indicating that a ram-jet [illegible] thrust; however, no experiments were available which [illegible] information on combustion efficiencies or thrust for the mass flows, temperatures, and pressures which would be encountered in supersonic flight. [illegible] calculations could be made but the results were no better than [illegible] guesses on the basic quantities.

[illegible] supersonic aerodynamic information was available from wind tunnel tests [illegible] scale models. This information had not been checked by flight [illegible] full scale missiles, and practically no information was available [illegible] complicated questions, such as hinge moments, lift and [illegible] base drag in presence of a jet, etc.

While many systems of control and guidance had been outlined on paper, none had been tried and no servo systems giving adequate speed of response were available. Mathematical calculations had been made on accelerations along various courses but these calculations did not include the effect of such [illegible] details as friction, back lash, saturation, etc., which are [illegible] important in determining the final performance.

[illegible] suitable for launching full scale missiles were even under development. [illegible] questions requiring answers during the first year's work were:

1. [illegible] a ram-jet give adequate thrust to propel a [illegible] missile at supersonic speed?

[redacted]

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2. Can aerodynamic control be obtained without excessive drag?

3. Are there any unknown basic difficulties in guiding?

B. General Understanding of the Problem.

The most important result of the year's work is the acquisition of a general understanding of the problem. Experts had to be developed. At the end of the year the Laboratory has a large group of people who know the problems if not all the answers associated with the design of guided missiles. This result cannot be over-stressed because it is an intangible accomplishment which can be easily overlooked in comparison with more concrete achievements. Items contributing to the general understanding of the problem are analysis of ram-jet performance, knowns and unknowns in aerodynamics, factors involved in choice of courses, limitations of control systems, methods of transmitting intelligence, limitations of launching procedures, and the whole body of know-how with regard to testing and measuring. This knowledge is based on close contact with and participation in actual experiments, in addition to calculations carried out during the year.

C. Propulsion.

1. Laboratory measurement of ram-jet thrust and combustion efficiency for both 6-in and 18-in models.
2. Demonstration that Laboratory efficiencies can be achieved in flight. First powered flights ever made by ram-jets at supersonic speeds were achieved this year.
3. Formulation of problems of temperature and fuel metering.
4. High altitude flight tests underway.

D. Aerodynamics.

1. Flight measurement of ram-jet thrust and combustion efficiency for both 6-in and 18-in models.
2. Open throat wind tunnel with preliminary tests.

E. Guidance.

1. Roll stabilization at supersonic speed.
2. Roll stabilization of CTV with hydraulic system.
3. Achievement of controlled turns at supersonic velocity.
4. Linear theory of 2-dimensional flow.
5. Simulator test of complete beam rider system.
6. Development and flight check of 4 types of beam rider receivers.
7. Modification of SCR-584 for beam rider system.
8. Flight tests of beam rider underway.

F. Missile Studies.

1. Design study of 12-in ram-jet (impractical as weapon)

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2. Complete design and fabrication of 1[illegible]-in ram-jet (possible prototype of antiaircraft type missile).
3. Comparison of ram-jet and liquid rocket vehicles for long range use.

G. Summary of Technical Results.

Work has been concentrated on the supersonic ram-jet as the primary emphasis. This work has demonstrated conclusively that ram-jets will develop adequate thrust in flight, but there are still numerous difficulties to be overcome in the line of fuel metering, temperature troubles, igniters, etc., before the problem can be considered solved. In aerodynamics (secondary emphasis), critical checks have shown that there should be no basic difficulties, and facilities and techniques have been established which will permit a rapid program of increasing the range and accuracy of supersonic missiles ~~by increasing the range and accuracy of supersonic missiles~~ by reducing drag and reducing the power requirements of servo systems. The beam rider has been chosen for the first complete guidance system to be tested, and its limitations should be known shortly. Launching rockets, test missiles, and facilities have been obtained as needed. Finally and most important, a large group has acquired first-hand experience with guided missile problems. A calendar showing technical results obtained is given in Appendix C.

VII. Contractors Activities:

The original contract planning included both university and industrial contractors. It was hoped that three major companies could be persuaded to assume an overall responsibility for the program with particular emphasis on one of the major fields. Other contractors would specialize in particular fields. In the course of the year's work the universities have made major contributions in research which has been of direct application. At present their main activies are in fields which are not directly applicable. The industrial contractors have made their major contributions in design engineering, production, and in the operation of Lone Star Laboratory. With the exception of Curtiss-Wright they have done little research and until recently have shown little initiative. None have shown any "responsibility for the program as a whole". The industrial contract situation for the future is brighter as the contractors are assuming a more and more active part in the program.

VIII. Money Expended:

The total expended in 1945 was roughly 8 million dollars. $3,000,000 was for facilities including Esso, Forest Grove, and Lone Star Laboratory. $1,860,000 was spent by the Applied Physics Laboratory and $3,000,000 by other contractors. The rate of expenditures has increased during the year to $700,000 per month and could continue to increase to $1,000,000 per month. Alternatively, it could be leveled off or decreased, depending on policy. The only commitments for facilities during 1946 are $200,000 for buildings at universities, which will permit continuance at Navy work.

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orig.Gen.A.R.Crawford/mlf/71500
AFDMA-1

5 October 1945

Army Air Forces Participation in Navy Bureau of Ordnance "Bumblebee" Project.

Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: TSEBG

1. It has been recommended by A-3 that the Army Air Forces participate financially in the "Bumblebee" project now being carried out by the Applied Physics Laboratory of Johns Hopkins University for the Navy Bureau of Ordnance. Insofar as is known the Navy have not requested this joint financing nor has the subject been discussed with them.

2. A-3 have suggested that the following advantageous features would accrue to the Air Forces, if joint financing were had:

a. Insure that in any future discussions or considerations of cognizance (agency primarily responsible for development or employment of ground-to-air missiles) that the Army Air Forces have a claim proportionate to other agencies in this specific research and development field.

b. Demonstrate conclusively to Congress in connection with budgets, etc., that the Air Forces are fully cooperating and coordinating with other agencies in development.

c. Insure for national defense the continuation of this project on an adequate and comprehensive basis, with consideration not only of naval but also of air force applications of specific missiles.

3. The "Bumblebee" budget currently amounts to $14,000,000 for the fiscal year 1946. It is expected that this amount will be increased for the next fiscal year to approximately $24,000,000. These figures apply to only one Bureau of Ordnance guided missiles project as distinct from the whole guided missiles programs of Bureau of Ordnance and Bureau of Aeronautics.

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AAF to the CG, ATSC, Attn: TSEBG, Subj: "Army Air Forces Participation in Navy Bureau of Ordnance "Bumblebee" Project", 3 October 1945.

2. Although the intent behind A-3's recommendation, which is the insuring of AAF interest in adequate anti-aircraft weapons in the future, is concurred in, wisdom of the joint financing, in view of the extreme limited research Air Force funds, appears highly questionable to this office. It is understood that complete reports on missile designs, propulsion devices, fuels, guided missiles, etc., are being furnished to the Army Air Forces and that close liaison is and has been maintained from the inception of the "Bumblebee" project. It is also understood that the Army Air Forces has full permission to visit any laboratory or test activity associated with the project and to discuss in detail relevant development phases with scientists and engineers working on the project. In view of this close liaison and since the AAF is faced with an extremely limited amount of research and development funds, it would appear to be more desirable to continue maintenance of close liaison with the Applied Physics Laboratory on all "Bumblebee" project developments plus the furnishing of AAF data on associated items and divert the expenditure of funds in amounts potentially deemed available for joint expenditure on the "Bumblebee" project to some other missile development which the Air Force considers promising, but which is not now adequately covered from a development standpoint. This impression is not to be construed against joint financing of projects in which two or more agencies have similar interests, but merely to insure the widest range of guided missiles development being undertaken with the greatest impetus, the consolidated funds of all Governmental agencies will permit.

3. Your comments on the recommendations contained in paragraph 1 and the opinion of this office outlined in the preceding paragraph, are requested.

By command of General ARNOLD:

ALDEN R. CRAWFORD
Brigadier General, U. S. A.
Chief, Production Division
Office, AC/AS-4

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ARMY AIR FORCES
AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

Major C. W. Guy
Ext. 35395

Date 21 August 45

SUBJECT: Mock-Up of Navy KAQ-1 "Lark" Guided Missile.

OFFICE TSESE-2G Contract or Order No.

SERIAL No. TSESE-2G-1212 Expenditure Order No.

A. PURPOSE:

1. To report on a mock-up conference on the Navy KAQ-1, "LARK," guided missile at Ranger-Lark Division, Fairchild Engine and Airplane Corporation, Jamaica, New York, from 8 August 1945 to 9 August 1945.

B. FACTUAL DATA:

1. The Lark is a one thousand and fifty (1050) pound, liquid rocket propelled, ship to air, guided missile. It was designed primarily for use against "snoopers" and Baka carriers. The Ranger Division of Fairchild Engine and Airplane Corporation at Jamaica, New York, and Consolidated-Vultee Aircraft Company at Downey, California, are each building separate versions of the Lark for the Navy. Both versions incorporate the same basic aerodynamic configuration and the same equipment; however, the internal arrangements are completely different and the over-all sizes differ slightly.

2. A third version of the Lark, known as "Little Joe," is being built by the Naval Aircraft Modifications Unit at Johnstown, Pennsylvania. "Little Joe" is a rush project to be completed in the earliest possible time and to use existing component parts wherever possible. A number of launchings have been successfully made with "Little Joe." Although "Little Joe" started out as a version of the Lark, it shows little resemblance in its final form.

3. The Lark is designed to meet a requirement calling for the destruction of a hostile aircraft travelling at 400 mph at 30,000 ft. altitude. However, the present design is only capable of destroying a 300 mph aircraft at 20,000 ft. It is assumed that the Lark will be launched when the hostile aircraft is at a horizontal range of 20,000 yds.

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4. The Lark consists of a streamlined fuselage mounting four wings in a cruciform arrangement just forward of the midpoint and four tail surfaces mounted at the rear and located in planes at 45° to the wings. The approximate principle dimensions are as follows:

a.	Span	74 inches
b.	Cord	21.2 inches
c.	Flap	20 % of cord
d.	Over-all length	155 inches
e.	Max. fuselage diameter	17 inches
f.	Tail span	48 inches
g.	Tail cord	15.4 inches
h.	Control surfaces	20 % of cord

5. The full angular movement of all control surfaces will be approximately as follows:

a.	Wing flaps	60° up or down
b.	Tail surfaces	45° up or down

6. The airfoil sections are as follows:

a.	Horizontal wings	NACA 16-109
b.	Vertical wings	NACA 16-009
c.	Tail surfaces	NACA 16-008

7. The performance of the Lark is estimated to be as follows:

a.	Gross weight	1,050 pounds
b.	High speed at sea level	670 mph

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c. Max. duration of flight 5 minutes

d. Maximum range 40 miles

8. The Lark will eventually be guided by a radar-beam follower until within two to three miles of the target, after which the AN/APN-23 radar seeker will take over control and guide the missile to the target. However, since there is no radar beam following equipment available at the present time, the first models of the Lark will be provided with an AN/ARW-37 five channel, frequency modulated, radio control receiver which will permit the Lark to be visually controlled during the first phases of its flight.

9. The AN/APN-23 radar seeker includes a transmitter, receiver, computor, scanning antenna, and power supply. It will automatically select and lock on a target, and thereafter will provide the necessary control signals to make the missile home on the target. The seeker dish antenna is gimbally mounted and is made to rotate in a direction opposite to the motion of the missile, thereby providing navigation to cause the missile to intercept its target rather than chasing it. The development of the AN/APN-23 is nearly complete. The first seeker is scheduled to be ready for test by 10 October 1945. The chief delay in the development of this seeker has resulted from difficulties encountered in the design of a satisfactory magnetron. This equipment is being developed by Raytheon Manufacturing Company.

10. The wing flaps rather than the tail surfaces are used to control the flight path of the Lark. A control signal, either from the radio set or from the radar seeker, will cause the appropriate pair of wing flaps to move, thereby producing a force at the center of gravity of the missile which will immediately change the direction of the flight path. An angle of attack meter, operating from pressure orifices located in the nose of the fuselage, causes the tail surfaces to move in a manner to maintain the missile at a zero angle of attack. This control system is novel in that control is applied first by changing the lift forces of the wings and then by rotating the body into the new direction of flight.

11. Roll stabilization is obtained by extending one of two ailerons from the tips of the vertical wings. These ailerons are controlled by a Schwein gyro similar to that used in the VB-1. The main disadvantage of this gyro, as was brought out in the meeting, is that it requires a motion in order to function; and, consequently, missiles using this gyro usually have an oscillation of approximately 20° amplitude.

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Memo Report No. TSESE-2G-1212
21 August 1945

12. A combination electrical and pneumatic servo system is used to activate the control surfaces. In each case, an electrical signal is received by a control valve which meters air pressure into a servo unit connected to the control surfaces. In the case of the wing flaps, a small servo is used for small deflections; and an additional large servo is brought into action for large deflections. The purpose of this arrangement is to conserve air.

13. A separate group of air bottles is provided for the control system. This air is stored in three manifolded bottles at a pressure of 1900 psi and is metered to 200 psi.

14. The structure of the Lark was designed for a limit load of fourteen factors, and the design was based entirely on the yield point of the material. The fuselage is of full monocoque construction, and each wing panel is a single 61 ST-5 aluminum alloy extrusion with a removable wing tip. The tail surfaces are of plastic since they must contain the radio receiving antenna.

15. The Lark is propelled by two acid aniline rocket motors. A 200 pound motor operates continuously, while a 400 pound motor is controlled by a Mach meter to operate when the speed of the missile falls below a Mach number of .81 and to stop when the speed reaches a Mach number of .85.

16. The acid and aniline tanks each have independent pressurization systems. In each case, nitrogen from a 1900 psi bottle is regulated to 450 psi and is then used to pressurize the tanks. The acid and aniline flow from the tanks through on-off control valves into the rocket motors. The acid is used to cool the rocket motors by passing it through jackets surrounding the motors before spraying it into the combustion chambers.

17. The armament of the Lark consist of a 100 pound fragmention bomb which was especially designed for use with this missile. It is designed to provide a fragmentation pattern conical in shape and extending forward from the missile. The electrical fuse is detonated by an impulse from the radar seeker which acts as a proximity fuse. The fuse is armed by an electrical motor after the Lark is launched.

18. The Mock-Up board considered the armament system to be, in general, inadequate. The warhead is located below and behind the power pack of the radar seeker which will blanket the upper hemisphere, thereby destroying the effectiveness of the warhead. It is also impossible to install or inspect the fuse after the fuselage has been assembled. It was decided

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Memo Report No. TSEAC-2G-1212
21 August 1945

that the first twenty-five Larks would be built according to the mock-up, but would contain no ordnance equipment. These missiles will be used for flight tests only. The twenty-sixth article will contain a redesigned armament system. The fuselage will probably need to be lengthened approximately five inches in order to permit an unobstructed location for the warhead. Provisions will be made to install the fuse after the missile is on the launching ramp. A new system of arming will be designed using an air-driven anemometer in place of the present electrical motor. Provisions will also be made for self-destruction of the missile on the cessation of thrust from the rocket motors.

19. The Lark will be launched from a specially designed multiple-cartridge ramp mounted on shipboard. Two 12 AS-1000F JATO units will be attached to the Lark to assist in launching and to continue the acceleration until operating speed is gained. The Mock-Up board decided that the JATO units should be dropped separately as soon as their thrust ceases.

20. The contractor is making a study to determine the possibility of launching the Lark by means of a high-thrust booster which would be dropped when its work is done. The booster, at present contemplated, consists of a metal cone which fits on the rear of the Lark and mounts the launching rockets. If this method of launching is used, no catapult will be needed.

C. CONCLUSIONS:

1. The present system of radio control by an operator who follows the missile visually from the ground appears impractical for a missile travelling 600 mph and with a duration of approximately five minutes.

2. The present power plant is considered questionable for shipboard use in as much as it uses fuming nitric acid and aniline. The Navy is considering a nitromethane fuel system once it is available.

3. The use of the Schwein gyro for roll stabilization is considered undesirable since an oscillation of approximately one second period and possibly 20° amplitude may be expected.

4. The present battery is considered undesirable in as much as it must be heated and floated on a charging power line continually until the time of its actual use.

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5. A considerable amount of confusion on the part of the contractor resulted from the transfer of information and instructions from personnel on the laboratory level to the contractor without going through the project officer.

D. RECOMMENDATIONS:

1. That the ATSC closely follow the development and testing of this missile in order to take advantage of the information to be gained.

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- Equipment Lab. TSEPL-3
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Prepared by Charles R. Fay
CHARLES R. GUY, Major, AC

Approved by John B. Carter, Wolf Col
MARCUS F. COOPER, Colonel, AC
Aircraft Projects

Concurrence:
Jack Leet, Maj AC

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HEADQUARTERS, CONTINENTAL AIR FORCES
ANDREWS FIELD
CAMP SPRINGS, MARYLAND

31 August 1945

CAF 312.1 (1 Sept 45)

SUBJECT: Establishment of a firm plan for research and development.

TO: Commanding General, Army Air Forces, Washington 25, D. C.

1. I find myself feeling far from satisfied with the past and present trends in the utilization by the Air Forces of the full potentialities of science. This arises from viewing, as we are forced to do, the future of Air Forces trends and requirements and their immense dependence upon our scientific achievement and its application to future warfare. It is realized that science has been called upon at almost all levels in the Air Forces, but my personal experience and that evidenced by many other commanders has been that it has been too scattered and decentralized. We find groups and agencies frequently engaged in competition. We find comparatively simple matters handled jointly by numerous staff sections in a manner that wastes time and makes for rivalry rather than for cooperation. We find that there is too much inertia and lack of technical skill in screening new ideas and advancing those which show promising possibilities. It is believed that much of this may be attributed to our lack of a firm scientific policy familiar to all and our lack of an organization to implement and carry it out.

2. The Army Air Forces is, in a scientific sense, on trial for its life. The whole concept of air warfare is undergoing a rapid change and unless we grasp the impact of these changes and adapt ourselves to them quickly, they will be lost to us. The fruits of scientific advances will be forced upon us whether we like it or not and if the Air Forces does not take them up as they develop, they will be snatched at random by all other branches and the confusion and loss of effectiveness will be tremendous.

3. To avoid this situation I believe three fundamental things must be done by the Army AirForces:

a. We should establish a staff section under a deputy whose sole responsibility is research and development. (Now set up under Gen LeMay)

b. We must indoctrinate the whole Army Air Forces into the principle of maintaining intimate access to the scientific world within the United States.

c. We must foster and build up among the scientific workers of this country a spirit of intense interest in the Air Forces and its problems. I believe that in the establishment of an AirStaff Section for Research and Development, the other essentials will follow easily along the lines indicated in the attached study. The proposed new section should be at top level and

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co-equal with the other normal sections. This is essential since its activities will of necessity cut across the field of interest of all other ~~activities~~ sections and its findings must never be put in a position where any other section can suppress them. While this new section should naturally be military in its makeup, it should nevertheless make use of high quality civilian scientists to a measure not heretofore attained. The work should have such a degree of permanency and high standing as to attract into it scientists of the highest calibre. These men cannot be just "government clerks" - they must be outstanding.

4. Attached is a skeleton plan for the organization of an AirStaff Section for Research and Development in the Army Air Forces. This has been the subject of study by a group of scientists experienced in the field of organization and appears to me to present a basis for starting and planning of such a section. I wish and recommend it as such, and will be prepared to study the matter in greater detail if you so desire. You will note that this emphasizes the drawing together into the Army Air Forces sphere of interest, the university and commercial research organization as well as the scientific societies of the nation.

5. Your attention is also invited to the very active reorganization of the Research and Development Organization of the Navy Department. They are concentrating their research leadership under a Naval officer with civilian advisory and are making additional extensive provision for spreading out and decentralizing such work into private and university laboratories. In fact, I am afraid we must be forced to admit that on the whole, the research program of the Navy Department has been much more realistic and sound than that of the War Department over the past several years. Our dilly-dallying methods have, in fact, thrown many projects from the War Department into the Navy Department with consequent later procurement difficulties on our part. The problems of rockets and proximity fuzes have been good examples in this respect. I cannot over emphasize my conviction that the most important single factor in the future of the Army Air Forces lies in our utilization of the full national scientific effort and our providing the necessary organization to properly handle it.

1 Incl:
T/C for Proposed Air Staff Div.

/s/
ST. CLAIR STREETT
Major General, USA

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A TABLE OF ORGANIZATION FOR A PROPOSED

AIR STAFF DIVISION

RESEARCH AND DEVELOPMENT

1. This is submitted as a sample of the type of planning that an adequate Technical Advisor Section (see program for Operational Research in Peacetime) could do.

2. The general question of the need and advisability of organizing a special Air Staff Division at this time is not discussed in detail since that is a matter for decision of the General.

3. An Air Staff Division for Research and Development is proposed rather than depending either on Joint Army and Air Force organization or on some civilian super scientific laboratory in order to concentrate interest and to assure continuity of support and control. Every war has seen the operation of some civilian research body but not one of them has been effective during the interim of peace.

4. It is thought that such an Air Staff Division would have four general functions:

a. To control and direct all research for the Air Forces, including that done in AAF laboratories and that done outside by contract. (Incidentally the laboratory facilities devoted to research in Science of Military Flight should be greatly expanded.)

c. To control tests of new devices and to propose and develop tactics for their use and methods of training personnel in their use.

d. - Not the least important - The Air Force requires for its continued support in peace time and for its continued progress during peace a growing constituence of interested and informed persons. This constituency, needed for political support and as a source of personal and new technical ideas, can be developed and kept alive; first by creating and supporting University courses in the Military Science of Flying; second, by supporting research in that field, and encouraging publication of such results as are not secret; third, there is the need of encouraging the organization of an Air Force Society, for both social reasons and for the publication of non-technical articles on Military Flying, its history, development and future.

5. Nothing is said in the Table as to the disposition of such existing research facilities as Wright Field, since decision on that requires considerations not known to the Consultant.

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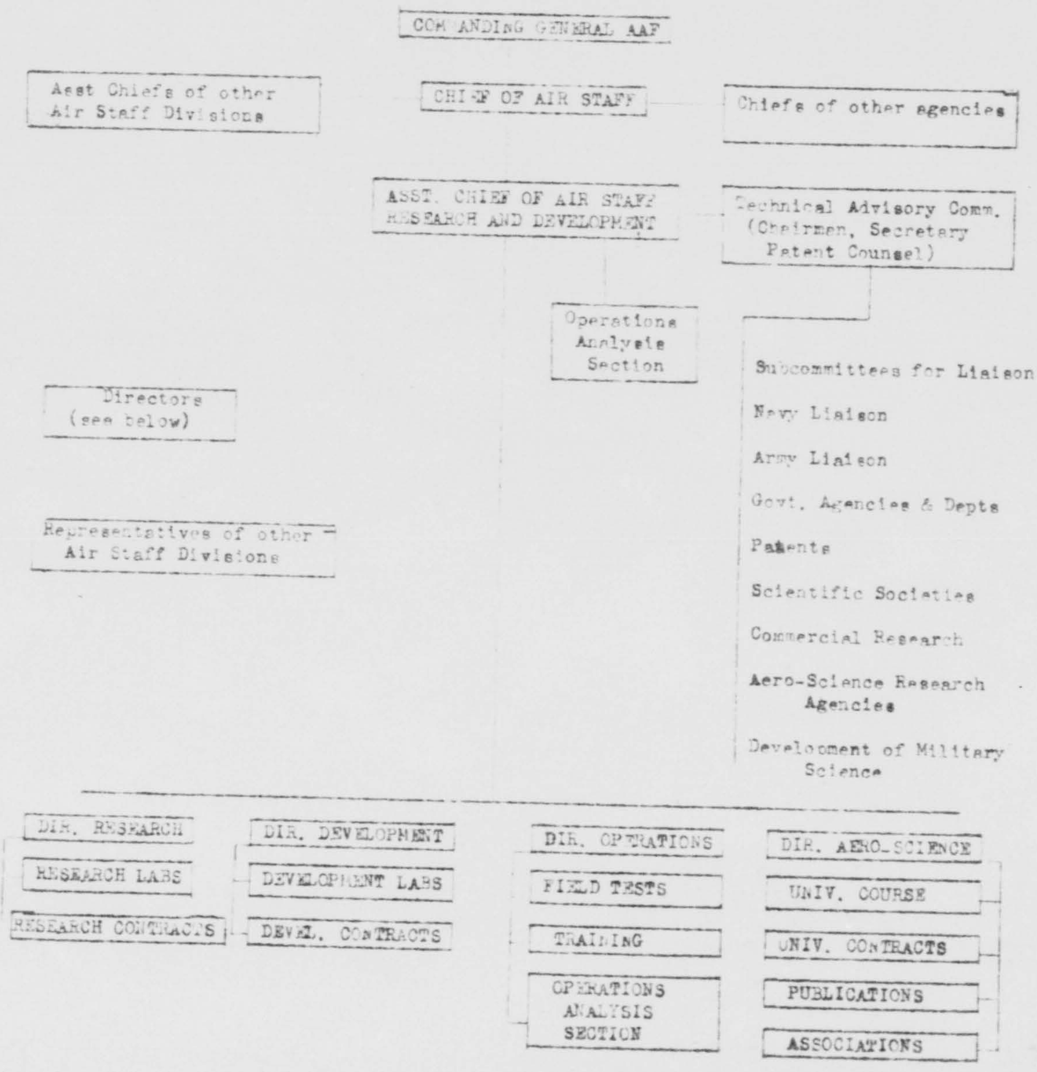
Outline Plan for an Army Air Force Staff Section

Research and Development



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THE TECHNICAL ADVISORY COMMITTEE

Duties

1. To inform AC/AS regarding new developments in aero-science.

2. To recommend new lines of research and development.

3. To review devices submitted by inventors and to recommend purchase, use, test or further development.

4. To review patent applications in field of aero-science.

5. Recommend agencies and persons for contract.

6. At request of AC/AS review project underway.

7. To advise on any technical matter submitted to it.

8. To recommend consultants and personnel

9. To record all its proceedings.

Organization

Paid President (Selected yearly from Committee).
Permanent Paid Secretary.
Permanent Patent Counsel.
Secretariat and Patent Examiners.

It is proposed that this body, which will be the normal liaison agency through which new ideas come from outside, will function through chairmen of subcommittees, forming with President, Secretary and Patent Counsel on Executive Committee.

Membership of the Subcommittee will be by nomination by the various agencies concerned. The following list is not exhaustive as to organizations.

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Organizations Represented on Committee

Navy Subcommittee
- Naval Research Laboratory
- Naval Ordnance Laboratory
- Annapolis Experimental Station
- Langley Field
- Towing Bases

Army Subcommittee
- Ordnance Laboratories
- Signal Laboratories
- Quartermaster Laboratories, etc.

Government Agencies
- National Bureau of Standards
- Regional Laboratory of Agriculture
- Public Health Service
- etc.

Patent Bodies
- Commissioner of Patents
- Inventors Council
- etc.

Scientific Agencies
- National Academy of Science
- National Reference Research Committee
- Carnegie Institute
- National Research Council

Scientific Societies
- American Association Advancement of Science
- American Chemical Society
- American Physical Society
- American Medical Society
- etc.

Technical Societies
- Civil Engineers
- Mechanical Engineers
- Electrical Engineers
- Radio Engineers
- etc.

Aeronautics Agencies
- Civil Aeronautics Administration
- etc.

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Commercial Research
- Association of Research Directors
- Bell Laboratories
- Westinghouse
- General Electric
- General Motors
- etc.

Aeronautical Industry
- Manufacturers Representatives
- Airline Representatives
- etc.

Universities
- American Association of University Professors
- etc.

Operations Analysis Section

The Sub-Staff

The funciton of the Technical Advisory Committee is advisory, that of the sub-staff is administrative. As such, it will be composed of the directors of the various laboratories and agencies under the Assistant Chief of Air Staff, Research and Developments Control, and such other personnel mostly representing other Air Staff Divisions having administrative interest.

The chairman of the Technical Advisory Committee and Secretary and Patent Counsel will be members of this Committee (excepting above the membership will generally be military).

Its duties will be to propose policies and administrative measures to Assistant Chief of Air Staff and to carry out his orders.

The Research Laboratories

It is vitally important as all industrial experience shows to separate completely research from development. (See the Consultant's book "Industrial Research".) This will mean some unscrambling at some existing agencies. The ideal is to have all research done in exclusively research laboratories.

A very considerable expansion of such research facilities is indicated. In general, the administration of Research Laboratories would be under Military Sub-Chiefs but the actual direction of research would be under civilian research directors as indicated.

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It is of vital interest both from the point of view of economy, broadening the experience base, acquainting scientific personnel with the problems of aero-science that every advantage be taken of university and private research facilities, wherever the problems can be defined sufficiently so that they can be done under contract. This farming out of research is one of the best ways of furthering aero-science.

The Development Laboartories.

The same considerations apply to research and development laboratories.

Director of Operations

The characteristic feature of Military Aero-Science is that there is no way of testing new devices under the actual conditions of use in war. Therefore, there is need of very special study of methods of testing, methods of training personnel, and methods of tactical employment of the new devices.

For this reason there are proposed three sub-agencies. That of Field Tests, which will having flying facilities and ability to test in maneuvers as well as the usual test laboratories. It is not proposed to include all test laboratories under this since Research and Development is not primarily a procurement agency, but it is intended to provide it with such test facilities as needed for its own products.

Training

Training here does not mean the routine training of Air Force officers and enlisted personnel but only the specialized training needed in connection with the new devices.

Tactice

Besides training personnel to operate new devices, it is necessary to work out the technical basis for employing the devices in war. This is a function similar to that done by Operations Analysis Sections during this last war and it is proposed that skeleton formation, now proposed to keep Operations Analysis Section alive, be fused with this section as it develops.

Director of Aero-Science

As has been said one of the most impprtant functions of the Air Staff Division of Research and Development is that of encouraging and developing the science of Military Aerology everywhere.

This included in the University by encouraging and supporting Fellowships and Professorships in Aero-Science.

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This includes encouraging the formation of Societies, both social and technical, for keeping up an interest in military flying.

This includes subsidizing publications of subjects of Military Science, Technical, Historical and Popular.

F. RUSSELL BICHOWSKY
Consultant in Research Organization.

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[redacted]

Auth: CG., ATSC
Initials:
Date:

TSEPA1

TSEPA1:PB:jm
12 December 1945

Guided Missile Inspection Trip

TSEPA (Colonel Gillespie)

1. In compliance with instructions, the undersigned visited various installations in the Western part of the United States in order to obtain information on:

a. Status of AAF Guided Missile Program

b. Existence of overlap with Army Ordnance Department and the Navy

2. The information obtained is contained in the attached inclosures and exhibits. Because it appears that the Guided Missile Program is being directed from Washington for the Army Air Forces, Army Ordnance Department, and Navy Department, it is not believed to be desirable to make positive statements concerning the status of the program or overlapping activities, until the appropriate policy forming guided missile personnel in Washington have been contacted.

3. The following tentative conclusions have been reached:

a. The Navy appears to be preparing to go into guided missile development work in a big way.

b. The Army Ordnance Department is more active in guided missile development work on the West Coast than are the Army Air Forces.

c. The Army Air Forces Guided Missile Program is progressing but not as rapidly as it could progress if more stress were placed on the Program and more funds were made available.

d. All V-2 type missile research and development work being done on the West Coast appears to be by the Ordnance Department for ultimate use by Army Ground Forces Artillery organizations.

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TO: TSEPA
Subj: Guided Missile Inspection Trip

12 Dec. 45

4. If further information similar to that contained in this report is desired, it is suggested that visits be made to Washington and appropriate establishments in the Eastern part of the United States.

PHILIP SCHWARTZ,
Colonel, Air Corps,
Special Ass't. for Armament,
Propulsion & Accessories Sub-Div.,
Engineering Division

Encls. 1 to 16 incl.
Exhibits "A" to "F" incls.

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INCLOSURE NO. 1

PERSONNEL INTERVIEWED

CALIFORNIA INSTITUTE OF TECHNOLOGY

Dr. Millikan
Dr. Lauritsen
Dr. Anderson
Dr. Stewart
Dr. Malina
Colonel E. H. Eddy, ATSC Liaison Officer
Major George Svehla, Ass't. ATSC Liaison Officer
Colonel B. S. Mesick, Ordnance Liaison Officer
Jet Propulsion Lab., Dr. Dunn
Cooperative Wind Tunnel

PASADENA, CALIFORNIA

Commander Stevenson, Br. of Aero. Representative
Giannini Company (Mr. Giannini, President)
Aerojet Company (Mr. Kimball, President)

LOS ANGELES, CALIFORNIA

Hqs., Western Dist., ATSC, Deputy C.G. and Major Hawkes
Hq., Los Angeles Ordnance Region, Chief
Hughes Aircraft Company, Mr. Black
Lockheed Aircraft Company, Major Satterly, P-80 Projects Engr.

INYOKERN

Captain Sykes, Station Commander
Dr. Thomson, Research and Development
Dr. Sage, Explosives
Dr. Brode, Sciences
Commander Richmond, Station Executive
Commander Casey, Experimental Operations
Dr. Cooper, Electronics
Dr. McLean, Fire Control

MUROC

Colonel Maxwell, Base Commanding Officer
Colonel Shoupe, Commanding Officer, Flight Test Base
Captain Pugh, Ass't. Chief, Aberdeen Mission

WENDOVER

Colonel McCauley, Base Commanding Officer
Lts. Adams, Clark and Thompson (Engineering, Operations and Armament Officers)

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PERSONNEL INTERVIEWED (cont'd)

OGDEN

Colonel Wolfe, Deputy Commander, Ogden, ATSC
Colonel Capram, Commanding Officer, Ordnance Arsenal

SAN BERNARDINO

General Spry, Commanding General, San Bernardino, ATSC

WHITE SANDS

Colonel Turner, Commanding Officer
Major Kersch, Chief Proof Officer

HQS., AGF

Lt. Colonel Lampl, Member of J.C. of S. Guided
Missiles Committee

Incl. No. 1

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INCLOSURE NO. 2

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OUTSTANDING OPINION AND STATEMENTS ON GUIDED MISSILE

RESEARCH AND DEVELOPMENT

1. Comparatively little information was obtained on the West Coast on the controlling of guided missiles.

2. The general opinion of responsible personnel was that the guided missile program was moving forward, but too slowly to permit the Air Forces to have and defend a strong position if a new emergency arose in the near future.

3. Visiting establishments on the Pacific Coast is not sufficient to obtain the whole guided missile picture. (Source: Lt. Colonel Lampl)

4. It would be necessary to visit establishments in the East which are working on guided missiles in order to obtain the whole story on needed action by the Army Air Forces on guided missiles.

5. It would be highly desirable to visit the personnel in Washington who are responsible for guided missile policies if it is desired to understand the present status of development. These personnel include those in Headquarters of ASF, AGF, WDGS, and the Navy Department. (Source: Lt. Colonel Lampl)

6. Too many visitors with only a surface interest in guided missile problems are visiting places where work is being done on these problems. (Source: Colonel Turner and Major Svehla)

7. Major Svehla helped the writer in a superior manner while he was in the neighborhood of Pasadena.

8. California Institute of Technology is interested in conducting only basic research on guided missile problems and desires to get out of applied problems as soon as possible. (Source: All responsible CIT personnel)

9. Although the Air Forces started jet propulsion investigations at CIT, the Ordnance Department has taken over sponsorship of most of the Army work at CIT during the last year and the Army Air Forces do not appear to be too active at CIT now. (Source: Major Svehla)

10. Outstanding activities in guided missile work at CIT pertain almost entirely to development of jet propulsion equipment. These activities have led CITinto the investigation of explosive propellants, and into explosives manufacturing methods.

11. Recent suspension of expenditure of Air Corps funds for the Jet propulsion Laboratory facilities at CIT has delayed work on guided missile

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projects. (Source: All responsible CIT personnel)

12. The Wright Field contract making people have delayed CIT development work because of the long time required to have Wright Field arrange for action on jet propulsion facilities. (Source: All responsible personnel at CIT Jep Propulsion Laboratory)

13. Effort should be made to expedite the preparation of the contract papers. It may be that the approved contract form is not suitable for contracting for research. (Source: Dr. Millikan)

14. Completion of construction of facilities for jet propulsion laboratories in the near future should permit speeding up research and development work at CIT. (Source: Dr. Millikan)

15. CIT expects Dr. Von Karman toreturn to that Institute about the first of the year. His absence has hurt the jet prop lsion research work at CIT. (Source: Dr. Millikan)

16. A representative of the Power Plant Laboratory should visit the Giannini Company in Pasadena early in 1946.

17. Reports requested from Wendover, Muroc, Giannini, and Aerojet should be studied by the Wright Field Guided Missile Project Officer, after the reports are received at Wright Field.

18. JB-3 fins should probably be changed to reduce control difficulties. (Source: Mr. Black)

19. Rocket used on JB-3 missiles being manufactured by Monsanto has not worked too well. The Aerojet Company has had much experience in the manufacture of rockets, and it may be desirable to give them a contract to develop a rocket for this missile.

20. Decision on future development of the Muroc Army Air Base should be made soon. (Source: Colonel Maxwell)

21. Chiefs of Laboratories at Wright Field should visit Muroc to see how Muroc facilities can fit into their requirements. (Source: Colonel Maxwell)

22. The Aberdeen Bombing Mission will probably remain at Muroc whether or not the ArmyAir Forces continue their activities there because the Muroc weather permits the maximum of efficiency in making high altitude test of bombs.

23. Consideration should be given to increasing the amount of flight test activities at Muroc. (Source: Colonel Shoupe)

24. Consideration should be given to moving rocket testing formerly at Dover, Delaware, to Muroc. (Source: Colonel Maxwell)

25. Muroc is at present not suited for firing guided missiles because the range is very limited. (Source: Colonel Maxwell)

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Incl. No. 2

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26. Wendover guided missiles testing facilities will be improved considerably if authority is finally obtained to fire on a large piece of land south of the present area. This extension will give Wendover the longest guided missile land range in the United States - 150 miles. (Source: Lt. Sherwood)

27. Decision on future of the Wendover Army Air Base, including its future strength, should be made as soon as practicable. (Source: Officers at Wendover)

28. Additional maintenance personnel should be sent to Wendover as soon as practicable. (Source: Lt. Adams, Engineering Officer at Wendover)

29. Ogden or Sacramento, ATSC depots should be directed to help Wendover supply and maintenance problems.

30. Jet Propulsion work at CIT is a joint job of the Army Ordnance Department and Army Air Forces and is watched by the Navy Department. (Source: Colonel Mesick)

31. The Ordnance Department has the following contracts now being worked on:

a. RCA Laboratories at Princeton, Dr. Vance - Shore to Ship missile.
b. Bell Laboratories at Morristown - Ground to Air missile.
c. General Electric at Schnectady - Ground to Ground missile.
d. California Institute of Technology - basic research for Army in guided missiles.

(Source: Colonel Mesick)

32. The Signal Corps is responsible under the auspices of the Ordnance Department for development of radio and radar equipment for tracking and guiding the Ordnance missiles. (Source: Colonel Mesick)

33. There are reported to be no AAF liaison officers at RCA, Bell, or General Electric guided missile activities. (Source: Colonel Mesick)

34. It may be desirable to obtain an undamaged V-2 missile from among those now stored at White Sands for sectionalizing and study at Wright Field or other competent Air Force establishment.

35. Inyokern is being built up as a place where Ordnance problems pertaining primarily to Naval aviation can be initiated and solved. (Source: Dr. Brode)

36. Navy Bureau of Ordnance appears to be moving much faster than Army Air Forces on aviation Ordnance problems.

37. The Navy Department appears to be putting more effort into aircraft armament development problems than the Army, if judged by the activities at Inyokern.

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38. Inyokern has been able to hire many leading scientists and is continuing the policy and is hiring more. Pay for the scientific personnel is in the upper brackets. Inyokern is able to use P-6, P-7 and P-8's.

39. The Inyokern policy is to give civilian scientific personnel full authority and responsibility over scientific work with little direct supervision by uniformed Naval personnel. (Source: Captain Sykes, Dr. Brode)

40. Dr. Whitson, one of the leaders in development of dive bomb sights, stated that he had offered his services to Wright Field but Wright Field was unable to accept them and he accordingly took a position with the Navy at Inyokern. (Source: Dr. Whitson)

41. Inyokern expects to concentrate on development of launcher for Bumblebee because Johns Hopkins is not working on this phase of the Bumblebee problem. (Source: Dr. Sage)

42. Inyokern is not suited at present for firing guided missiles at long ranges. (Source: Captain Sykes)

43. The Navy is seriously considering the use of long range over-water guided missile firing point near Oxnard, California. (Point Mugu) The Navy may also have a Bureau of Aeronautics development station located at Mohave, California, which is expected to supervise the Point Mugu firing point after it is established. (Source: Commander Stevenson)

44. The Navy has basic research being conducted at Johns Hopkins University as well as development of ground to air missiles. Colonel Corton is the Army Ordnance Liaison Officer at Johns Hopkins and Colonel Beman is the Air Force Liaision Officer. (Source: Colonel Mesick)

45. The Navy has taken over the Allegheny Ballistic Laboratory from the Army Ordnance Department. (Source: Major Svehla)

46. Development of Tiny Tim is being worked on at present so as to permit dropping it from an ordinary bomb rack without necessitating the use of the lanyard arrangement of the original design. (Source: Major Svehla)

47. V-1 and V-2 weapons development work in the U.S. has not progressed much beyond the stage where the Germans developed them in 1944.

48. If not now available in the U.S., information sho ld be obtained from Germany concerning the difficulties connected withthe early use of V-2, especially concerning duds and shorts. (Source: Dr. Stewart)

49. Dr. Lauritsen furnished the following opinions;

a. Guided missile development should be connected with atomic bomb development.
b. Someone at Wright Field should have sufficient information on atomic bombs so that he can answer questions pertaining to future design of armament equipment in guided missiles and jet propelled airplanes.

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50. Ground Forces are taking an initiative in use of guided missiles by organizing guided missile batteries and battalions as part of the Coast Artillery. One guided missile battery is stationed at White Sands Proving Ground. (Source: ColonelTurner)

51. Most important now is a decision on the direction of development of guided missiles during the next ten years. (Source: Dr. Millikan)

52. Loss of highly trained personnel still available should be avoided if practical. Efforts should be made to retain them on guided missiles work because it will be practically impossible to replacethem. (Source: Dr. Millikan)

53. The AAF Ordnance and Armament problems are suffering because scientific establishments and personnel similar to those available to Naval aviation at Inyokern are not being obtained for the Army Air Forces.

54. There appears to be no AAF development work on V-2 types of missiles notwithstanding the fact that publicity releases of Headquarters, AAF indicate that V-2 types of weapons are considered by Headquarters, AAF to be weapons which will be used by the Army Air Forces.

55. Rate of accomplishment of results in guided missile activities can be measured to a certain extent by the amount of money made available for the investigations. If early results are required, funds for the purpose must be increased accordingly. (Source: Dr. Millikan)

56. Action should be taken to see that information on research in jet propulsion is disseminated promptly to all places in the United States where recognized persons or organizations are working on jet propulsion or related problems. If this is not done, the AAF will have to pay more for its research and development program and it will also take much longer to obtain the final serviceable product. This is a very important matter. (Source: Dr. Millikan)

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INCLOSURE NO. 3

14 November 1945 Time: 10:00 A.M.

Major George Svehla (Assistant ATSC Liaison Officer, Cal. Inst. of Tech.)

1. Colonel E. H. Eddy was absent on temporary duty. Major George Svehla was Acting Liaison Officer during his absence.

2. Major Svehla stated that large numbers of people were visiting CIT in connection with guided missiles. He showed a number of lists of groups of people. These included a group of about fourteen Ground Force officers, a group of three officers from A-4 AAF, a group of three officers from the AAF Board, and one civilian from A-3 AAF. These groups indicated to him that many organizations and individuals were getting into the subject and probably making decisions with only a limited amount of information. The large number of people representing the Army Ground Forces and the Army Service Forces indicated that the subject was not restricted to Air Force organizations. There appeared to be at CIT a greater interest in guided missiles on the part of the Army Ground Forces and Army Service Forces than on the part of the Army Air Forces.

3. Major Svehla stated that the Wright Field representatives who had visited CIT in the past had been interested primarily in power plants rather than in the finished guided missile.

4. Colonel French of the Equipment Laboratory, recently visited CIT for the purpose of obtaining an exploratory opinion on the feasibility of a new electronic projector.

5. Major Svehla stated that he was assigned to Inyokern but because there was so much more activity at CIT than at Inyokern, he spent most of his time at CIT and visited Inyokern frequently in order to keep in close touch with activities at that station. In the opinion of the undersigned, Major Svehla is doing an excellent job at CIT insofar as he is responsible for acting as an administrative liaison officer. Major Svehla said that the Navy had suggested that visiting Inyokern periodically as he now does, should serve the Air Forces purposes just as well or better than if he stayed at Inyokern permanently. Injokern, according to Major Svehla, is converting from an organization consisting mostly of Naval personnel to one consisting largely of civilians. Many of the scientists who were formerly connected with CIT and who worked on research problems connected with the war have been hired by Inyokern on a civil service basis. At present, Inyokern is in a reconversion period and is not accomplishing too much because of the reorganization which is now in process.

6. Major Svehla said that it was his understanding that the Dover rocket testing installation was also closing down. If Dover is closed completely, he suggested that we might want to continue testing aircraft rockets at a place such as Muroc. Muroc had previously been used by Dover for testing

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aircraft rockets because Muroc is convenient to CIT where the 5 inch HVAR rockets were being developed and manufactured.

7. According to Major Svehla, the Navy has taken over the Allegheny Ballistic Laboratory which had previously been used by the Army Ordnance Department for the development of 4-1/2 inch aircraft rockets.

8. Section L of Division 3 of NDRC at CIT (developing 5 inch HVAR rockets) has been closed and some of the scientists formerly connected with Section L have been transferred to Inyokern. Dr. Fowler now has the details. The Eaton Canyon rocket powder plant has been closed and transferred to Inyokern.

9. Major Svehla stated that it was CIT's understanding that in jet propelled airplanes, aircraft rockets would be carried internally in order to reduce drag.

10. It has been found that the Tin Tim rocket can be fired without a lanyard from the external bomb shackle of a fighter airplane. It was CIT's understanding that Tiny Tim had never been used in combat and therefore not too much was known concerning its value in combat.

11. A 2000 pound 14 inch aircraft rocket is now being developed. This rocket has a motor weighing about 1000 pounds and a head weighing about 1000 pounds.

12. In 1943, the AAF Board turned down an assisted take off rocket using acid aniline jet propulsion which had been developed by the Aerojet Company.

13. CIT is developing a ram jet engine.

14. TheRocket Board is moving from Ft. Sill to Ft. Bragg where the Army Ground Forces Board is located.

15. CIT is anxious to get out of Government work. Biggest thing done at CIT during the war was the development of the 5 inch HVAR rocket for the Navy. This work was supervised by Dr. Lauritsen. He is now out of this work.

16. CIT is willing to let some of its staff go to places like Inyokern to be hired by the Government in a civilian basis, leaving only basic research at CIT.

17. Major Svehla has been on this job for more than a year. At first he was assistant to Colonel Joiner. He is now assistant to Colonel Eddy. Skinner was Ordnance Liaison Officer at CIT until July when he was succeeded by Colonel Mesick. Lt. Colonel Stace who is in charge of guided missile work in A-4 Headquarters, AAF, was formerly a radar man. He went into guided missiles work early in 1943. Historical Office at Wright Field may have written up history of development work on guided missiles.

18. The Aerojet Corporation was organized by a group of CIT professors

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and later was sold to the General Tire and Rubber Company.

19. The Navy is reported to be moving an Annapolis Group to Oxnard, California. This Group has been working on jet propulsion power plants.

Additional Remarks made by Major Svehla - after 14 November 1945.

20. Major Svehla said that there may have been some complaints by Wright Field that not enough has been produced by CIT.

21. Major Svehla said that there may have been some complaints that the Aerojet Corporation made profits for CIT personnel.

22. He also said that there may have been some complaints that CIT did not propose to use construction money properly as a result of which there may have been some delay at Wright Field in furnishing construction funds.

23. CIT feels that there has been an unnecessary delay at Wright Field in furnishing funds for construction at the Jet Propulsion Laboratory. There is an existing shortage of about $200,000 for construction; this is causing delay in production of results at the Jet Propulsion Laboratory.

24. Among the concrete results at CIT, there are thus far:

a. Development of assisted take-off rocket used by the Navy in large quantities thereby increasing the pay load of aircraft using these rockets by approximately twenty-five percent.

b. Research work on V-2 type of weapons. This have been done primarily for the Army Ordnance Department.

25. Question has sometimes been raised concerning the desirability of the Air Forces suspending research work at CIT leaving CIT as a place under the jurisdiction of the Army Ordnance Department insofar as jet propulsion and guided missiles are concerned. Perhaps all engine work can be done at the NACA engine research establishment at Cleveland. This question may be answered as follows: This Army Ordnance Department may like the idea of having CIT as their research organization without cooperation from the Army Air Forces. However, CIT has been closely associated with the Air Forces on aerodynamic as well as jet propulsion research and it is probably that CIT would not be happy to lose its connection with the Army Air Forces. The Army Ordnance Department may for some reason lose its interest in research on V-2 types of missiles at CIT but the jet propulsion work being done there will always be important to the Air Forces from the point of view of the conventional jet propelled type of aircraft. If V-2 types of weapons become more important, the Army Ordnance Department will probably have additiona. activities at CIT.

26. CIT is interested in jet propulsion investigations which are outside the field of the Army Ordnance Department. It is interested in jet propulsion equipment, in addition to the V-2 type of rocket, in the following types of engines:

a. Intermittent jet
b. Turbo jet
c. Ram jet
d. Assisted take-off rockets

These are of comparatively little interest to the Ordnance Department but their early perfection may radically affect the future of the Army Air Forces.

27. The B-36 aircraft may have use for assisted take-off rockets.

28. Improvement of turbo jet engine by tail pipe injection of fuel is reported to increase thrust by about twenty-five percent.

29. A study should be made of the comparative value of research done at CIT Jet Propulsion Laboratory and the NACA Power Plant Laboratories at Cleveland. Cleveland has the advantage of being close to Wright Field.

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INCLOSURE NO. 4

14 November 1945. Time: 11:00 A.M.

Colonel B. S. Mesick, Ordnance Department (Liaison Officer - Cal. Inst. of Tech.)

1. Colonel Mesick stated that he had just returned from a conference at Aberdeen which had been called at his request in order to clarify responsibility for the Ordcit Project. At this meeting, representatives were present from the Office Chief of Ordnance, Office Chief Signal Officer, CIT and Aberdeen Proving Ground. The specific question raised at the meeting concerned the responsibility of the Signal Corps for development of radar equipment. He said that at the meeting it was agreed that the Signal Corps would have two kins of responsibility: (a) Responsibility for development of radar measuring equipment which was to be used at Aberdeen Proving Ground for making measurements pertaining to the ballistics of guided missiles, and (b) Responsibility for advising CIT and such companies as Sperry concerning the development of radar equipment suitable for tracking and controlling guided missiles. The Signal Corps was also to be permitted to test its own radar equipment at White Sands Proving Ground independently of Aberdeen Proving ground in order that the Signal Corps could make preliminary developments of measuring equipment ultimately to be used only at Aberdeen Proving Ground.

2. In Colonel Mesick's opinion, it is satisfactory to develop guided missiles independently of the pay load whether the pay load be in the form of an atomic bomb, a conventional type of bomb, or even personnel. In this connection, he stated that V-2 had an acceleration of only 2 g's and, therefore, it was not impossible to have personnel ride in a V-2 safely provided there was some method of getting out safely before impact.

3. Colonel Mesick believed that General McNarney's Memorandum on Division of Responsibility between the GroundForce and the Air Force was reasonable and logical and could be followed satisfactorily by all atencies responsible for development. He further said that General Craigie of the Engineering Division and General Barnes of Research and Development Subdivision of the Office Chief of Ordnance, have conferred frequently on guided missiles and see eye to eye on the subject of responsibility for development.

4. Colonel Mesick felt that the term "guided missile" was a satisfactory term and that guiding was an essential part of the development. He did not concur in a suggestion that the name be changed to something equivalent to "jet missile". Colonel Mesick was apparently not up to date on the accuracy of JB-2 now being obtained. It is probable that he did not realize that in the Air Forces, guided missiles were supervised at Wright Field in the branch where radio-controlled anti-aircraft targets were first developed and where the development of such bombs as Azon and Razon was supervised. In both Azon and Razon, the guiding was the essential characteristic and the jet propulsion feature was not involved.

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5. Colonel Mesick let me have a copy of theAgenda for the meeting at Aberdeen Proving Ground which he attended. He also let me have a copy of monthly progress report produced by the Office Chief of Ordnance, entitled "Rocket Development Projects" dated 10 October 1945.

6. He said that the Ordnance Department is doing nothing on V-1 types of missiles so far as he knows.

7. He said that the only knowledge of the atomic bomb required for development of guided missiles were the space and weight requirements. From this point of view there is a minimum volume and weight which should be set up for the warhead of guidedmissiles.

8. He said that General Electric Corporation is working on development of V-2 missiles. He said that CIT was not really working on V-2 types of missiles. CIT is really trying to obtain basic principles on all types of jet propelled and guided missiles but was not developing V-2 even though some of the "Privates" and "Corporals" were of the V-2 type. He said that CIT had been working on jet propelled missiles of the V-2 type long before the Ordnance Department took an interest in the subject. He listed the agencies interested in guided missile work at present as follows: (a) Applied Research, (1) RCA at Princeton (Dr. Vance) shore to ship (seacoast), (2) Bell Telephone Laboratory at Morristown, ground to air, (3) General Electric at Schenectady, ground to ground; and (b) Basic Research, (1) for Army at CIT, (2) for Navy at Johns Hopkins University (Colonel Gorton is the Ordnance Liaison Officer).

9. The only place where the Air Forces appear to be connected with basic research in guided missiles, is at CIT where Colonel Mesick and Colonel Eddy coordinate their activities.

10. There is no Air Forces Liaison Officer at RCA, Bell Telephone, or General Electric Laboratories as far as he knows.

11. He understands that the Douglas Aircraft Corporation had the ROC Project and that Douglas had either recently fired some at Muroc or expects to fire some. He understands that the project is to be closed shortly.

12. He said that all jet propulsion basic research at CIT is done jointly for the Air Forces and the Ordnance Department. The Ordnance Department may use the information obtained at CIT for itspurpose and the Air Forces for its purpose, but the two purposes may be different. He said that many fuel combinations had been tried out in the development of jet propulsion equipment, including acid aniline.

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INCLOSURE NO. 5

14 November 1945   Time: 4:00 P.M.

Professor C. C. Lauritsen - Cal. Inst. of Tech.

1. Professor C. C. Lauritsen said that he did not believe that the present method of tackling the guided missile problem was as good as it could be. He stated that even in the Navy the research people were not necessarily always agreeing with the Bureau of Aeronautics and the Bureau of Ordnance. He said that if a completed item was wanted soon, the present method of development was not satsifactory; but that if we were interested only in long range development, the method might be satisfactory. He pointed out that the work now being done is not truly research but would properly be called development since the research work had been completed previously. Dr. Lauritsen was asked if he felt that the development now going on would produce the desired article and whether it was sufficient to develope a vehicle regardless of the kind of personnel or materiel to be carried by the vehicle. He stated that in his opinion the type of guided missile which should be developed was connected with the atomic bomb development and that no statement could be made concerning the effectiveness of guided missiles now under development unless knowledge of the atomic bomb development and supply situation is available. For this reason he indicated that if Wright Field were to answer such questions there should be someone at Wright Field who is sufficiently familiar with the Atom Bomb technical and supply problems to prevent Wright Field from designing and manufacturing guided missiles and conventional types of airplanes which would not fit into an era when atomic bombs are available in fairly large quantities.

2. He was of the opinion that if a new emergency were to arise, with the present equipment we should be able to carry an atomic bomb in a B-29 (just as we did over Japan) to a point 100 or 200 miles away from an important target and then aim a guided missile with an atomic bomb warhead and effectively destroy the target.

3. In his opinion, targets suitable for atomic bombs are large cities. Since an atomic bomb cannot be used economically against unimportant targets, the best protection against atomic bombs is dispersion. For certain highly important installations, such as the activities carried on in the Pentagon Building, where concentration is necessary, underground installations properly protected by concrete overhead structures should be a suitable counter measure against the atomic bomb. Except for dispersion and underground protection, he did not feel that a suitable counter measure existed at present. He referred to Commodore Parsons of the Navy and Dr. Stearns who was formerly in AC/AS Plans, Headquarters, AAF. He also said that General Giles, now in the Pacific, had kept in close touch with the atomic bomb situation, but he did not feel that there were enough people within the Air Forces who had sufficient information on the atomic bomb to permit proper planning for the use of this weapon.

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INCLOSURE NO. 6

15 November 1945.

Jet Propulsion Seminar - Cal. Inst. of Tech.

A. Colonel Mesick

1. Purpose of seminar is to give Ground Force Officers and a few Air Force Officers information on jet propulsion activities at CIT.

2. There are four liaison officers now at CIT.

a. Ordnance - Colonel Mesick
Captain Bradshaw
Lt. Miles (not yet arrived)

b. Air Forces - Colonel Eddy
Major Svehla

c. Ground Forces - Lt. Colonel Nickerson

d. Signal Corps (Tied in with Office Chief of Ordnance)

Additional liaison officers may come in later. Closer liaison with the Navy is desirable (one Navy officer is at CIT. He is keeping in touch with things in a small way). General Craigie and General Barnes are working together and hope to get the Navy into one overall committee and other subcommittees so that all services interested will be represented.

3. The work on guided missiles is done at two type of installations:

a. Basic research is done at CIT.
b. Applied research is done at industrial establishments such as General Electric, Bell Telephone, RCA, Sperry and some aircraft companies.

4. There are three categories of guided missiles in which the Ordnance Department is interested:

a. ground to ground
b. ground to air
c. shore to ship (Coast Defense)

Basic research on all types of missiles is done at CIT. The applied research is divided as follows: -

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a. ground to ground (General Electric)
b. ground to air (Bell Telephone)
c. shore to ship (RCA)

Allprograms are long-range programs in terms of years so that quality of final results should be quite high. In from 3 to 10 years there should be great strides in guided missile development.

5. The Secretary of War has suspended the expenditure of funds for completing the Jet Propulsion Laboratory. It is hoped to get funds from other sources. Some of the facilities are seventy-five percent to eighty percent completed and funds should be obtained to complete the project.

The Committee under Dr. Dewey of the Joint Chiefs of Staff has submitted a short term report and a ground to air missile report. Program for development of guided missiles in the United States (research and manufacture) is just being submitted.

6. Dr. Delasso of Aberdeen Proving Ground obtained exterior ballistic measurements on the Wac Corporal during the test at White Sands.

7. There was a Signal Corps Group under Major Jackson at White Sands Proving Ground which assisted in:

a. obtaining weather data
b. obtaining measurements
c. determining weather conditions at high altitudes

8. A group of contractors' engineers and mechanics was also present at the test.

9. All of these groups, plus the Proving Ground personnel concerned, were coordinated by Colonel Mesick. The cooperation was excellent.

B. Major Svehla

10. All Army Air Force work at CIT is under Engineering Division, ATSC. The Engineering Division is interested primarily in power plants. The Army Air Forces started jet propulsion investigations at CIT before the Army Ordnance Department. The Air Forces problems at CIT now are as follows:

JPL-1 Fuel research
JPL-2 Hydrobomb
JPL-3 Ram jet engine

Assisted take-off unit developed for the Army Air Forces was not used by the Army but it was used by the Navy. The Navy ordered 180,000 one thousand pound units. The Army Air Forces have not used acid aniline assisted take-off units principally because the AAF Board rejectedthis type of equipment.

11. The facilities at CIT used for jet propulsion investigations have been constructed primarily with Ordnance money.

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C. Dr. Clark Millikan

12. Dr. Von Karman has been the leader and spark plug in jet propulsion development. He has been in Washington for the last year. It is hoped that he will return to CIT about 1 January. Dr. Malina is his first assistant.

13. The guided missile development cognizance and jurisdiction is very difficult because it affects all Army and Navy activities. The organisation of future development is still far from clear.

14. The most important thing now is to decide the direction of development for the next ten years. Decisions are needed now on future programs.

15. CIT should work on basic and fundamental research. CIT would waste its time if it went into the work of development of missiles.

16. Cancellation of construction funds is the most serious headache. If facilities cannot be completed, whole development program may be injured irretrievably. Personnel who have obtained knowledge of and skill in this development program could not probably be collected again if once dispersed.

17. The Laboratory has suffered because so much attention has been paid to construction rather than use of facilities.

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INCLOSURE NO. 7

19 November 1945 Time: 11:00 A.M.

Captain Sykes, Commanding Officer, Inyokern Naval Ordnance Test Station

1. Captain Sykes said there was not much difficulty in obtaining scientists to work in a civilian capacity at his station. All research and development at Inyokern was headed up by civilians with very few Naval uniformed personnel in research and development work. Dr. Thompson is the civilian head.

2. Bureau of Aeronautics and Bureau of Ordnance had several discussions on the responsibility for guided missiles as a result of which the Bureau of Ordnance was given full responsibility. At one time it was proposed that the line of demarkation between Bureau of Aeronautics and Bureau of Ordnance be at the place where the missile gained or lost altitude. If it gained altitude, it was proposed that it pertain to the Bureau of Aeronautics, and if it lost altitude, to the Bureau of Ordnance. This proposal was not accepted, and the Bureau of Ordnance now has full responsibility.

3. Inyokern is entirely Bureau of Ordnance. Point Mugu near Oxnard, California, is expected to be used by the Bureau of Aeronautics for long-range tests of guided missiles. Inyokern can be used only for comparatively short-range tests. On V-J-Day the plans contemplated the expenditure of $57,000,000 at Point Mugu but after VJ-Day, that quantity was reduced approximately to $100,000. An Army area north of the Inyokern range area is also being investigated by the Navy to see if it can be used by Inyokern for long-range missile firing.

4. The Office of Research and Inventions in the Navy Department in Washington will probably go into guided missile work and that office should have much money for this type of development. Admiral Bowen is head of that Office.

5. Captain Sykes believes that if ten percent of the basic research projects on which funds have been expended, can be used in the practical problems of the Navy, this percentage justifies the expenditure involved in the other ninety percent.

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INCLOSURE NO. 5

19 November 1945. Time: 2:00 P.M.

Inyokern Meeting for AGF Officers

A. Lt. Williamson, Assistant to the Officer in Charge of Experimental Operations at Inyokern

1. The first test on Bumblebee was made in August 1945. Development work was done at Johns Hopkins University. The principal developments were in:

a. burner
b. guiding equipment
c. aerodynamics
d. power plant

So far Inyokern has tested only on the power plant. To date, nine athodyds (ram yet engines) have been fired using four 5 inch HVAR rockets coupled together by manifolding for obtaining the necessary high initial speed. The initial tests were made with a small scale Bumblebee having adiameter of six inches. The rockets raise the velocity of the missile to 1800 feet per second and then the athodyd takes over. So far only testing work has been done at Inyokern. No design work has been done at Inyokern. Last Friday one test was attempted but trouble was encountered due to inexperience of personnel.

2. No tracking has yet been done using radar. The principal problem now is to obtain rocket assist equipment which will raise the ram jet engine to the velocity of approximately 1800 feet per second because the ram jet engine does not operate satisfactorily at low speeds.

3. The Lark is being developed by Vultee and Fairchild. Up to the present, contracts have been let primarily through the Bureau of Aeronautics. Bumblebee is a Bureau of Ordnance project but Lark is a Bureau of Aeronautics project. Inyokern is furnishing facilities for testing Lark. Lark is a subsonic missile with an acid aniline power plant. The Lark is twelve feet long and weighs about 1000 lbs. The diameter of the fins is about six feet. It is launched from a catapult using seven cartridges. One liquid propelled rocket gives 200 lbs. thrust and the other 600 lbs. thrust. The 200 lbs. unit is for the purpose of adjusting the thrust which is based primarily on the 600 lbs. unit. The missile has a speed of about 150 miles per hour at the end of the launching.

4. Lt. Williamson mentioned the following missiles without explanation: "Little Joe", and "Gargoyle". No work has been done at Inyokern on V-1 or V-2.

5. Many civilians have left Inyokern since the war ended. The

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Ballistic Computing Section is a month or more behind because of this loss of personnel.

6. Facilities for static firing of jet propelled power plants are located at Inyokern. For testing Lark, a special area will be used.

7. No wind tunnel is now being planned for Inyokern.

Johns Hopkins is now putting up buildings in Texas for supersonic wind tunnels for testing power plants. Johns Hopkins now has testing equipment in the East.

B. <u>Commander Casey, First Assistant to the Officer in Charge of Experimental Operations.</u>

8. There is a guided missiles Board at Inyokern which has gathered together all of the data in the country on guided missiles. Ultimately this Board will be prepared to coordinate all Navy developmental work on guided missiles. The Board includes at present: Dr. Thompson, Dr. Brode, Dr. Sage, and Dr. Ellis. So far, only Bumblebee has been tested at Inyokern. Consideration has been given to an 18,000 lb. missile but this is much larger than anything which has been tested at Inyokern. Inyokern wants to get into the launcher development program. This applies principally to the ram jet engine where a speed of 600 miles perhour is needed to start the engine.

9. The launching is the important part of the Lark project at Inyokern. The Lark has a power range of forty miles and a gliding range of seventy miles more. Much can be learned on the thirty-three mile firing range at Inyokern. This firing range has a good back stop for overs. (Nine thousand feet mountain). However, much more can be accomplished if theDarwin Army area north of the Inyokern area can be obtained, thus permitting much longer range tests.

10. An extensive laboratory is being built at Inyokern to investigate propellant research, ballistics and assessments. The laboratory is expected to be used for long-range programs and for immediate answers. This laboratory will be close enough to CIT to get good advice from that source. It will also obtain advice from the University of California at Berkley. There is an advantage in having the laboratory at Inyokern because the test area is in the same place as the development area. Inyokern also has good security.

11. Development work is now being done on rockets. Research work is being done on rockets and rocket propellants. Most of the work is on solid propellants although some are liquid.

12. Work is now being done on spinner type of rockets and adaptability of aircraft rockets to VT fuzes. The after buring of the rocket appears to affect the functioning of the VT fuse. The five inch HVAR rocket has a length of about five calibres. This round is stable up to approximately 1.8 mach number. For air to air firing, arming in 100 yards is required.

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The ionized jet may trigger the fuse after the fuse has become armed.

13. Development work is now going on toward obtaining plastic powders for rockets. Facilities other than Inyokern are also making rocket propellants. CIT designed the five inch HVAR round and grain shape. Dr. Sage came from CIT.

14. A Board has been set up to assess reports from amphibious forces on the use of barrage rockets. New aircraft rockets are expected to be fired from tubes and will be spin stabilized. There are many projects covering ordinary aircraft or ground rockets using solid and liquid propellants. Forty millimeter guns and four and a half inch rockets with VT fuses have been used as AA weapons. Twenty-four tubes on a thirty-six inch search light frame have been used against "drones" with apparently good results. Many "drones" have been destroyed. There are sixteen officers and seventy men in the Drone Unit but by January this personnel may be down to three officers and six men. The "drone" is a twin engine airplane target having approximately 125 miles perhour speed. Firing is done usually at approximately 1500 yards range. A burst of four rockets is usually fired at the plane with 1/2 second interval between rockets. The interval is needed because of the possibility of one rocket being affected by the blast of another rocket.

15. The work at Inyokern is divided into two principal parts:

a. Research and Development
b. Experimental Operations

Both parts are under the Director of Research and Development. Under Research and Development there are the following:

a. Ordnance
b. Explosives
c. Sciences
d. Engineering
e. Technical Services

Under Experimental Operations are the following:

a. Air Ranges
b. Ground Ranges
c. Plate Range
d. Air Facilities

As Naval uniformed personnel are lost, they are being replaced with civil service personnel. Job sheets for civil service personnel are now being prepared and much difficulty is being encountered in the process. The principal trouble is due to the fact that the higher paidjobs are authorized at present only for those who supervise large numbers of personnel. Sincemost scientific personnel do not supervise large numbers of people, it is sometimes difficult to obtain suitable professional ratings for them.

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16. In addition to testing facilities at Inyokern there are other guided missile facilities at:

a. Johnsville, Pa.
b. Naval Aircraft Factory (north of Philadelphia)
c. Marine Corps Station at Mohave
d. Point Mugu

Inyokern is the only Bureau of Ordnance testing place and has limited range facilities.

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19 November 1945

Lt. Colonel M. B. Lampl, Development Section, Headquarters, Army Ground Forces, Pentagon, Washington.

1. Lt. Colonel Lampl is a member of the Joint Chiefs of Staff Guided Missile Committee. He accompanied the Army Ground Forces personnel who visited CIT and Inyokern. He said that his Chief of Section, Headquarters, AGF, is Major General A. W. Waldron (formerly Field Artillery) and his Deputy Chief is Brig. General H. H. Hewitt (formerly Coast Artillery).

2. Lt. Colonel Lampl said that the Joint Chiefs of Staff Guided Missiles Committee was ready to submit a program for the future and then disband. In order to understand the present situation regarding policy on guided missiles, it would be desirable to visit Washington and contact the following:

a. Army Ground Forces - Development Section
b. Army Service Forces - Research and Development Division
c. War Department Special Staff - New Development Division
d. Ordnance Department - Research and Development Service

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INCLOSURE NO. 10

20 November 1945 Time: 9:00 A.M.

Inyokern

A. Dr. Sage, Explosives Department

1. The pilot powder plant is capable of producing 300,000 pounds of rocket propellant powder per month. About 400 people are now working in the plant. The colloided material is obtained from a standard Army or Navy powder plant. It is received in the form of black sheets. These black sheets are cut up into small pieces. They are then put into the press and extruded in cruciform shape. The extruded powder is cut into lengths and cured. The plant makes solid propellant only. The propellant is a combination of nitro cotton and nitroglycerin. A high explosive plant was being built, but the undersigned was not permitted to see it. It is believed thatthis plant may be connected with the Manhattan District. It is expected that liquid propellants will be made at the rocket propellant powder plant later but at present only solid propellants are being made. The plant is a model plant with many modern safety precautions. It was originally built and operated by CIT. Many of the CIT personnel who operated the plant during the war are now being transferred to Civil Service status at Inyokern. Many of these have high professional ratings. The Navy is apparently having not too much difficulty in obtaining scientific personnel with high professional ratings. There is reported to be some trouble, however, with processing civil service job sheets.

B. Ranges

2. The rocket ranges use cameras pointing in fixed directions to photograph the rocket projectile. Cameras are synchronized with each other and with the rocket launchers. Towers and range rakes are used for locating point of impact of rockets. One unique range was inspected which is used for testing rockets against steel plate. The range consists of a pair of rails which are 1500 feet long. The rocket is fired at one end of the rails and it is guided by rails directly to the other end where it is bound to hit the target in the form of the steel plate. The Inyokern range area is generally hilly and in some parts mountainous.

C. Dr. Cooper, in Charge of the Electronics Developments at Inyokern

3. He expects that Johns Hopkins University will furnish tracking and guiding equipment. The SCR 584 is expected to be useful up to 40,000 yards range. Other radar equipment will be used for longer ranges and at extremely long range, radio equipment will be used. Little has been

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done by Dr. Cooper so far. He is in an organizing stage. At present his functions are testing only.

D. Dr. McLean in Charge of Fire Control Developments at Inyokern

4. Dr. McLean expects to furnish mechanical controls for guided missiles. He also goes into all problems pertaining to aircraft fire control, such as AIBR dive bomb sights as well as modification of the K-14 sight. He believes that there is an initial launcher problem from the guided missile stability point of view. While in Dr. McLean's office, Dr. Whitson appeared. In conversation with hime, it developed that he had offered his services to Wright Field but the offer had not been accepted because Wright Field was unable to obtain a suitable civil service rating for him. As a result, he had made a connection with the Navy at Inyokern. (Dr. Whitson has probably had more experience with the field use of dive bomb sights such as AIBR in the European Theater than any other individual and should have been an asset to Wright Field if his services could have been obtained).

E. Meeting of Inyokern Guided Missiles Committee

5. Members of the Inyokern Guided Missiles Committee are as follows:

Dr. Thompson	Dr. Arnquist
Dr. Sage	Dr. Elvey
Dr. Brede	Dr. Ellis
Dr. McLean	Commander Hayward
Dr. Cooper	Ensign Kranick (technical aide)

6. Dr. Tuve of Johns Hopkins and Commander Sawyer of the Navy Department in Washington, were present. Dr. Tuve said that it is necessary that investigations be continued of thrust and drag at supersonic speeds. He also stressed the necessity for investigation of steering missiles at supersonic speeds. He believes in obtaining the necessary high speed for Bumblebee using rockets with high acceleration and feels that gyros capable of withstanding 75 to 150 g's can be developed, if necessary.

7. Dr. Sage said that Inyokern would concentrate on the launching problem. Inyokern is also making some new rockets of various sizes. These rockets are designed to be used during the launching period for raising the initial speed of Bumblebee to 1800 feet per second. Dr. Sage's program involves about eight different rockets divided into two categories - the first category being rock ts that have an excellent chance to working satisfactorily and the 2nd category including rockets which are experimental in nature.

8. Dr. Sage stated that he believed that a liquid propellant with resulting low g's would be better than a solid propellant. This would give the necessary 1800 feet per second after ten seconds' flight rather than after one second's flight. He also said that the aerodynamics problem during the launching period was important. Dr. Tuve said that some guiding of missiles had been accomplished but that it was not too good so far.

F. General (Colonel Schwartz)

9. It was stated without verification that more than $50,000,000

had been expended at Inyokern. The station is reported to have more than a thousand sets of quarters for officer and civilian personnel, in addition to enlisted men's barracks. It is primarily a testing station, although it is expected that research and development will begin after the laboratory now under construction, is completed. It was reported that a detachment of Inyokern is located near Pasadena at the Foothills Laboratory where scientific personnel are engaged in research work. There was considerable discussion at Inyokern concerning the desirability of having scientific personnel moved from Pasadena to Inyokern. Many of the scientific personnel believe that Inyokern is so isolated that the Foothills Laboratory in Pasadena is preferable, especially because of its nearness to CIT and other scientific establishments such as U.C.L.A. and the University of Southern California, as well as the aircraft companies.

10. An extremely unusual organization exists at Inyokern in that scientific personnel are given the status of officers of the Navy for all practical purposes and are permitted to run their own activities. Dr. Thompson, who is the head of Research and Development activities, has only one person superior to him at Inyokern and that is Captain Sykes, the Station Commander. Most of the personnel in uniform at Inyokern are used forhouse-keeping purposes and for operating ranges, airdromes, and airplanes. The important work being done at Inyokern is at present in the hands of the civilian scientists, and they run all of this work themselves. How long this arrangement will last is questionable. Inyokern appears to have plenty of money for its program and it gives the impression of an active station which is in a preparatory period and which will ultimately accomplish a great deal. Although the Station Commander reported to the Bureau of Ordnance, he himself was a pilot and most of the work which was being done at Inyokern appeared to relate almost entirely to Naval aviation. The officer in charge of Experimental Operations is also a pilot. From this point of view, it appears that the Navy is putting more effort into the development of armament and ordnance than is the Army. Matters pertaining to surface or submarine ordnance are handled at the Naval Ordnance Laboratory in Washington or at the Dahlgren Proving Ground in V irginia. It is probable that if the AAF were to have an establishment corresponding to Inyokern, similarly staffed with a large number of scientists, the guided missile program would be benefited tremendously. Such an establishment would insure the position of the Army Air Forces in the future expecially if guided missiles become of the importance which General Arnold has predicted in many of his official reports and statements.

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INCLOSURE NO. 11

21 November 1945

Muroc

A. Main Base

1. Colonel Maxwell, Commanding Officer of Murox, said that he had about 185 officers and 11 sets of married officers quarters. He said that personnel problems, especially delay in offering regular army commissions to officers, were coming up frequently. 4th Air Force installation moved from Muroc as a result, according to Colonel Maxwell, of the request of ATSC. The facilities at Muroc, according to Colonel Maxwell, are not being used to their fullest extent. Colonel Maxwell recommended that Chiefs of Laboratories and equivalent personnel of the Engineering Division, visit Muroc as soon as practical to see how the facilities at Muroc could fit the requirements of Wright Field activities. According to Colonel Maxwell, General Craigie had stated recently that bombing tests were to be conducted at Muroc instead of at Eglin Field. Because there are no ranges adequate for air to air gunnery activities at Muroc, gunnery tests should remain at Eglin Field, according to Colonel Maxwell.

2. There were three important activities at Muroc:

a. 4th Air Force Training (Colonel Maxwell)

b. Aberdeen Bombing Mission (Colonel Wilson)

c. Engineering Division flight test organization (Colonel Shoups)

3. The 4th Air Force organization had moved out about 15 October, but the Flight Test and the Aberdeen Bombing Mission activities were still being carried on.

4. In August 1945 a plan for permanent construction at Muroc involving $30,000,000 was prepared. General McCoy of Washington said this was the approved plan for Muroc as of 4 August 1945.

5. Flight test activities started about July 1942 and until recently were independent of the rest of the activities at Muroc, reporting directly to the Engineering Division at Wright Field.

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6.- The Aberdeen Mission arrived in April 1945 and is used to con-
duct tests on bombs which require dropping from extremely high altitudes.
When this Mission arrived it was attached for administration to the 4th
Air Force group located at Muroc.

7. Colonel Maxwell commanded the 4th Air Force group at Muroc when
he was in the 4th Air Force. Since approximately 15 October 1945 he has
been assigned to ATSC and now commands all installations at Muroc. He is
under San Bernardino ATSC for certain administrative purposes. He does
not believe that Muroc should be placed under San Bernardine in order to
prevent it from becoming a supply or maintenance station, instead of an
engineering station.

8. There is an area north of the Inyokern area called Salina Valley.
This area was used by Muroc organizations for training in air to air gun-
nery. During the visit to Inyokern, it developed that Captain Sykes
hoped to be able to make use of this area as an impact area for guided
missiles. Colonel Maxwell said that it had been recommended to the 4th
Air Force headquarters by Muroc some time ago that the Salina Valley area
be turned back to its owners. Muroc now has not any connection with this
area.

9. Colonel Maxwell believes that Muroc should be developed as a
flight test base instead of using Wright Field for this purpose. Colonel
Maxwell was asked to make a study of the possibility of firing guided
missiles at Muroc with impact point located approximately 150 miles away
and surrounded by an area approximately 20 by 20 miles in extent. The
maximum length of range at Muroc is now about 20 miles. If it were permitted
to fire guided missiles at Muroc over non-government desert areas, it should
be possible to fire from Muroc to the Salina Valley and obtain a range of
about 150 miles. Colonel Maxwell said that he would make a study of the
possibility of using Muroc for firing guided missiles and send me a copy
of the report on the study at an early date.

B. <u>Flight Test Base - Muroc (Colonel Shoupe)</u>

10. Colonel Shoupe said that he had about 29 officers and 250 men, al-
though his T.O. calls for 450 men. Until recently he had 500 men. He has
50 civil service employees and averages about 25 contractor civilian per-
sonnel who are involved in testing equipment. There are only a few CIT
people at this activity.

11. Principal activity appeared to be flight testing of P-80 and simi-
lar airplanes. The hangar contained several flying wing prototype aircraft
for test. There was also a P-81 with a combination propeller and turbine
for test. Five officers from Dover, Delaware were present for the purpose
of testing rocket installations on P-80 airplanes using external suspension.
CIT was also testing a 20,000 lb. thrust unit statically.

12. Colonel Shoupe was of the opinion that Muroc was a very fine place

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for flight testing airplanes and that more of this type of work should be delegated to Muroc by the Engineering Division. He listed the advantages of Muroc as follows: (a) unlimited runways, (b) unlimited weather, (c) stabilized flying conditions, (d) proximity to aircraft factories.

C. <u>Aberdeen Bombing Mission</u>

13. In the absence of Colonel Wilson, the Chief of the Bombing Mission, information was obtained from Captain Pugh, his assistant. Aberdeen Bombing Mission consists of 26 Air Corps officers and 204 Air Corps men assigned to the 620th AAFBU of the Proving Ground Command. There are also 15 Ordnance officers and 68 Ordnance men. There are also one officer and 11 men of a weather organization for obtaining wind and temperature aloft, using radio sound equipment. The C.O. of the Air Corps troops is Lt. Col. Rodney K. Gunther. The number of airplanes assigned to the Mission is probably to be reduced in the near future because maintenance men are not available in sufficient quantity. Three bomb ballistic missions a day are scheduled - two in the morning and one in the afternoon. It was estimated that 20% of the time cloudy weather was encountered during the winter months from October to March. During the rest of the year wheather was always unlimited.

14. One Ordnance officer and one enlisted man (electronics) go on each flight mission. Electronics men and all of the Ordnance officers (proof officers), exept supply and safety officers, are on flight status. It takes about one and a quarter to one and half hours to climb to 35,000 feet. A B-29 usually carries six to eight bombs and the average length of flight is two and a half hours per mission. Twenty-two to twenty-four men are required to operate the equipment on the range.

15. Ballistic data obtained at Muroc by the Aberdeen Mission is analyzed at Occidental College at Claremont, California by two soldiers and four civilians, with part time assistance from qualified students of the college. Occidental College may be overcharging and The Aberdeen Mission would like to move the analysis unit to CIT from Occidental College.

16. The Aberdeen Mission started its activities at Muroc in 1944. It lasted only three months during 1944. In March 1945 its activities were started again at Muroc. The present plan contemplates continuing this work during peace. It is expected to replace both Ordnance officers and Ordnance men with permanent civil service employees. If the Air Forces moved out of Muroc, the Ordnance Department would probably have to continue operating there because Aberdeen does not have either weather or safety adequate for very high altitude bombing.

17. The equipment used for observing the flight of bombs includes: (a) ballistic cameras, (b) Mitchel cameras (Bowen Knapp), (c) four theodolite stations for locating impact points. Camera men and electronics

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men are assigned to the Ordnance Detachment. There is a station Ordnance officer who works for Colonel Maxwell and is not assigned to Aberdeen Mission. Living conditions have improved since the 4th Air Force Unit moved from Muroc. Colonel Weber was the first Chief of the Aberdeen Bombing Mission. He was succeeded by Major Brown, and Colonel Wilson, the new Chief, arrived about four weeks ago.

18. It is expected to test live bombs at Muroc, but so far only inert bombs have been tested. Only one bombing range is used by the Mission. Most of its projects involve high altitude bomb dropping for the purpose of obtaining ballistic data. Plans are being made for the dropping of 12,000 lbs. Tall Boys at maximum practical altitude. There are about 20 Tall Boys and 20 Grand Slams at Muroc, but airplanes have not yet been modified to carry them. There are about eight B-29's and four B-17's used by the Mission.

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INCLOSURE NO. 12

23 November 1945

Wendover Army Air Base, Utah

1. Colonel McCauley, Commanding Officer, and Lt. Colonel Blankenhern, Station Executive, were interviewed. Nothing is being done now at Wendover except special weapons work. There are approximately 800 men assigned to Wendover, of which 300 are now at Albuquerque on the Silver Plate project. Men are being lost rapidly due to discharge by points. There are about 85 special weapons people at Wendover. There are located at the Base, one B-17, one B-25, one C-45, two L-5's, and three AT-11's. The special weapons test unit has other airplanes. There are three organizations represented at Wendover.

a. Special Weapons Test Unit

b. Silver Plate Project

c. Remnants of training units of the 2nd Air Force.

Normally the Special Weapons and Silver Plate units furnished their own airplanes and trucks. In an emergency, help was obtained from Base personnel. The primary function of Base Personnel was housekeeping for the two active development projects. Colonel McCauley had been informed by the Chief of Staff of the 2nd Air Force that no more 2nd Air Force personnel will be sent to Wendover because the 2nd Air Force expects that Wright Field will take over Wendover about 15 December 1945. There are about 300 apartments for married personnel located in a housing unit just off the base. There are dormitories for 75 additional unmarried people. Wendover itself is a railway siding, but has a few hotels which appear to specialize in gambling. The polulation of the town is about 250.

2. The maximum capacity of the Wendover buildings is 6300, although 12,000 have been housed at one time using tents. Water and latrine facilities exist for 12,000. The hospital capacity is 250 beds. Bituminous coal is available from the State of Utah. One hundred and sixty civilians now work at the base. They will probably be able to get as many civilian personnel as needed from Ogden, ATSC, which is cutting down. Seventy-five per cent of the barracks at the base are nailed closed. Electricity is generated by their own equipment

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which has a capacity of 1200 KVA. Equipment is now running around 400 KVA. Water is pumped thirty miles. Sewage is disposed of by running into alkaline water near the base. The length of the runways is 8100 feet. No repairs have as yet been necessary to runways. There is a gunnery area bout two miles from the main base which was used during the war for training aircraft gunners with the help of special ground equipment. The capacity of housing is 1600 men at the gunnery area.

3. The base was used early during the war for training purposes. At first bomber groups were located there and later fighter replacement pilots were trained. Ninety-five per cent of the days of the year it is possible to reach 25,000 feet altitude at some time during the day. Because of the tremendous amount of flat land within the range area, it is possible to have emergency landings without much loss of airplanes or personnel. Installations near the main base permit quite a good deal of shooting on pistol, rifle and skeet ranges.

4. One six degree ramp for firing JB-2, using intermittent cartridges, was observed. Another German ramp had just been erected and a moble ramp for JB-2 was being installed.

5. The Base Commander felt that Wendovershould be held for test purposes and gave the following reasons for holding Wendover:

a. There are many bombing and gunnery ranges within the Wendover reservation.

b. The weather is usually good for flying. (Better than the weather at Salt Lake City).

c. The long distance from one end of the reservation to the other end is good for testing long-range guided missiles.

d. The area is well isolated for security purposes.

The only bad feature about Wendover is its distance to civilization. (130 miles to Salt Lake City)

6. In view of Colonel McCauley's statements concerning the desirability of retaining Wendover, it was suggested that he prepare a plan in cooperation with the Special Weapons Test Unit showing how Wendover could be used efficiently during peace. It was suggested that matters pertaining to personnel, facilities, land, airdromes, and ownership of property where ranges are located, be considered.

7. Before I left the base, Colonel McCauley stated that he did not desire to submit a report directly to a Wright Field installation

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because he was under the command control of the 2nd Air Force. In the circumstances, it was suggested to him that any information which he had collected on the potentialities of Wendover, be turned over to the Senior Officer of the Special Weapons Test Unit at Wendover for transmission to me at Wright Field. This arrangement was communicated to the Operations Officer of the Special Weapons Test Unit at Wendover.

<u>Special Weapons Field Test Unit - Wendover</u>

8. The Special Weapons Unit moved to Wendover in October 1944. The Unit hadpreviously been at Tonapah, Nevada. It moved from Tonapah because of complications which had been introduced by the training activities of that place. Major Chiba was with the Unit when it moved from Tonapah. In the absence of Major Chiba who was about to be separated from the service, information concerning activities of the Unit was obtained from Lt. Sherwood.

9. Lt. Sherwood said that he understood that ATSC will recommend to Washington that it take over Wendover on 15 December 1945. Lt. Sherwood said that he had been asked by Colonel McCauley to help prepare a plan for the future of Wendover. Lt. Sherwood further stated that he believed the preparation of such a plan wouldhelp the Wendover situation. Data have already been given to Colonel French's office at Wright Field, on personnel required for the Special Weapons Unit. The request for the additional piece of land south of the present range has been held up somewhere in Washington. When the new piece of land is acquired, the range will reach 150 miles from the firing point. It is understood that the cost of rental of the new piece ofland may be as much as $300,000 annually. This is about one cent per acre. There is one ranch and one abandoned mine in the proposed area. One JB-2 has already strayed into the new area. Otherwise no firings have been made into it.

10. Two fixed ramps for JB-2 and another portable ramp have been installed. A fourth ramp is to be installed later. At present it is not safe to shoot JB-2's because the P-51 airplane on hand which is used for safety purposes when shooting JB-2's is not in serviceable condition, due to engine trouble. It is expected that a P-80 may be assigned to Wendover from Muroc. An A-26 airplane is fast enough to be useful for this purpose.

11. There are 35 men and 8 officers of Colonel French's organization at Wright Field now stationed at Wendover. This number had been approximately 200 men and 9 officers on VJ-Day. The reduction in manpower is accounted for principally by discharges on points. Twenty-five enlisted men and two officers are present from other organizations. The complete breakdown of personnel is as follows:

a. Field Test Unit, Wright Field - 8 officers and 35 men (services only).

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b. Performance Test Unit, Wright Field - 2 Officers and 18 men (prepares JB-2 missiles only).

c. Eglin Field Radar Detachment - 7 enlisted men (tracks and guides JB-2 only).

12. Whenever JB-3's are tested civilians from Hughes Aircraft Company and officers from Major Kotchar's office witness the tests. Colonel French, Wright Field, sends officers to watch the control mechanism only. Major Kotchar's representative has supervision over the test. Major Kotchar's representative probably supervises JB-3 because it is in an experimental status now. JB-2 is in production status and this may explain why ColonelFrench's representatives supervise tests on this missile.

13. So far only one JB-3 has had successful flight and even in this case the rocket did not function properly. Twelve to fifteen JB-3's have been fired thus far. Of these, three exploded. Five or six went straight down as vertical bombs and three flew to some degree, but the rockets did not work satisfactorily. The control surfaces on JB-3 are small; and unless the bomb reaches a speed of more than 550 miles per hour the turn tabs do not work satisfactorily. There are no JB-3's at Wendover now. All JB-3's which have been sent to Wendover have been tested. The Hughes Aircraft Company is making more and the additional JB-3's are expected to be tested during the second week in December. Mr. J. W. Black is the Hughes representative on JB-3.

14. Last spring azon, razon, and spazon were tested at Wendover. War weary airplanes were tested during August andSeptember for use against caves. Tests were suspended at the end of the war. Inert loads were used. The war wearies worked satisfactorily. They were controlled from the ground and hit within a few feet of the target. The control point on the ground was about three to five miles back of the target and two to three miles at right angles to the line of fire. Two stations were used.

15. Glide bombs have been tested with heat and light seekers. Radar seekers were not tested. All war weary airplanes, glide bombs, and ground guided razon were tested in connection with the Hermit project (Japanese caves). Heat seeking vertical bombs (Felix) were tested at Tonopah. Tonopah was abandoned probably because training activities at that point interfered with tests of guided missiles.

16. Lt. Sherwood does not feel that Wendover competes with Eglin Field. All testing of JB-2's at Eglin Field has been done by detachments from Colonel French's office. These detachments are now at Wendover. Eglin Field apparently received credit for the work which was being done by these Wright Field detachments. Lt. Sherwood said

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that he understands the Wright Field project officer prefers to move all JB-2 testing equipment from Eglin Field to Wendover. Eglin Field is considered to be unsuitable for testing JB-2's because they fall in water and cannot be recovered for examination. At Wendover recovery is always possible and accordingly the causes of difficulty can be determined at Wendover better than at Eglin. Lt. Graham, an officer from Colonel French's office, is located at Wendover permanently until the JB-2project is complete. Lt. Skinner is project officer for JB-3 and is detached from Major Kotchnar's office.

17. Dugway Proving Ground, which is about 50 miles from the Wendover Airdrome, is on the other side of the range. Dugway is sometimes used as a base for operating the Wendover ranges. Wendover has some motor transportation at Dugway. Range detachments are flown from Wendover to Dugway on the day of a test. The detachments to the radio station, about 40 minutes away, and take photographs of the missile and record impact locations by radar. A plane is also used to locate the impact point. Photo theodolites are used to get information on the descending portions of the trajectory. This has not been possible at Eglin. Whenever a short range is desired for a JB-2, it may be obtained by causing the missile to drop using a radar signal or the missile may be made to drop at the desired point using the air log.

18. Lt. Adams, the Engineering Officer of the Test Unit, suggested that Sacramento or Ogden, ATSC, be directed to help Wendover in maintenance of airplanes as much as practical. He suggested this because Wendover is short of maintenance men. These men are badly needed. If authorised, Lt. Adams believes he can get civilian mechanics who are being separated from the Ogden, ATSC. Lt. Adams requested that ATSC release one P-47 to Wendover. Captain Klain, who works for Colonel French, was asked for this P-47. The P-51 which is on hand has a new engine available, but there are no qualified personnel at Wendover for installation of the engine. Lt. Adams estimated that 500 manhours would be required to change the engine. He felt that it was risky business to make this change at Wendover. Lt. Adams expressed the opinion that if Wendover were furnished with two P-80 airplanes and two P-80 mechanics, the present delay in testing JB-2's would be eliminated. It is expected that JB-3 tests will also be delayed because of inadequate availability of fighter airplanes. Lt. Adams said that he needs additional maintenance personnel very badly and requested that I do something to help him. About 22 November 1945 there was submitted to Wright Field (Colonel French), a request for 67 men, all civilians, who can be obtained locally if Wright Field will authorise it.

19. The personnel contacted at Wendover included the following Colonel McCauley, Base Commander, Lt. Colonel Blankenhorn, Executive, Major DuBarry, Post Engineer, Lt. Sherwood, Adjutant of the Test Unit, Lt. Clark, Operations Officer, Test Unit, Lt. Adams, Engineering Officer of the Test Unit, Lt. Thompson, Armament Officer of the Test Unit.

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20. A one-hour flight was also made over the range area at Wendover and the three principal areas inspected. One area is useful for ordinary horizontal bombing and has the usual bombing target practice circles on the ground. This area has been used for testing VB's. A second area is used for testing glide bombs and JB-3 bombs as well as light and heat seeker devices on glide bombs. The third area inspected from the air is located about 75 miles southeast of Wendover and is approximately 40 miles wide. This range has an observation tower and is used as an impact area for firing JB-2.

21. It was noted while the undersigned was at Wendover that clouds appeared in the morning and lasted for a good part of the day. These clouds would probably have limited high altitude bombing to altitudes below 10,000 feet above the target. The range areas are very flat and were reported to be dry for most of the year. These range areas appear to be very flexible and ideal for the purpose, especially because of the flatness of the range area. This flatness permits observation and accessibility without difficulty. This flat condition does not exist nearly as much at places like Muroc, Inyokern, and White Sands.

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INCLOSURE NO. 13

24 November 1945

Ogden, ATSC

1. Arrived Saturday afternoon and left early Sunday morning. Talked to Colonel Wolfe who said that most of their personnel was being steadily reduced and that a large part of their work involved preparing airplanes for storage.

2. While in this vicinity a quick visit was made to the Ogden Ordnance Arsenal. This arsenal is cutting down in personnel, but it has quite a large quantity of Ordnance materiel on hand. It was reported that Ogden Ordnance Arsenal is expected to become the main Ordnance supply point for servicing all Army stations on the Pacific Coast and will replace Benicia Arsenal, California in this respect.

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INCLOSURE NO. 14

26 November 1945

Various Places in Pasadena

A. Giannini Company - Pasadena, California

1. Mr. Giannini and his chief engineer, Mr. Close, were interviewed. Mr. Giannini said that he had proposed an auto-pilot, but no contract had been furnished. This auto-pilot could be used as a universal control system for guided missiles. He indicated that he had discussed this matter with someone from Colonel French's office.

2. Mr. Giannini has a project covering jets emanating from propeller tips, from the Propeller Laboratory at Wright Field, involving $100,000. The analytical and experimental work has been completed on the project. This is about 25% of the total project. He now expects to make some of those jets and to test them at high and low speeds.

3. Mr. Giannini also says that he had a pulse jet engine contract for $47,000. He said that he uses carburetion rather than injection methods. He expects to have a thrust of over 100 lbs. in a 7" diameter engine by the first of the year. He recommended strongly that a qualified person from the Power Plant Laboratory visit Pasadena for the purpose of observing the performance of the improved 7" engine. The best time for such a visit would be after the first of the year. The 2" and 7" engines were operated while the undersigned observed them.

4. The next step should be a contract for ten 1500 lb. thrust units (flyable type). This has been proposed to Wright Field and will involve about $200,000. In his opinion this 1500 lb. engine should ultimately be at least twice as good as any other pulse jet engine. He expects that this engine may compete with ram jet engines at higher speeds. He believes that this type of engine may be suitable for fighter airplanes. After the 1500 lb. thrust engine has been developed he is ready to work on the development of a 4-5000 lb. engine for supersonic airplanes.

5. The low temperature of the valves used in his pulse jet engine is accomplished by the use of carburetion rather than injection. A 500 lb. thrust per frontal square feet is expected as a result of tests made on the 100 lb. thrust engine. This is twice what was accomplished by

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the German V-1 engine. These figures are for static or zero speed conditions. He expects that at speeds of 1000 miles per hour, he can get four times as much unit thrust. He believes that his pulse jet engine may be suitable for taking off an airplane or a guided missile without requiring assisted take-off equipment, such as is now contemplated for the Bumblebee. According to Mr. Giannini, the Wright Field Power Plant Laboratory has stated that his pulse jet engine is 10 to 20% better than any other pulse jet engine being developed.

6. Mr. Giannini was requested to prepare a one or two page statement of the status of the projects which he had accepted from Wright Field. This statement would permit him to express his own opinion of the up to date situation in his investigations.

B. Aerojet Corporation - Pasadena, California

7. Mr. Kimball, President of the Corporation, was present with the undersigned at all times during his visit to the plant of the Corporation. He said that he had a contract with the Army Air Forces to develop a 7500 lb. nitromethane engine using four rocket motors and having its own pumping plant. A 6000 lb. unit has been developed using nitric acid and aniline. A hydrogen peroxide generator is used to power the pump. Depending on further developments, he may ask that nitromethane be used to power the pump instead of hydrogen peroxide. The engine which he is developing is to be used for conventional type airplanes. He is also making rockets for launching the Bumblebee.

8. Mr. Kimball was asked to prepare a one or two page memorandum stating the present situation with regard to the projects which he has from Wright Field.

9. Mr. Kimball says that he is willing to get into other phases of the guided missile development program. He doesn't know too definitely how far he shouldget into this program. He is willing to submit proposals to Wright Field on other phases of the guided missile program. In view of the competent organization which appears to exist at the Aerojet Corporation plant, it would appear to be highly desirable to make further use of the plant, especially because its activities have been reduced since VJ-Day.

10. Mr. Kimball said that one of his principal advisors was Dr. Zwicky, who is a CIT professor.

11. Mr. Kimball was quite enthusiastic about nitromethane which he called a mono-propellant. He said that some people expressed the opinion that nitromethane was too explosive for satisfactory use and he had had his chief engineer prepare a paper on the subject. Copy of this paper was obtained from Mr. Kimball. He pointed out that for one-time use, nitromethane is not dangerous, but if it is used for powering an airplane, it will have to be watched.

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12. The Aerojet Plant appears to be a typical small explosives (pyrotechnic) plant. Potassium perchlorate is used in making up rockets containing solid propellants. An inspection was made of the test stands which were used for development purposes at the plant. A demonstration of the ability of nitromethane to do damage was made for the undersigned.

C. Dr. Stewart - California Inst. of Tech. (Jet Propulsion Lab.)

13. Dr. Stewart believes that no reliable information has reached him concerning the proportion of failures and shorts obtained by the Germans when firing V-1's and V-2's and for that reason it is difficult to tell about the comparative accuracy of the German V-1 and the American JB-2.

14. The problem now is to make controls which act fast enough in order to obtain adequate manouverability (high angular rate of change of direction). Spoilers are suitable for low speeds, but at supersonic speeds there is a mechanical problem.

15. In V-2 there was an internal as well as an external method of stopping of the power.

16. The Signal Corps is building a beacon for telemetering. Dr. Del Sasso at Aberdeen Proving Ground is working on radar for the V-2 tests which are being conducted at White Sands. It is expected to control the Corporal by radar. The Evans Laboratory near Lakehurt is doing most of the work pertaining to the guiding of missiles. This laboratory probably helped in the development of the American JB-2 radar equipment.

17. Dr. Pickering at CIT is the man who is best qualified to talk about problems pertaining to remote control, but he is at present in Japan. Dr. Stewart makes mathematical estimates and is responsible for exterior ballistics studies in the Jet Propulsion Laboratory.

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e. Ram jet research - Douglas Aircraft Company is making a supersonic airplane and Wright Field has asked CIT to cooperate with Douglas in the development of a ram jet engine for this airplane. However, no money has been furnished by Wright Field to CIT for thisinvestigation. The time of personnel working on this project is being charged to MX 527.

6. There have been some delays at CIT due to paper work delays at Wright Field.

7. Colonel Eddy recommends complete de-classification of all AAF projects at CIT.

C. Dr. Clark Milliken - CIT

8. Dr. Von Karman is returning from German and expects to have a meeting of the scientific advisory group of the Commanding General, AAF on 5 December.

9. CIT probably has a larger num er of personnel competent in jet propulsion work than any other educational institution in the United States.

10. The con ract people at Wright Field are too slow on acting on proposals of CIT. The standard type of contract does not appear to be suitable for contracting for research activities.

11. It is understood that NACA is not going to jet propulsion re-search work.

12. It is believed that information on results obtained in guided missileinvestigations is not adequately disseminated. This dissemination will be helped considerably if CIT reports are de-classified. It should not be necessary in this connection to publicize applications to specific weapons but the information pertaining to the scientific work or basic research should be available to all personnel who may be able to contribute to this type of development.

13. Dr. Millikan said that he understood Boeing is making a comprehensive study of the guided missile program.

14. Dr. Millikan again stressed that CIT wants to stay with basic research and get out of applications.

15. Dr. Millikan was asked whether or not Universities could be expected to make researches into guided missileproblems even if funds were not furnished to the Universities. He said that this was possible, but in view of the high cost of some of the equipment required for guided missile investigations, it would be impractical to expect that Universities would make investigations without help from the Government.

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INCLOSURE NO. 15

27 November 1945

Pasadena

A. Commander Stevenson, Bureau of Aeronautics Representative in Pasadena

1. Commander Stevenson's primary duties pertained to the Aerojet Company which the Navy has contracts with for assisted take-off rockets and for some development work on jet propulsion.

2. Commander Stevenson was trying to keep in touch with guided missile research activities at CIT. There are other Naval officers in Pasadena, including some Bureau of Ordnance officers, who are also interested in the research work at CIT.

3. Information resulting from research work at CIT is not disseminated soon enough to personnel who are developing guided missile components for the Army and Navy.

B. Colonel F. H. Eddy, ATSC Liaison Officer, CIT

4. This was the first opportunity to talk to Colonel Eddy because he had been away on temporary duty in the eastern part of the U.S. or had been absent from his office on previous visits of the undersigned to his office. Colonel Eddy said that expenditure of funds had recently been authorized for facilities at the Jet Propulsion Laboratory from Mx 527 which involves $396.000. He felt that CIT was not specifically interested in the guided missile program as such, but was interested in basic research. He said that the Ordnance Department (Colonel Toftoy) was now supervising the preparation of a joint program on research in jet propulsion matters at CIT. General Craigie was in on the preliminary discussion with General Barnes and Colonel Wassel was later appointed representative for Wright Field. Asfaras Colonel Eddy knows, no development work on V-1 is being done for the Army Air Forces at CIT.

5. The Army Air Forces contracts at CIT include the following:

a. Instruction of student officers in jet propulsion activities
b. Compressibility research in using wind tunnel (Dr. Hans Leipmann)
c. Liquid propellant research - MX 121
d. Hydrobomb - Westinghouse and United Shoe Manufacturing Company are getting out of the Hydrobomb development work. This leaves only Dr. Dunn of the Jet Propulsion Laboratory working on the Hydrobomb. Dr. Dunn had some money for this investigation but not too much of the money is left. The project is not very active.

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16. Dr. Millikan also expressed the opinion that if funds for research were increased, the rate of obtaining results would be correspondingly increased, but if funds were held down, then it couldnot be expected that all answers to guided missile problems could be obtained quickly. When questioned as to the desirability of waiting until a threat of war arises before putting pressure on the guided missile program, he expressed the opinion that this would be highly undesirable. He said that it was a problem for Washington to decide and that if guided missiles were needed in the near future; by providing sufficient funds for intensive research and development, they could probably be developed in a comparatively short time.

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INCLOSURE NO. 16

28 November 1945

White Sands Proving Ground

1. Major H. K. Karsch (Chief Proof Officer) said that he had arrived only a few days ago. Most of the men at the Proving Ground were selected for technical qualifications, although all tests at the Proving Grounds are conducted by representatives of the development organizations. The strength of the Proving Ground was approximately:

9 officers - 160 men (Ordnance)
1 officer - 4 men (Medical)
1 officer - 36 men (Engineers)(Utilities)
3 officers - 125 men (Bat. A of 1st guided missile Bn. of Coast Artillery with Hq. at Ft. Bliss)

The Proving Ground was first occupied by Ordnance personnel about July 1945.

2. The facilities at the Proving Grounds include the following:

a. Camp for housing above personnel and for storing materials.

b. WAC Corporal firing point

c. Static firing stands (two)

d. Landing Field (C-45 and C-47 airplanes have landed safely)

e. Ranges equipped with radar observation points and expected to be equipped with complete telephone communications. Maximum range is 95 miles.

f. Warehouses and shops for storing and assembling V-2 components.

3. The purpose of the Proving Ground is:

a. Conduct tests on new types of guided missiles.

b. Assemble and conduct tests on German V-2 missiles (A number of them have been received from Germany and are expected to be assembled and fired with the help of German technicians who have also arrived.)

4. Las Cruces, New Mexico is about 25 miles from the camp. Married officers with families must list in Las Cruces. There is little contact

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with Almogordo Army AirBase. Clearance to the landing field at White Sands is obtained through Biggs Field.

Colonel Turner - Commanding Officer, White Sands Proving Ground

5. Present static test equipment is to have capacity of 25,000 lb. thrust. Larger one may be up to 200,000 lbs. thrust.

6. A new launching stand for firing the Wac Corporal is to be designed as a basic structure so that any missile can be fired vertically from this stand.

7. General Meyers of AA Command at Ft. Bliss is very much interested in guided missiles.

8. No manufacturing or development or building of guided missiles is expected to be done at White Sands. The Ordnance Department has three contracts for which tests are to be conducted at White Sands. Ten fairly powerful radio stations are installed on the ranges. Col. Turner said that he hopes to get some radar people permanently assigned to the Proving Ground. Six SCR 584's or equivalent are available for use on the ranges.

9. The areas near the Proving Ground are jointly used by, Almogordo Army Air Base (bombing) Ft. Bliss AA Command (AA target practice), Atomic Bomb testing, Ordnance Proving Ground tests.

10. About 120 German technicians are expected to be located at Ft. Bliss, and White Sands will be able to obtain help for assembling and testing V-2 from this group. The group is also to do other types of research work. Colonel Turner understands that the Navy Department is also getting German scientists, but they are being scattered over the United States instead of being concentrated in one place.

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EXHIBIT "D"	-	Progress Report on Ord. Dept. Rocket Devel. Projects submitted under date of 10 Oct. 45 in Office, Chief Ordnance, Washington.

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[redacted] /Gen. Crawford/[illegible]/71500
6th 31 Jan 1946

MEMORANDUM FOR: [illegible] State

Subject: Guided Missiles Development

1. Reference our conversation of January 29th, regarding (1) the current Navy proposal for guided missile development and airfield facilities at Point Mugu, California; (2) specific examples of development or contract duplication between the Army and Navy for similar or parallel items; and (3) the [illegible] action of the Senate Naval Affairs Committee to the Navy planning the development and procurement of 1200 long range land based airplanes, the following are submitted:

2. Point Mugu - The Navy initially submitted a request to the Bureau of the Budget for an appropriation of approximately $30,000,000 to be used in the construction of a joint Army-Navy long range guided missile testing range. After hearings by the Bureau of the Budget, attended by Army and Air Force representatives, the Bureau of the Budget recommended to the President the establishment of a joint Army-Navy Committee to review the Navy's budget request. The President, [illegible] Admiral Leahy, appointed a sub-committee of the Joint [illegible] Committee to undertake this review.

3. During the initial hearings of the Sub-committee appointed to [illegible] this matter, the Navy representatives stated that the items requested were primarily for the development of a guided missile development center and [illegible] short over-water testing range. The joint Army-Navy long range [illegible] from the proposal only so that the site established for the development center and short over-water range might be reasonably satisfactory [illegible] long range at some future date.

4. The Sub-committee report to the Joint New Weapons Committee [illegible] in effect that, since the Navy stated they had no development facilities for guided missile development, such facilities should be furnished them, [illegible], since the Navy stated they had no other satisfactory short over-water testing range, such a range should also be made available to them. The report [illegible] stated, in effect, that the Sub-committee had not investigated the details of the Navy proposal, inasmuch as it was felt that an analysis of the detailed extent of the facilities required, and justification of such facilities, was more properly charged to the Navy alone. Insofar as the specific selection of the site at Point Mugu was concerned, the Sub-committee stated, in effect, that the site was selected by the Navy after a reasonably exhaustive survey of other possible site locations, and that, having been chosen by the Navy, appeared to be satisfactory to the Sub-committee.

5. [illegible] of the Guided Missiles Committee referred the matter back to the Sub-committee, with instructions to consider the major detailed items. At this time, it developed that the Navy proposal was in the total amount of $[illegible], with the first increment requested from the 1946

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[illegible]

[illegible] modified for use as radio controlled [illegible] [illegible] program attempted to accomplish approximately [illegible] mission and apparently employed the same basic [illegible] [illegible] of aircraft.

[illegible] camera which [illegible] developed [illegible] [illegible] project would [illegible] [illegible].

[illegible] computer which [illegible] [illegible] from [illegible] contractors [illegible] [illegible] to each other.

[illegible] at the first part of the war, [illegible] [illegible] procurement of [illegible] [illegible] [illegible].

[illegible] and Navy [illegible] [illegible] aircraft [illegible] [illegible] in the two services.

[illegible] study of [illegible] [illegible] This would [illegible] [illegible] of effort, and the [illegible] [illegible] of this type. It is [illegible] that [illegible] [illegible] [illegible] the amount [illegible] would be required, [illegible] [illegible] control of [illegible]

[illegible] E. LeMay
Major General, [illegible]
Deputy Chief of Air Staff for
Research and Development

-4-

[illegible]

[redacted] [illegible]

28 February [illegible]

MEMORANDUM FOR: Assistant Chief of Air Staff-4

SUBJECT: Guided Missiles

1. Instructions of the War Department Deputy Chief of Staff, dated 2 October 1944, subject: "Guided Missiles" assigned to the Army Air Forces the responsibility for development of all guided and homing missiles, [illegible] or launched from aircraft and all guided or homing missiles launched from the ground which depend for sustenance primarily on the lift of aerodynamic forces. The same instructions assigned to the Army Service Forces the developmental responsibility for guided or homing missiles depending primarily upon momentum for sustenance in flight. No division of guided missiles responsibility between the Army and Navy Departments was announced.

2. It is the understanding of the Air Forces that their responsibility for development of those missiles which are dependent for sustenance primarily on the lift of aerodynamic forces includes those missiles which use airfoil surfaces for an extension of the range which would be had through their momentum alone, as well as those missiles which depend on airfoil surfaces for maneuverability or guidance in flight.

3. In accordance with this interpretation of the directive of 2 October 1944, Air Forces characteristics have been established for air-to-air, air-to-ground, ground-to-air, and ground-to-ground missiles, all of which [illegible] some of guidance after launching. The ground-to-air missile established by the Air Forces is for the purpose of combating enemy guided missiles or hostile aircraft of transonic or supersonic speeds. The development of this type of weapon, prior to the knowledge of guided missiles, was an exclusive function of the Ordnance Department. However, since any missile capable of intercepting an aircraft or missile, traveling at speeds approaching or exceeding that of sound, appears to obviously require corrective guidance after launching, and, since such guidance appears at the present time to be most logically obtained by use of aerodynamic forces, the development of such guided missiles are believed to be definitely within the sphere of responsibility of the Army Air Forces. This statement is not based upon an Air Force interpretation of the directive of October 2, 1944 alone, but because of the close relationship between the development entering into a ground-to-air and air-to-air missile, the latter item being of undoubted permanent interest to the Air Forces, but, of even more importance, upon the principle of economy and efficiency of effort in this development, since the Air Forces are the agency most qualified and experienced in the field of aerodynamics.

4. In carrying out the Air Forces responsibility for guided missile development, it was initially advisable that development be concentrated on missiles of probable war time application. Initial development was, therefore,

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Memo to Gen. [illegible]

development projects which can reasonably be included as a charge against the guided missile program. Approximately 50% of the $35,000,000 included in this estimate for the development of guided missile components would be required by other AAF development projects, if not included under guided missiles. It is also believed pertinent to point out that the AAF Air Technical Service Command has been instructed to make an immediate and thereafter periodic review of all their existing guided missile projects, with a view of [illegible] Air Force, or other appropriate agency, cancellation of all projects where either an undesirable duplication or overlap of development [illegible], or where later developments have rendered inadvisable the continuation of a previously instituted project.

4. [illegible] Air Force developed guided missiles which are considered to have progressed to a state warranting immediate use and the quantities of such missiles currently available are as follows:

[illegible]	[illegible]	12,000
	[illegible]	500
	[illegible] testing, Service test quantities	
[illegible]		1,800
[illegible]		950

[illegible] addition to these currently available missiles, there are three [illegible] test stage. There are also three contracts [illegible] and nine contracts in process of preparation for other complete [illegible]. There are four contracts in existence, and three contracts in process for research and development in the field of aerodynamics and ballistics. [illegible] contracts are in existence, with one in process of preparation [illegible] of research and development of propellants, fuels, and [illegible]. Twenty-six (26) contracts are in existence, with nine additional in process, for research and development in the fields of guiding and control equipment. [illegible] different prime contractors are involved in these contracts with one or more sub-contractors being involved in a [illegible] of the prime contracts.

[illegible] of the AAF projects which are in being at the present moment, the [illegible] the most promise is the development by the Boeing Aircraft Company of a ground-to-air missile for use against improved versions of present [illegible] aircraft. Even this project, however, has not progressed to a point [illegible] an accurate estimate of the date of completion of development [illegible] commitment to provide large quantity production for operational [illegible] a fixed date. In general, the completion of any missile is dependent on the successful development of numerous components or elements. [illegible] difficulty in arriving at an adequate solution for one or more [illegible] components which will comprise the type of missile

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currently contemplated, will introduce consequent delay in the full development of the complete missile. Further, the organization and execution of large scale production of items, some of which have never been produced in this country before, may be expected to set back the date of operational use eighteen (18) months or more beyond the completion of development. With full realization of the magnitude of the undertaking and without undue optimism or pessimism, it is not anticipated that any of the missiles now in development, excluding those which are experimental, can be used in quantity in the field for a period of time varying between three (3) and ten (10) years.

11. The augmented guided missile program tentatively planned for the Fiscal Year 1947 is mainly accounted for by a contemplated increase in the placement of contracts for specific missiles, due to a possibility that research and development in allied fields will have progressed to a point warranting the placement of an increased number of contracts for the development of specific missiles, and a contemplated greatly expanded program of research and development in the field of radio and radar equipment applicable to the guided missile field.

12. Any development program of the size above, involving the many unknowns and the unpredictable amount of money contemplated by the Air Forces, when superimposed on the related programs of the Signal Corps, Ordnance Department and Bureau of Aeronautics, is obviously a fertile field for a great amount of duplication, a keen developmental competition to the detriment of an efficient administration of these programs, and of equal or greater importance, a strong and uncoordinated competition for the limited facilities and qualified personnel capable of contributing to the desired rapid development of a weapon possessing the enormous potentialities of a guided missile. In an effort to eliminate to the maximum extent this undesirable duplication and unhealthy competition, an extensive system to insure an exchange of information on the guided missile programs and plans of the various interested Services, and a committee control of such programs, has been established. Specific committees and a brief outline of their purpose is as follows:

a. War Department Special Staff New Developments Division - Among the functions of this office is the responsibility for an overall control of the research and development programs of the War Department Technical Services, with the view of an elimination of unnecessary or undesirable competition and duplication.

b. Joint Chiefs of Staff's Joint Committee on New Weapons and Equipment - Functions of this Committee include the responsibility for recommending to the Joint Chiefs of Staff appropriate solutions to any discovered undesirable overlap of functions or operations between the Army and Navy.

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Memo to General [illegible]

d. Guided Missiles Committee of the Joint Chiefs of Staff Joint Committee on New Weapons and Equipment - Among the functions of this Committee are the responsibilities for collecting and disseminating information on the guided missile programs of the interested Services and, where appropriate, recommending to the Joint Chiefs of Staff, through the Joint Committee on New Weapons and Equipment, the placement of developmental responsibilities with a specific Service, when it appears unnecessary or undesirable that two or more Services engage in the same type of research and development.

e. The Guided Missiles Committee of the National Advisory Committee for Aeronautics - Among the functions of this Committee is the coordination and exchange of information on the basic aerodynamic research and development projects of the N.A.C.A., Bureau of Aeronautics, and Army Air Forces.

e. The Research and Development Sub-Committee of the Aeronautical Board - In addition to a general review of the guided missile programs, as a part of their overall review of the entire Research and Development Program, of the Air Forces and Bureau of Aeronautics, this Sub-committee has available to it an additional sub-committee composed of representatives, at the working level, of the Air Forces and Bureau of Aeronautics, whose responsibility is to coordinate in detail the programs and plans for guided missile research and development of each of the two Services.

f. Technical Committees - Each Technical Service has a Technical Committee among whose functions is the responsibility for insuring that projects proposed for initiation are not in conflict with, or an unnecessary duplication of projects initiated by the Navy Department or any other Technical Service.

g. Liaison Offices - The Air Forces have by mutual consent established a system of liaison offices with appropriate offices of the Navy Department and in each of the other War Department Technical Services in which research and development projects of interest or concern to the Air Forces are initiated and administered. Through this liaison, each agency interested in the development of guided missiles, either in the War or Navy Departments, has access to all information pertinent to that development which is being administered by other Services.

11. In summary, the field of guided missile research and development is in its early infancy. There are many unknowns and a great amount of basic research required prior to any Service being able to develop a missile of the characteristics which can undoubtedly be obtained in the reasonably near future. Two or more agencies of each of the War and Navy Departments are interested in this field. A large amount of money has been made available to both the War and Navy Departments for prosecution of the research necessary before the desired objective can be obtained. An approach to the problem of this magnitude from a multiplicity of agencies results in a great potentiality for an uneconomical expenditure of money, an unnecessary

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ITEM 23905
APPROVED BY ORDNANCE COMMITTEE
25 May 1944

ARMY SERVICE FORCES
OFFICE OF THE CHIEF OF ORDNANCE

Prepared on 12 May 1944

From: Subcommittee on Rocket Materiel

To: Ordnance Committee

Subject: LONG-RANGE AND LAUNCHING EQUIPMENT - Initiation of Development Project, Recommended.

1. Reference:

a. Headquarters, Army Ground Forces, memorandum to Headquarters, Army Service Forces, O.O. 461.94/2313 (s) of 9 February 1944.

b. Headquarters, Army Service Forces, 1st Indorsement to Chief of Ordnance and Chief Signal Officer in turn dated 12 February 1944.

c. Chief of Ordnance, 2nd Indorsement, to Headquarters, Army Service Forces through Chief of Signal Officer of 4 March 1944.

d. Chief Signal Officer, 3rd Indorsement to Headquarters, Army Service Forces of 3 April 1944.

e. Memorandum, Headquarters, Army Service Forces to Chief of Ordnance, O.O. 471.94/2841 (s) of 22 April 1944.

f. Memorandum to N.D.R.C. signed by Colonel R.M. Osborne dated 13 April 1944.

g. Memorandum to Colonel Trichel signed by Colonel C. H. Morgan returning file o.o. 471.94/2841 (s) dated 26 April 1944.

2. Discussion:

a. Reports reaching this country during the past year record that extremely large rocket projectiles carrying large quantities of high explosives and capable of traversing distances in excess of 100 miles are under development by the Germans, and that large, guided, rocket-type missiles have already been used by the Germans with some success.

b. Recent progress in the field of jet propulsion by the Air Corps Jet Propulsion Research Project, the National Defense Research Committee, and the Aerojet Engineering Corporation indicates that the development of a long-range rocket projectile is well within engineering feasibility. The success

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of these experiments and the high potential military value of such a projectile in situations which might arise recommends the immediate investigation of a long-range rocket missile for military use. The Army Air Forces have also shown considerable interest in such a project, since it may be expected that the experimental devices and data resulting therefrom will contribute towards a great improvement in the efficiency of jet-propelled bodies.

c. In a 1st Indorsement, dated 12 February 1944, file O.O. 471. 94/2313 (s), the Director, Requirements Division, Army Service Forces forwarded to this office an inquiry from Headquarters, Army Ground Forces, concerning the possible development of a direction controlled, major caliber, antiaircraft rocket torpedo. It is contemplated that the results of the investigation encompassed by the long-range rocket project will provide the essential devices and data for satisfying the antiaircraft requirement also.

d. It is desired that a project be initiated for the development of a long-range rocket missile, together with suitable launching equipment, for a rocket having the following military characteristics:

(1) Minimum weight of high explosive pay load, 1,000 pounds
(2) Maximum weight of missile to be consistent with good design.
(3) Range of missile to extend 75 to 150 miles.
(4) Dispersion at maximum range not to exceed 2 per cent, or missile to be suitable for direction by remote control.
(5) Velocity sufficient to afford protection from fighter aircraft.

e. Funds are available in the Technical Division.

FISCAL REF. O.K.,
FISCAL DIVISION

3. Recommendations:

a. That the Ordnance Department enter into development contracts and procure pilot models of a long-range rocket having the military characteristics designed in 2d above.

b. That the Ordnance Department enter into development contracts and procure pilot models of special launching equipment for the long-range rocket to be developed as indicated above. 20

c. That this project be placed in Category II, i.e. "Secret".

Action by : Rocket Development Branch, Technical Division
Report approved by Ordnance Committee
Approval of higher authority is required, but was not given at the meeting.

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Subject: LONG-RANGE ROCKET AND LAUNCHING EQUIPMENT - Initiation of Development Project, Recommended.

JULIAN S. HATCHER Brig. Gen., Ord. Dept.	G. M. TRICHEL Col., Ord. Dept. T.D.
G. M. Wells Brig. Gen., Ord. Dept	J. G. BAIN Lt. Col. Coast Artillery
R. C. COUPLAND Brig. Gen. O.D., A.O.O.	D. B. DIEHL Lt. Col.,A.A.F.

C. S. REED
Col., Ord. Dept.

I.A. LUKE Colonel, Ord. Dept. T.D.	WALTER J. PRESTON Major, Field Artillery
HORACE A. QUINN Colonel, Ord. Dept.A.A.	JOHN A. STEWART Major, Corpof Engine rs
D. G. SANGER Colonel, A.G.F.	L. HARPER Capt. Signal Corps
P. M. BELKEN Col. Ord., Dept. W.A.	C. E. BURNS Ordnance Dept.

Action by: Rocket Development Branch, Technical Division

Approval by higher authority is required, but was not given at the meeting.

APPROVED BY ORDNANCE COMMITTEE
25 May 1944
/S/ PHILIP J. BROGAN
Lieut. Ordnance Department
Assistant Secretary
Action recommended is aut orized
Formal Approval will follow
/S/ J. M. GRUITCH, Lt. Col. O.D.
For AC/AS, MM&D

APPROVED
/S/ S. B. RITCHIE
Colonel, Ordnance Department
Chairman Pro Tem

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NAVY DEPARTMENT

(SC)
RJC:ahb

WASHINGTON 25, D.C.

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15 August 1944

MEMORANDUM FOR COORDINATOR OF RESEARCH AND DEVELOPMENT:

Subject: Jet-Propelled Missiles, Report of Visit to Los Angeles - Pasadena Area, with Certain Recommendations.

1. During the period August 3 - 9, various research activities on the West Coast were visited. This report deals only with those projects concerning jet propulsion, and in particular with jet-propelled missiles.

2. THE JET PROPULSION LABORATORY OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY

This is a natural outgrowth of projects which the Services have placed with CIT, commencing with the Army Air Forces Jet Propulsion Project in 1939, generally known as Project GALCIT (Guggenheim Aeronautical creation and has the following work in hand:

Item	Agency	Amount
(a) Liquid assist take-off units; Liquid jet motors	AAF Contract MX 121 (Wright Field)	$300,000.
(b) The Hydrobomb	AAF Contract MX 263 (Wright Field)	$140,000.
(c) Ramjet development	AAF Contract MX 527 (in process)	$150,000.
(d) Jet Propelled missiles	Army Ordnance Project ORDCIT	$1,875,000.
	Construction by Defence Plants Corp.	$383,000
	Supplement (in process)	$100,000
(d) Educational course in jet propulsion	AAF (Wright Field)	....

These figures are for the current fiscal year, and are only approximate.

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Memorandum for Coordinator of Research and Development

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3. The Jet Propulsion Laboratory is operated by the Aeronautical Department of CIT, and the Army Air Forces and Ordnance contracts which support it are made with the Institute. The liaison officers at CIT are Colonel W. H. Joiner for AAF work and Colonel L. A. Skinner for ORDCIT, and these two officers work in close collaboration. The Wright Field contracts (AAF) are supervised by Colonel Kemmer (Aircraft Lab.), Colonel Jarman (Armament Lab.), Colonel Keirn (Power Plant Lab.) and Colonel Dane and Major Grow of the jet section of the Power Plant Lab. On the CIT side, Dr. Th. von Karman (now incapacitated by illness) heads the JPL, with Drs. Clark Milliken and Malina as his principal deputies.

The work is centered in Arroyo Canyon. Comprehensive plans have been made for additional facilities needed for the ramjet and ORDCIT projects, and construction is being pushed as rapidly as possible. Enclosures (1) and (2) are plans showing the entire establishment as now visualised. (Note: These enclosures are to be filed with the copy of this report placed in the Jet Motors and Fuels file.)

4. DEFINITIONS OF JET PROPULSION DEVICES

Before proceeding further, an outline of the jet field and its terminology is desirable.

Rockets burn fuel which contains its own oxidizer.

Thermal Jets burn fuel mixed with air for combustion.

The rocket field is divided so:

```
                      (Aerotojet
         (Liquid Fuels (Centrojet
         (             (Turborocket
Rockets(               (Pressurised (as in ATO units)
         (             (
         (Solid Fuels  (Restricted burning
                       (Unrestricted burning
```

While the thermal jet field is:

```
                                (Aeropulse
Thermal Jet        (Ramjets     (Athodyd
                   (            (Airesonator
Propulsion         (
                   (Turbojets
                   (Turbodyne
```

Terms which may not be familiar in the above table are defined below:

Aerotojet is a cluster of liquid fuel rockets set at a slight

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[redacted]

angle to a central shaft, so that the shaft is rotated by the tangential thrust component; this in turn drives the fuel pumps which supply the combustion chambers.

Centrojet is similar, except that the jets have a common combustion chamber which rotates, and the pumping is mostly or wholly by centrifugal force.

Turborocket obtains pumping power from a small turbine wheel which projects a short way into the jet from the main combustion chamber, or in which the turbine is driven from a small separate combustion chamber of its own.

Airesonator is a form of aeropulse in which shock waves at the natural frequency of the system cause auto-ignition.

Turbodyne is a gas turbine-compressor system driving a propeller, designed for maximum torque rather than for maximum jet thrust, as in a turbojet.

These devices are explained further in this report.

5. PROJECT ORDCIT
(Item (d), Paragraph 2)

The orga nization planned by CIT for this work is very comprehensive. The tentative outline, bearing in mind that the project has scarcely commenced, is for six sections, as follows:

(a) Theory (rocket and thermal jets, aerodynamics, external ballistics, analysis of data, etc.) Drs. Tsien and Stewart.
(b) Rockets (liquid and solid types) Drs. Malina, Siefert, Mills.
(c) Thermal Jets
(d) Special Materials (refractories, metals, plastics) Dr. Duwez
(e) Engineering (missiles and launchers) Dr. Sandberg
(f) Remote Control

Much of the work will necessarily be subcontracted. Personnel at JPL will be of the order of 150, as planned now. The section heads named above are provisional, as the organization is not finally worked out yet. The job which Army Ordnance has assigned ORDCIT is in very general terms. A "big" jet-propelled missile is wanted, with a range of

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"over 100 miles." No one expects quick job, and it will certainly take over two years. The Ordnance Department will be responsible for the explosive, fuse and range facilities.

6. JPL plans to start with a more modest job in order to get experience, aiming at a range of 12 miles with a GALCIT (nolid fuel) rocket motor, weight of pay load about [illegible] lbs. The motor designations will be:

XF 10 S 1000 - A

where X is for 'experimental', F for 'fin-stablised', 10 for motor diameter in inches, S for 'solid fuel', 1000 for thrust in pounds, and A for 'model A'. The motor will be made by the Aerojet Corporation; see paragraph 16 below. For take-off shcemes, see paragraph 15.

7. THE HYDROBOMB PROJECT
(Item (b), paragraph 2)

Under the AAF contract with CIT, a large test basin has been built at JPL, the main features of which are obvious from Enclosure(3) The tank is 500 ft. long, 12 ft. wide and 16 ft. deep. The carriage is driven by acid-aniline jet motors and is about ready for its maiden voyage. A speed of about 40 mph is expected; the carriage will be stopped by wheel brakes. A rope drive will probably replace the rocket motors, which were installed for lack of any other immediately-available source of powe . Enclosure(3) also shows the hydraulic elevator for raising the carraige so that the model may be attached and removed, and motors inserted in the mode. (Note: Enclosure (3) is to be filed with the copy of this report placed in the Hydrobomb file).

8. CIT-JPL's part in the hydrobomb project is limited to this testing work, with the models and motors supplied by other contractors. AAF (Wright Field) has contracts with the United Shoe Machinery Co. for the shells, and with Westinghouse and Aerojet for motors, plus a project with NDRC Div. 8 for a motor using the solid propellant originated by Kistiakowsky and being developed by the Monsanto Chemical Co. at Dayton. The Westinghouse work is mainly on the hydropulse motor, and both NRL and Dupont are supplying the special gas-generating chemicals required for this system.

9. It isunnecessary here to describe the hydrobomb. By an Army-Navy agreement, the NDRC is keeping in touch with all phases of this project, as well as with new torpedo developments for the Navy. The relations between CIT and Aerojet are complex, and it is difficult to trace responsibilities.

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10. **RAMJET PROJECT**
(Item (c), Paragraph 2)

This AAF contract with CIT, now being negotiated, is intimately associated with the Army Ordnance ORDCIT project at JPL, and the prospects for realistic joint supervision between these Army services appear bright.

11. The testing will be done in the proposed blower and test pit structure at JPL, buildings 57 and 58 on enclosure (1). The technique consists simply of blowing air into the ramjet and burning fuel in it, measuring the thrust and related data; in essence, making a test tunnel of the device itself. The eventual installation contemplates three test stands or pits, fed by air from four blowers, two of 14,000 cfs capacity and two of 8000 cfs. The test stands will accommodate ramjets (athodyds or aeropulse motors) up to 15 inches in diameter. Construction should start in a month. Second-hnad blowers have been located for temporary initial use.

12. This large available supply of compressed air may also be used to operate a high-speed wind tunnel in which 1/4 sections of the ORDCIT missiles may be placed, but plans for this are neither authorized nor crystallized as yet.

13. **LIQUID AND SOLID JET MOTORS AT JPL**
(Item (a), Paragraph 3)

This work has long been known as the GALCIT project, or more accurately as the "Army Air Corpe Jet Propulsion Project No. 1" The solid propellants of asphalt and potassium parchlorate for assisted take-off are well known and are being procured in quantity by the Navy from the Aerojet Corporation. Research on solids is actively continued at JPL, and a large variety of properties for special jobs are now obtainable. Jelled oils, similar in principle to gasoline gels, are being used in place of asphalts in some mixes; and various chemicals are being tried.

14. On the liquid propellant side, nitromethane with a chromic acid catalyst promises to replace the acid-aniline biliquid system since the former is much more stable and safer to handle. Developments are proceeding rapidly, but to date have been confined to studies of ignition and burning; no applications have been made. Here again the allocation of work is very confusing between CIT-JPL and Aerojet. Certainly similar work is going on at both places.

15. The largest experimental ATO unit with liquid fuel (acid-aniline) at JPL gives a thrust of 6000 lbs. The use of several of these is being considered as a take-off system for the ORDCIT missile; see paragraph 9.

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16. RESEARCH AT THE AEROJET CORPORATION

This concern, starting in business as a manufacturer of asphalt-perchlorate ATO units developed by GALCIT, has lately built up a considerable research department of its own, holds a research contract from the Bureau of Aeronautics and expects others from the AAF and from Buker, and in addition is developing the power plant for Project AVION (see paragraph 28). The interests of the Army, the Navy, CIT and this firm are closely interwoven, for most of the work done for any one client inevitably benefits the others.

17. Liquid fuel rocket motors under development include:

(a) Aerotojet is being developed under AAF (Wright Field) contract MX 121 for the Northrop-Avion man-carrying flying wing. This engine has two 750 lb. thrust motors and tow 250-lbs. thrust "cruising" motors, or a total thrust of 2000 lbs. About 40 hp is taken from the shaft to drive the fuel pumps, or some 10% of the total jet energy. The test engine has run for 10 minutes and is expected to run over 20 minutes with the proposed fuel capacity. It has not been tried in any vehicle.

(b) Centrojet, also supported by contraxt MX 121, will follow the Aerotojet. It is hoped to get 500 lbs. of thrust on a (dry) weitht of 70 lbs., with the chamber rotating at 6000 rpm. The original model had no fuel pumps. The current model has them, although of small capacity because centrifugal force does most of the work. However, pumps serve a useful function in throttling and braking.

(c) Turborockets, defined in paragraph 4, are considered very promising. A contract from the AAF is expected soon to support this work. The tentative design now in hand is for a 6000-lb. thrust unit which will weigh (dry) only about 450 lbs., far exceeding present performance of turbojets (gas turbine-compressor systems). The Army intends this for a fithter aircraft at just under the speed of sound. Pumps and fuel tanks will be at the C.G. of the plane. A good deal of preliminary component work has already been done, and it is expected to complete the forthcoming contract in about 8 months.

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(d) Another type of turborocket is the scheme of Lt. Comdr. Truax, in which the pumps are driven by a vane wheel projecting into the main jet itself. It is intended as the power plant for the guided missile GORGON, and work on it at Aerojet is supported by BuAer's present research contract with the firm.

18. The aeropulse motor is being developed under a contract with BuAer, and this is the job which is consuming most of Dr. Zwicky's time at present (he is Director of Research at Aerojet). Three novel principles are being investigated which should greatly improve such a motor over that used by the Germans in their "buzz bomb"; these principles are:

(a) The augmentation of thrust by accelerating air entrained in a casing surrounding the motor; this is in essence is an injector-type pump, and obviously improves the efficiency since large masses of air can be dealt with;

(b) the increase of power by cascading the fuel jets, so that the detonation of one mixture causes the compression and ignition of another mixture injected at a different point. This also is obviously an improvement, since the initial pressure in the cycle is raised; and

(c) equalizing the exhaust pressure by an oscillating cone placed in the jet exit venturi, so that the exit is constructed when the pulse pressures are low, and vice versa.

A BuAer contract for about $200,000 is expected for construction and test of such a motor. Plans are already drawn and a motor, with a casing about 10 ft. long, is actually being built by subcontractors. A large blower and compressed air banks have been acquired and installed in the Corporation's Azusa plant, and tests are rather optimistically expected to commence in a week or ten days.

19. As a part of the present BuAer contract, Dr. Zwicky is preparing a comprehensive report on the theory of ramjet-aeropulse systems. This is a very large undertaking and less thatn 50% complet. It will include "topological" charts showing, for various altitudes, the areas of speed and duration in which any type of propulsion is most efficient. Prior to the completion of this report, which has promise of being a classic, Dr. Zwicky is reluctant to discuss the details of his work or his plans.

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20. It is of interest that Dr. Zwicky is convinced that the German "buzz bomb" motor flies at a speed determined by its altitude and requires no assisted take-off, no ignition and no mechanical injection system. He has named this "airesonator" to distinguish it from the more efficient and flexible aeropulse system.

21. Dr. Zwicky is also involved in the development of the hydropulse motor, for which he envisions much promise. This system is a possible source of power for the hydrobomb (see paragraphs 7 and 8), and is the underwater analogue of the aeropulse motor. BuAer has some expectation that it may be used to assist the take-off of large flying boats.

22. JET PROPULSION WORK AT THE NORTHROP AIRCRAFT COMPANY

This firm has the following work in hand:

(a) Experimental fighters XP79 and XP79B
(b) Experimental bomber XB35
(c) Jet missile, AAF contract MX543
(d) "Turbodyne" engine, under BuAer contract.

The XP79 is a tailless flying wing of characteristic Northrop design, formerly subcontracted to the Avion Co. (hence known as Project AVION). The Avion people are unable to carry on, however, and the project has recently returned to Northrop. The power plant was to have been supplied by Aerojet (see paragraph 17(e)), but although the AAF will presumably continue to support the work at Aerojet, the Northrop plan is to proceed with the Westinghouse turbojet motors instead. This version is the XP79B, and the Aerotojet-powered XP79 model is dead, at least for the present.

23. Two full-scale wooden versions of the XP79 have been built and flown. Power was supplied by a simple acid-aniline Aerojet motor, adapted from an ATO unit, giving a 200-lb. thrust for 5 minutes. This thrust was too low for take-off or sustained flight; it was admittedly a makeshift affair justified only by the desire to get some preliminary experience quickly. The flights were made by towing aloft as a glider and then cutting loose. The pilot lies prone in the center of the wing, which must be an unenviably exciting experience. One of the two models crashed, the pilot making an "assist walk-off" from the wreck. The other is being shipped to Wright Field.

24. Meanwhile, Northrop is proceeding to construct a prototype metal model of the XP79B, and there is every reason to feel that this effort will be successful. It will have two of the 19-inch Westinghouse turbojets.

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25. The CB35 is the 4-engined, tailless, turbodyne-powered bomber. It is in the mockup stage, and has a low priority at present.

26. Northrop's "buzz bomb", AAF contract MX 543, is one of the many which are frantically being build by various contractors. This particular one is probably the most daring in conception of all. It is a single-wing tailless airframe, similar to the XP79, with the center section formed of 1/4" magnesium plating. This center section carries two 2000-lb. bombs in nacelles, with the motor on the central axis. The motor may be the German aeropulse (or airesonator , as Zwicky claims it is to be) now being copied by Wright Field, NACA Cleveland, and the Ford Motor Company. But Northrop has another idea: use a turbosupercharger with a combustion chamber as a gas turbine system. Such a unit, known as the "BI" engine, is being developed by the German Electric Company and is expected to give a thrust of 430 lbs. With this unit, Northrop calculates a range of 600 miles as compared with 200 miles using a copy of the German unit. BI units are now on order from GE, but delivery dates are problematical. The airframes are proceeding rapidly, and the first on should be finished in a few days.

27. The turbodyne, being developed for BuAer under the supervision of Mr. Phelan, is an extremely promising engine. Unlike other turbojets, shaft power is maximazed instead of jet thrust, and the the advantages of propeller takeoff, where turbojets are weakest, and of variable pitch control while flying. An 18-stage axial-flow compressor is driven by a 4-stage turbine. The combustion chamber is annular, a unique design occupying surprisingly little space.

28. Turbodyne components are being manufactured. Special blade-profiling machinery was designed and built by Northrop. The combustion chamber has been tested satisfactorily. A test stand is nearly finished. A subsidiary company has been formed with the Joshua Hendy Iron Works for the Production of the turbodyne engines. It is quite evident that this engine will be a strong competitor of turbojects.

29. So much for the jet propulsion development work on the West Coast which as inspected on his trip. Other projects visited are reported separtely.

30.

DISCUSSION OF WEST COAST SITUATION

It appears that the Los Angeles - Pasadena area contains the greatest concentration of talent for developing self-powered missiles, and when the Jet Propulsion Laboratory at CIT is constructed for ORDCIT, [redacted] it is obvious that facilities there will be by far the best in the country for such work. The various agencies and activities involved, however, are poorly coordinated. Considerable mutual benefit can be expected, from improved liaison arrangements and from actual collaboration.

31. The Navy Department has a well-organized liaison office under Rear Admiral Holmes. This office, however, deals almost entirely with work under the NDRC contracts to CIT, and these contracts are mainly for torpedoes, rockets and anti-submarine ordnance. The Navy has two officers stationed at the Aerojet Corporation in connection with BuAer contracts, but no one at the Northrop Aircraft Company.

32. The War Department has an AAF officer (Col. Joiner) stationed at CIT for liaison with GALCIT projects and with NDRC contracts. An Ordnance officer (Col. Skinner) has recently been assigned for liaison with the GALCIT project. There is no Army officer stationed at the Aerojet Corporation (although Col. Joiner keeps in touch with work done there in connection with GALCIT). These officers are apparently not kept sufficiently informed by their respective commands at Wright Field and Washington concerning work being done elsewhere, and evidently have most unsatisfactory arrangements for obtaining supplies, and transportation and clerical assistance. By contrast, the Navy CIT liaison office is quite adequately supported by funds transferred to the CIT-NDRC contracts by BuOrd.

33. A number of examples were noted whereby matters would be much improved by a free and more complete interchange of information among contractors (including CIT), Army and Navy personnel. No one example is convincing by itself, but the numerous discussions held with all the principal people involved in this general field led most convincingly to the conclusion that the existing liaison arrangements must be improved if the best progress is to be made.

34. It is therefore recommended that

(a) An officer representing the Bureau of Aeronautics be assigned to Rear Admiral Holmes' staff, and that he be accredited as liaison officer to Army contracts with CIT, the Aerojet Corporation, Northrop Aircraft Company, and such others as may be placed on the West Coast related in any way to power jets or jet-propelled missiles; furthermore that he act as technical representative for all such BuAer contracts in the area.

(b) An officer representing the Bureau of Ordnance be similarly assigned, with similar credentials and responsibilities for representing the interests of BuOrd.

(c) The War Department consider enlarging the responsibilities of Cols. Joiner and Skinner similarly to the above recommendations for the Navy, and setting up a central liaison office along the lines of Admiral Holmes' organization.

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(d) The War and Navy Departments keep the liaison officers on the West Coast more completely informed as to the work in hand elsewhere, and as to the general policies and trends of jet power developments.

REMARKS ON JET POWER RESEARCH IN GENERAL

The West Coast situation is of course but a part of the national picture. Leaving turbojets aside (or any variations such as the turbodyne), the following facts may be noted:

(a) Jet-propelled missiles can be achieved in a wide variety of forms. Developments are proceeding at such a rate that it is increasingly difficult to keep informed, or even more to evaluate, new possibilities.

(b) A certain amount of coordination is being achieved through the NACA on the develo ment of ramjets. This followed from the Whitman Committee's recommendation that the Joint New Weapons and Equipment Committee of the Joint Chiefs of Staff undertake the guidance and coordination of ramjet work, which JNW in turn passed to NACA. (NB: The Special OSRD Committee on Jet Propulsion, under the chairmanship of Dr. W.C. Whitman, was organized at the request of the Services, made its report on March 20, 194 , and has since been dissolved.)

(c) Related metallurgical problems are being studied by the War Metallurgy Committee with Division 18 of the NDRC, and coordinated with the Services and with NACA by this Office.

(d) Related problems of supersonic flight are being studied by the NACA.

(e) Assisted take-off and superperformance of aircraft are related possible applications of jet systems also suitable for powered missiles.

(f) The Bureau of Ships has various gas turbine contracts which may produce useful auxiliary information. Negotiations are now under way for a research contract with the Esso laboratories for fundamental studies of combusti n.

(g) The Bureau of Aeronautics has contracts with Curtiss-Wright (aeropulse system), Reaction Motors (jet power), American Cyanamid, and possibly others; and in addition maintains an experimental establishment at Annapolis.

(h) The Bureau of Aeronautics has requested NACA to investigae ramjets, and NACA has organized a project at its Cleveland Laboratory.

(i) Army Air Forces have requested BuAer to obtain aeropulse design data from Aerojet.

(j) The Army Air Forces, Material Command, are believed to have a number of contracts which are directly or indirectly related to jet power suitable for missiles.

(k) Only a few firms or educational institutions are in a position to do effective work in this field. Manpower is extremely limited, and much of that available is already engaged in developing turbojects for primary aircraft power plants.

SUMMARY

36. If jet-propelled missiles are to be developed, an inter-Service program is highly desirable. Otherwise duplication and inefficient employment of the talent available is certain to retard progress. The least that should be done is to open formal channels for collaboration and interchange of information in Washington, and to strenghten the West Coast situation as recommended in paragraph 34.

R.D. Conrad
Commander, U.S.N.

J.K. Wakelin, Jr.
Lieutenant, U.S.N.R.

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[30 Nov, 1944]

ORDNANCE PROGRAM

For the Development of Long-Range Guided Missiles
November 1944

1. The Ordnance Department has three principal projects under way concerned with the development of guided missiles. The objective sought may be summarized as follows:

a. To develop wingless, jet propelled missiles together with suitable controls for directing to a target.

b. Subsequent to this general development, to develop:

(1) An antiaircraft guided missile with the necessary fire control equipment to meet the military characteristics desired by ground or air forces.

(2) A suitable long-range missile and the necessary fire control equipment required to attack and destroy a capital ship, capable of being launched and controlled from a shore installation, and with military characteristics conforming to those required by Army Ground Forces.

(3) A large long-range missile suitable for the economical bombardment of strategic objectives beyond the range of conventional artillery. This missile to be launched and controlled from a ground position and to conform to military characteristics to be set up by Army Ground Forces.

2. To carry out these developments the Ordnance Department has two major projects, one with the California Institute of Technology and another with the General Electric Company. In addition, we have a major project at the Aberdeen Proving Ground to deal with the many new problems of exterior ballistic measurement of trajectories, etc. The projects at California Institute of Technology and General Electric Company are independent and will represent separate attempts to solve the problems of suitable guided missiles previously outlined. These developments are all looked on as being Class III projects. If the results of firing next spring are encouraging, it may be possible to proceed with the design of an antiaircraft missile as a Class II project.

3. California Institute of Technology -- This project, usually referred to as ORDCIT, is being developed under the scientific supervision of a group of scientists. These are Drs. von Karman, C.B. Millikan, F.S. Malina, and R.R. Martel. The project is proceeding step-wise to the development of long-range guided missiles suitable for ground-to-ground, ground-to-air, and ground-to-water targets. Phase I of the development is the

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development of a non-guided prototype having a range of about fifteen miles. This will be used to study flight characteristics. First firings about 1 December. Model II will weight about 10,000 pounds and will be guided in azimuth only. The control devices of Model II are being developed by the Sperry Gyroscope Company on a subcontract from California Institute of Technology. Model II will have a range of about forty miles. If Model II is successful, it should provide a basis for the immediate design of an antiaircraft projectile. Its successful performance will also be used as the basis for a long range (at least 200 miles) missile. Firings of Model II should take place about May 1945.

4. General Electric Project -- This project, designated by the code name HERMES, is just getting under way. It provides for a broad study on the part of General Electric and for the training of a group of scientists and engineers on the German V-2. It is proposed to send this latter group into Germany after the collapse to secure as much firsthand information as possible, including samples. Subsequent to this, it is proposed that General Electric will design missiles in the antiaircraft, seacoast, and land-to-land types.

5. Aberdeen Proving Ground Program -- These long-range missiles present many new problems in exterior ballistics. Aberdeen Proving Ground has been given the problem of doing the necessary ballistic research, as well as the determination of suitable methods for observation. In this connection the Ballistic Research Laboratory is expected to procure the necessary instrumentation and train the scientific personnel required to operate the proving ground for these missiles.

6. Long Range Proving Ground -- The Ordnance Department, assisted by the Corps of Engineers, has been conducting a nation-wide search for a suitable firing range to be used in the development of long-range guided missiles. While it is felt that we must ultimately go to a water range, we believe that during the early development it is essential to have firing done over land. The first prototype missiles will be very expensive and it is believed worth while to recover them if possible. Also, until we are certain of our radar observation, it would appear desirable to combine this method of tracking with visual and photographic means. We believe we have located a suitable range 150 miles in length and about 40 miles in width.

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Subject: Army Guided Missiles Program. 30 November 1944

NOTE FOR RECORD:

The summaries submitted resulted from much work having been accomplished in each Force in cleaning up its own program and formulating its own ideas. The imminence of this conference hastened their work.

Army Ground Forces has no "Program" except to maintain an active interest in what ASF and AAF are doing, and to insure that as techniques are developed they are applied to Ground Force uses. An outstanding specific example is their following of the AAF "buzz-bomb" development at Eglin Field.

The Summary of Projects which served as a work sheet for the Forces in considering their programs will not be continued. A correction, however, is being sent to all agencies who still are using this summary. It is expected that all copies will be recalled in a few weeks, in order to prevent their use for any purpose other than as a general status summary of projects for reviewing the program. It is impractical to continue its publication in view of the reports already published by various agencies concerned, and the great amount of constantly changing detail which the "working levels" must have. This does not preclude the distribution of an occasional general survey such as in this paper.

Air Force reports can be distributed directly from M & S to Ordnance. Ordnance Reports, however, due to present ASF policy, have to be idstributed from Col. Osborne's Office (Research and Development Division) to MDD and thence to AAF.

The British have formed an elaborate "Guided Antiaircraft Projectile" (GAP) Committee. Their efforts in this probably are intensified because of a strategical need for AAA defenses due to the geographical location of the Isles. This application of guided missiles is being explored by various agencies in this country with what is considered an effort adequate to our tactical needs. The ORDCIT rocket, for instance, provides one type of vehicle. As controls are developed by Air Forces for this missiles and applied as practicable to the ORDCIT project, our own G.A.P. program will develop. It is expected that coordination with the Navy should be quite close in this particular facet of the guided missiles field, since the Navy has a very live interest in developing G.A.P. protection for surface vessels.

The range in question, north of El Paso, contains land at both ends now owned by the Army. It is a tract about 140 miles long by 40 miles wide, and will serve for obtaining trajectory data in the preliminary tests of both winged and wingless missiles. Such a range ill become more essential as time goes on. Colonel Trichel had surveyed possibilities throughout the United States, and none other

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offered the same combination of favorable points. Questions of first cost, maintenance, servicing, altitudes, freedom from highway and air traffic are involved.

The "Navy Jet Missiles Board" will hold a comparable conference on 6 December 1944. We shall then propose an "on the table" conference to see that our two programs really dovetail, and where overlapping exists that it is to the good of the service.

OSRD has at times pointed out the lack of direction and the confusion of effort in the guided missiles programs of the Armed Forces. It is believed that the above progressive steps in cleaning house within the Services is essential before any outside agencies can assist in coordinating the program. Once the Army-Navy prgram on policy-level is clarified, we shall certainly need OSRD and NACA assistance in simplifying and coordinating its technical aspects.

ARTHUR A. FICKEL
Colonel, A.C.

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file 43

2 [illegible] Solid Program Reports [illegible]

[illegible]

[illegible] [illegible], [illegible] solid propellant rocket unit [illegible] thrust [illegible]. A type is first [illegible] launcher. [illegible] A type missiles to be [illegible].

[illegible]

[illegible] for a [illegible]

[illegible] Corporal [illegible] thrust [illegible] sec. [illegible] All [illegible] should [illegible] for Corporal [illegible].

[illegible]

[illegible] Corporal [illegible] motor.

Private [illegible] range extension [illegible] nearly complete on missile booster and launcher.

Jan [illegible] [illegible] Airfoil tester:

[illegible] Corporal is [illegible] vertical flight. [illegible]

Private A tested in first [illegible] weeks of Dec. Successful program of [illegible] firing.

Private F [illegible] Aerojet [illegible] thrust [illegible] sec. solid propellant rockets with [illegible] and [illegible].

Corporal - designing [illegible] thrust [illegible] motor for test in late Dec.

Method worked out for estimating shell temp. arising during high speed flight of large missiles.

[illegible] Vel. Aircraft Rocket] mount test. airfoil in nose of rocket and get data by means of strain gage telemetering system.

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Several reluctance type strain gages to be used. [illegible] as they will give satisfactory results.

Private F - "Interval timer" to cut time between firing of missile and its booster designed.

WAC Corporal [illegible],000 lb thrust .[illegible] sec.

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Ordnance
9-1/4

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O.O. 386.3/953
ATTN: SPOTU 1st Ind HNToftoy/mpg/6565

ASF, Ord O, Washington 25, D. C., 8 March 1946

TO: Commanding General, Army Air Forces, Attn: Chief, Research & Engineering Div, AC/AS-4

1. In reply to the request appearing in paragraph 1 of basic letter, the following information is furnished:

a. It is anticipated that great difficulty will be met in assembling the twenty-five rockets now required for the White Sands Proving Ground tests scheduled to begin in May 1946. The stock of V-2 parts at White Sands Proving Ground is insufficient to assemble one hundred rockets due to shortages and damages incurred in shipment. Practically no control equipment was captured and will have to be constructed for purposes of this test. Extensive overhaul and repair of parts will have to be accomplished prior to assembly. Assembly of the thousands of parts that make up a V-2 is a time-consuming hand process. Further, German experience indicated the V-2 rocket should be fired within a few days after assembly; otherwise, a large percentage of failures resulted.

b. The objectives of the V-2 firing tests are as follows:

(1) To gain all possible scientific knowledge and background pertaining to the V-2, including research on its design, functioning, flight characteristics, etc.

(2) To gain experience in the handling and firing of large missiles of the V-2 type.

(3) To utilize the V-2 as a vehicle for testing U. S. developments in rocket components.

(4) To obtain data on the effectiveness of radar equipment in detecting and tracking V-2 type missiles for application in the development of countermeasures.

(5) To expedite development of instrumentation required for test of guided missiles.

(6) To collaborate with scientific institutions in research into the physics of the upper atmosphere.

(7) To get incidental training of personnel in operation and detection of long-range rockets.

c. In June 1945 one V-2 rocket, which was one of seven damaged ones shipped from Europe, was turned over to the ATSC at Wright Field. It is

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O.O. 386.3/953 1st Ind (contd) 8 Mar 46
Attn: SPOTU

understood this rocket is now at Freeman Field. This rocket was slightly damaged and contained very little control equipment. It is believed sectionalization and study of this rocket, and the additional separate components which have also been furnished the Army Air Forces, would give quite complete information on the warhead, fuel and propulsion system, airframe construction, and certain components of the control system.

d. Upon completion of the White Sands Proving Ground tests a certain number of components will remain on hand and it is anticipated that these will be made available to any interested agencies having a need for them.

2. The Ordnance Department desires to cooperate with the other services in every way possible, but in view of the above, and the fact that the Army Air Forces and the Navy Department are participating in the V-2 tests at White Sands Proving Ground, it would not be reasonable to delay the program in order to assemble the V-2 rocket requested in the basic letter.

FOR THE CHIEF OF ORDNANCE:

H. N. TOFTOY
Col, Ord Dept
Assistant

[redacted]

COPY No. [illegible] [redacted] AFDMA-[illegible]G/Lt Col Stace/bje/2100
Written 2 October 1945

Recommended Assignment of Guided Missiles Development Responsibility in the Army.

AC/AS-3

AC/AS-4

Brig. Gen. Crawford/VAS/bje/2100

1. Attached is a draft of a proposed Memorandum to the Chief of Staff, subject "Memorandum of 2 October 1944, from the Chief of Staff, Assigning Guided Missiles Development Responsibility", (Inclosure No. 1).

2. Since Guided Missiles promise to play a major role in the future military program, there is a great deal of competition to secure the foremost place in the development program by the Army Air Forces, Ordnance, Navy BuAer and Navy BuOrd.

3. The assignment of Army Guided Missiles Development responsibility in the 2 October 1944 Memorandum (Inclosure No. 2), resulted in widely differing interpretations by the Army Service Forces and the Army Air Forces.

4. Ordnance is increasingly entering into the field of aeronautics on their guided missiles program, and it is evident that a clarification of the Army division of responsibility is imperative.

5. Due to the major importance to the future of the Air Force of this development assignment, copies of a proposed memorandum presenting the Air Forces' views to the Chief of Staff are being forwarded to the following offices for comment and suggestions:

a. AC/AS-3

b. AC/AS-4

c. AAF Scientific Advisory Group

d. Office of Dr. Bowles, Special Consultant to the Commanding General, Army Air Forces.

6. Your comments and suggestions will be appreciated on the attached proposed memorandum. It is requested that these comments be forwarded to this office by 1[illegible] October 1945.

2 Incls:
Incl 1 - Proposed Memo
Incl 2 - Memo, 2 Oct 44.

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14. G.M. Policy
G.M. Dev actions 3
16 - (4/11/47)

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AFDMA-PG/Lt Col Stace/bja/2100
8 October 1945.

DRAFT OF Proposed Memorandum to theChief of Staff from the Chief of the Air Staff

SUBJECT: Memorandum of 2 October 1944, from the Chief of Staff, Assigning Guided Missiles Development Responsibility.

1. The subject memorandum was originally prepared with the belief that development responsibilitites for guided missiles should be assigned on the basis of background, experience and ability.

2. This basis of division was - and still is - satisfactory to the Army Air Forces. The present interpretation of this directive by the Army Service Forces, however, assumes responsibilities for development in the aerodynamic field and results in duplication of effort.

3. The development situation has changed greatly since 2 October 1944.

a. It is now apparent that practically all guided missiles will be pilotless aircraft operating on principles of aerodynamic control and stabilization (Tab A).

b. The Army Air Forces leads the field in guided missiles development (Tab B). As long as actual fighting continued, highest priority was assigned to developments that could shorten this war. High priority was not assigned to developments of obvious post-war nature.

c. The Army Air Forces is now shifting top priority to long-term development and it is apparent that the development of piloted and pilotless aircraft will be so similar and complementary that both must be developed by the same agency in order to insure efficiency (Tab C).

d. Competitive programs to the Army Air Forces programs are planned by Ordnance, and the peace-time development budget for the Army will not permit such competiti ve programs (Tab D).

4. It is requested, therefore, that theoverall Army responsibility for all present and future development programs of guided missiles be assigned to the Army Air Forces.

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8 October 1945.

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"TAB A"

Guided Missiles Will Be Pilotless Aircraft with Airframes Built by Aeronautical Manufacturers.

1. It has become increasingly ap arent since the preparation of the 2 October 1944 directive that adequate control of a guided missile cannot be secured, as originally believed by Ordnance, through the use of control vanes or rudders only - without the addition of wings.

2. An example of the necessity of wings for maneuverability is the right and left turn of an airplane. The reason the wings are tilted is to put them in a position where their lift effect can assist in the turn. An airplane can turn right and left without tilting the wings, but the resultant turn is a "skidding" turn of a much larger radius, and the turn takes much longer. With the high speeds of guided missiles, control response must be very prompt.

3. It is apparent also that missiles following a trajectory that is largely a momentum projectile trajectory during the ascending path can have ranges of 1½ to 2 times as great as having wings to secure a glide effect in the atmosphere.

4. Wings may, of course, be a variety of shapes. The lift-rings on the Razon and Felix vertical bombs are an example of wings because they are basically there to secure an aerodynamic lift effect. It is possible also that the whole missile may be designed as a wing in itself, similar to the Northrop Flying Wing. All of these designs to permit aerodynamic lift are evidently in the same design field as aircraft, where lift must be balanced against resultant drag for the most effective result. Momentum projectiles are designed primarily to secure a minimum of drag.

5. The use of such nomenclature as "fins" or "Fings" instead of "wings" is merely an evasion. These devices are placed on the missile to secure the results required of a wing and no matter what their size or shape is, they secure these results through aerodynamic reactions.

6. Ordnance has increasingly realized that aerodynamci vehicles with wings are necessary:

a. The California Institute of Technology "Orfcit" project has gone to the Douglas Aircraft Company (an Air Corps contractor on airplanes and guided missiles) for development and construction of the vehicle. Dr. Milliken of C.I.T. stated in his address to the A.S.F. and A.G.F. on 24 September 1945, that wings were necessary for both control and long range in guided missiles.

b. The Bell Telephone Laboratories "Nike" project has also gone to Douglas Aircraft as a vehicle subcontractor. Both Dr. McNair and Dr. Quarles of Bell Telephone Laborntories had previously stated that they would refuse to undertake any surface-to-air project unless a leading aircraft contractor could be secured to develop the vehicle. The 5g lateral acceleration in the "Nike" design will permit it to fly level, climb, dive, and outmaneuver a heavy bomber.

c. The "RCA", in their study contract on a surface-to-ship missile have approached Douglas also. They are particularly interested in the aerodynamic development by the A.A.F. with Douglas of a supersonic experimental piloted aircraft.

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d. General Electric in their "Hermes" surface-to-air project are copying closely the German, "Wasserfall". This missile (4.4 g lateral acceleration) can also outmaneuver an aircraft. Dr. Porter of General Electric has also stated that ranges of rocket-type guided missiles can be greatly increased by the addition of wings.

7. There are a number of other illistrationsof the crystallization of thinking to the belief that guided missiles must have wings in order to have adequate control and truly long ranges.

a. Dr. Von Karman, Chief of the A.A.F. Scientific Advisory Group, foresees forthe future long-range strategic bomber, "two types of pilotless aircraft, both with wings; one with a high trajectory reaching far into the outer atmosphere, and the other designed for level flight at high altitudes".

b. The Navy projects for anti-aircraft missiles plan on wings, and the airframes are being built by Curtiss-Wright, Consolidated-Vultee and other aeronautical manufacturers.

c. The Germans had wings on their anti-aircraft guided missiles and their plans for missiles having longer ranges than the V-2 contemplated the use of wings for gliding in the atmosphere.

d. The British plan high lateral accelerations and wings for their anti-aircraft guided missiles.

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BELL TELEPHONE LABORATORIES MISSILE:

1. Description:

Length 19 ft., diameter 1 ft., wing spread 4 ft., weight 1,[illegible] lbs., maximum speed 2,400 ft. per second, effective horizontal range about 12 miles, [illegible] ft.

2. Outstanding Design Features:

Vertical launching with rocket ATO; acid-aniline propulsion; fuel weight 800 lbs., duration [illegible] seconds; total flight time [illegible] to 60 seconds; ground control system of two tracking radars and intercepting computer; warhead [illegible] lbs. total; maneuverability [illegible]; firing rate about 1 per [illegible].

3. Intended Employment:

To [illegible] interceptor for [illegible] aircraft.

4. Present Status:

Survey just completed by Bell Telephone Laboratories and verbally reported [illegible] characteristics and military [illegible] now being studied for the purpose of determining the future course of action.

5. Priority:

a. Priority predicated upon operational requirements. Not expected to be available for anti-aircraft use.

b. Relative precedence accorded to this project with reference to all other missile projects of the individual services. Priority [illegible] in Army Ground Forces development program, as based on post-war use.

6. Target Date:

(1) Experimental models for test - November 1947.

(2) Service test models - May 1948.

(3) Production - January 1949.

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[illegible]

[illegible]

Air Technical Service Command, Office of the Chief of Ordnance,

Bell Telephone Laboratories.

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BOEING "CONDOR" MISSILE

1. Description: The Study now being conducted by Boeing has not yet reached the point of laying out a specific missile.

2. Outstanding Design Features: Will probably have athodyd propulsion, supersonic speed; length on the order of 15 - 20 feet, diameter about 1 ft; radar tracking and control.

3. Intended Employment: To complement or supplant interceptor fighter aircraft. This project is also being prosecuted for its value in contributing to the ultimate solution of the problem of supersonic flight by man-carrying aircraft.

4. Present Status: Boeing is still making survey and will report about 1 August 1945. Decision to proceed with development contract will depend on report.

5. Effort:

a. Urgency predicated on operational requirements. Not expected to be available for anti-Japanese use.

b. Relative precedence accorded to this project with reference to all Guided Missile projects of the individual services. Priority 38 in Army Air Forces development program, as based on post war use.

c. Target Date: Not established - probably June 1947 for experimental models, July 1948 for service tests models and January 1949 for production.

d. Estimated Cost of Development: Survey Cost $33,000.00. No estimate available for complete development.

6. Relation to Similar Guided Missiles Projects: Will take advantage of all prior work done in the field, particularly on propulsion, aerodynamics, and control.

7. History of Project: Was first proposed under the name "Condo

Boeing by Air Technical S_rvice Command in January 1945. Letter contra

[redacted]

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issued 28 April 1945.

8. Research and Development Agencies:

Air Technical Service Command

Boeing Aircraft Company

National Advisory Committee for Aeronautics.

[redacted]

[redacted]

HEADQUARTERS ARMY AIR FORCES — Lt Col Stace/mjn/2100

Office, Asst. Chief of Air Staff, Materiel and Services

Inter-Desk Memorandum

433

TO: BRIG. GENERAL J. F. PHILLIPS — Date 20 June 1945

SUBJECT Potential Ordnance Contract with Bell Telephone Laboratories on a Surface-to-Air Guided Missile

1. Following the conversation of 16 June with Dr. Quarles of B.T.L. a discussion was held with Colonel Trichel of Ordnance on 18 June.

2. Colonel Trichel gave the following information concerning the potential B.T.L. contract.

a. No contract has actually been placed, but the New York Ordnance District has been directed to negotiate and it is just a matter of time until the details are worked out.

b. B.T.L. were unwilling to accept the contract on a war-time basis. They were willing, however, to accept a contract involving 3 to 4 years for flying models, at a cost of approximately $1,500,000.00 a year (on a cost plus a fixed fee basis) and involving direct participation of approximately 120 of their personnel (including approximately 60 of their "scientists") and indirect participation of about 60 plus the personnel of the subcontractors that B.T.L. brings in.

c. The period of time involved is longer than Ordnance had hoped for and will result in dropping the priority back.

d. The contract will specify the original characteristics proposed by B.T.L., but will not be at all air-tight. Colonel Trichel believes that these characteristics will actually be obsolete before the first models are complete.

e. B.T.L. will get a completely integrated contract on the whole project (including launching) with authority to subcontract. No portion will be passed out to any of the other Service Forces or to the Air Forces for development. Colonel Trichel states that some of the other Service Forces are not happy about this arrangement, but that Ordnance feels the various guided missiles operational and launching components are so inter-related that it is imperative the responsibility be centered in one agency. He feels that the amount of liaison necessary to make any other procedure operate would be prohibitive.

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HEADQUARTERS ARMY AIR FORCES
Office, Asst. Chief of Air Staff, Materiel and Services

Inter-Desk Memorandum

TO: BRIG. GENERAL J. F. PHILLIPS (CONT.) Date 20 June 1945

SUBJECT Potential Ordnance Contract with Bell Telephone Laboratories on a Surface-to-Air Guided Missile

f. Colonel Trichel acknowledges the agreement that a decision would be made on "who was the proper development agency" after receipt of the B.T.L. proposal, but states that he felt the B.T.L. missile was definitely "Ordnance", and that there was no question on the matter. If the Air Force questions this decision, however, he will be glad to arrange a discussion with Major General Barnes and feels that the AAF and Ordnance can work out any differences of opinion satisfactorily.

g. Colonel Trichel states they have not considered a joint contract with B.T.L. Joint contracts have the obvious disadvantage of lack of a single authority for decisions -- and he couldnt see any balancing advantage in such a joint arrangement.

h. In regard to the potentiality of a Boeing - B.T.L. Joint contract, Colonel Trichel stated it might be worthwhile considering, but he felt that such an arrangement would set B.T.L. up as a subcontractor and remove much of their development incentive.

i. Ordnance had just received sets of drawings and charts (requested by the AAF). A set is attached, and other sets are being forwarded to The Special Assistant for Anti Aircraft, The AC/AS, OC&R, and the ATSC.

j. Colonel Trichel has an overseas transfer effective 1 July 1945 and is being replaced by Colonel Tuftoys, formerly Head of the Ordnance Intelligence Team, ETO.

Bruce B Price AC/AS

FRED. R. DENT, Jr.
Colonel, Air Corps
Chief, Engr. Br. Mat. Div.

1 Incl
Cy #2 Chart

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From ________________

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M.M. Div. AC/AS-3
4 (1/5 pp)

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Brief of talk by
Gen. Rich. to A-3

15 Feb. 46

AAF Policy on Guided Missiles

1. Only one directive assigning responsibility for guided missiles. This is the War Department directive of 2 October 1944 assigning research and development responsibility.

a. Army Air Forces responsible for all missiles launched or dropped from aircraft.

b. Army Air Forces responsible for all missiles which depend for sustenance primarily on the lift of aerodynamic forces.

c. Army Service Forces responsible for development of all missiles which depend for sustenance primarily on momentum of the missile.

2. This directive, in the manner it is being interpreted, allows for duplication of effort and results in confusion and spending of unnecessary funds.

3. There is no directive assigning the operational responsibility for guided missiles. It is felt that an operational assignment might aid in clearing up some of the duplication and confusion in the development field.

4. At a conference between guided missiles personnel of AC/AS-3, AC/AS-4, and AC/AS-5 it was decided to present the problem to General Spaatz for his presentation to the War Department. AC/AS-3 has prepared a paper on the the following assignment to the Army Air Forces:

a. All air-to-ground missiles

b. All air-to-air missiles

c. All ground-to-ground missiles and related launching and control equipments except those used to complement, supplement or supplant field artillery in the fulfillment of the basic field artillery mission.

d. All necessary equipments, weapons, ground-to-air missiles and systems required to provide a coordinated defense against foreign aggression by aerial attacks of any type.

5. AC/AS-4 has prepared a paper on the research and development responsibility. Both the paper from AC/AS-3 and the paper from AC/AS-4 were forwarded to AC/AS-5 for consolidation and presentation to General Spaatz.

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6. AAF program of guided missiles is to procure, through pertinent research and development, guided missiles necessary to perform the overall AAF mission of air offense and defense, and to train personnel capable of operational employment of these guided missiles.

7. We are making the following progress:

a. Through research and development, the guided missiles and associated equipment set forth in military characteristics (prepared by A-3) are being secured, as outlined in answer to question No. 10.

b. Training is to be accomplished through the following mediums:

(1) 1st Experimental GUided Missiles Group
(Stalemated for six months)

(2) CAF
(Obsolete material-Azon, Razon)

(3) AAF University
(Very indefinite program)

(4) Civilian Universities
(Handful (12) of officers)

Equipment

1. Long Range Program.

a. Military characteristics have been prepared on the following:

(1) Ground-to-ground

(a) Ranges up to 13,000 miles
(b) Velocities 3,000 m.p.h.
(c) Warheads 12,000 lbs.

(2) Ground-to-Air

(a) Ranges up to 550 miles
(b) Velocities 5000 m.p.h.
(c) Altitude 100 miles

(3) Air-to-Air

(a) Range 3.5 mi. 5.0 mi.
(b) Velocities 1500 m.p.h. 1500 m.p.h.
(c) Warheads

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(4) Air-to-ground

(a) Ranges　　　　300 mi. (Radio Control to 100 mi.)
(b) Velocities　　　300 m.p.h.
(c) Warheads　　　11,000 lbs.

(5) Air Defense System

(a) Warning Systems
(b) Control Center
(c) Guided Missiles Operations Center
(d) Piloted Aircraft Operations Center
(e) Antiaircraft Operations Center

f. Equipment expected to be operational in the next five year period.

a. Ground-to-Ground

Description	Development Complete	Oper. Date	Range	Warhead	Speed
Tactical &	1947	1948	3000	20,000	Subsonic (B-29
Strategic	1948	1950	Less than 500	2,000	Supersonic
Bombardment	1949	1951	500	2,000	Supersonic
	1949	1951	1000	2,000	Supersonic
	1950	1950	2000	2,000	Supersonic

b. Air-to-ground

Description	Development Complete	Oper. Date	Range	Warhead	Speed
Vertical	1947	1948	-	1[illegible],000	Sonic
Glide	1948	1949	100	2,000	Subsonic
Glide Atomic	1949	1950	300	11,000	Subsonic
Glide	1949	1950	100	2,000	Supersonic
Glide	1949	1950	300	2,000	Supersonic

c. Ground-to-Air

Description	Development Complete	Oper. Date	Altitude	Speed	Range
A	1948	1949	40,000	Supersonic	12-15
A	1949	1950	50-60,000	"	35
A	1950	1951	80,000	"	50

d. Air-to-Air

Description	Development Complete	Oper. Date	Range		Altitude
Air Defense	1948	1949	6,000 yds	Subsonic	Aircraft
	1949	1950	6,000 yds	Supersonic	"

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3. Navy

a. Bumblebee

(1) [illegible] research on [illegible] supersonic missile [illegible] air and surface-to-surface. [illegible] by Johns Hopkins University. [illegible] test [illegible].

(2) All other guided missiles are [illegible] the next five years. All are [illegible].

4. Army Ground Forces

a. Ground-to-ground

(1) Hermes project - firing of captured German V-2's at White Sands Proving Ground, New Mexico.

(2) ORDCIT - Ordnance contract with California Institute of Technology to study liquid fuel rockets for fundamental research. Includes tests of the outer atmosphere and of telemetering systems.

b. Ground-to-air

(1) Nike - Short range supersonic antiaircraft missile. AAF was participating in program but dropped it in favor of Boeing GAPA.

5. Types of Seekers under consideration.

a. Heat - Felix bomb (VB-6). Operational suitability still in doubt.

b. Light - Several test models have been tried. Very susceptible to camouflage.

c. Radar - Navy successfully used bombs to attack enemy radar transmitters. Radar transmitter and receiver seeker successful against metallic targets with uniform background - ships at sea.

d. Audio - Developed mainly by the Germans. Still looked upon as a possible solution if other type seekers nullified by camouflage.

e. Television - Not strictly a seeker, but an excellent method of guidance. Used on experimental glide bombs, and on the Hermit Project - war weary airplanes against enemy front-line targets.

f. Radar Beam - Not a seeker, but the favored means at present of directing a ground-to-air missile.

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6. New liaison is [illegible]

a. Mainly with [illegible] largest part of work at present.

b. Field [illegible] research, development, and test agencies.

c. Liaison of [illegible] research agencies by officers stationed at agencies (also).

(1) Universities.

(2) Industry.

7. Projects Curtailed

a. 1st Experimental Guided Missiles Group stopped for six months by Crossroads Project.

b. Development of Solid Fuel Rockets

(1) All basic research stopped at end of war.
(2) A-4 has to request Air Ordnance to continue basic research.
(3) Solid fuels necessary for boost to supersonic speeds (for ram-jet operation).
(4) Definite possibility that solid fuel may be the ultimate propulsion solution.

c. Shortage of contractors for research and development

(1) Present indefinite responsibilities are causing services to compete in industry.
(2) Sudden interest in guided missiles putting too great a lord on industry.
(3) Lack of expensive facilities (supersonic wind tunnels).

8. Unsatisfactory progress of projects

a. Reported to A-3 by General Richardson verbally.

b. Reported by directives (for A-3 signature) to agencies involved.

9. Status of V-1 (JB-2)

a. Research and Development stopped

b. 1406 now on hadn

c. Reached production stage
(1) Production rate was:
(a) Willys Overland - 500/month
(b) Republic Aviation - 225/month

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ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

Use this form for inter-office correspondence within headquarters.
Use entire width of sheet, both sides.

Use authorized office symbols to designate addressor and addressee.
Number all comments consecutively. 737

Place initials of dictator and typist, telephone number and location to right of signature.
Separate comments by horizontal lines across page.

SUBJ: Project MX-606, Ground-to-Air Pilotless Aircraft. AB-8

TO TSEPP FROM TSESA-7 DATE 12-28-45 COMMENT NO. 1.
ATTN: Col. Wessell

1. A copy of A.F.P. 438842 was recently forwarded to your laboratory for information. This A.F.P. initiates the contract for the second phase of the ground-to-air pilotless aircraft development. Inclosed is a copy of the Boeing Aircraft Company letter proposal on which this A.F.P. is based.

2. Project MX-606 was initiated in compliance with S.I. 2003 and is in accordance with a military characteristic dated 29 June 1945, a copy of which is inclosed.

3. The development of a ground-to-air pilotless aircraft was initiated by a design study made by the Bell Telephone Laboratories under a joint Army Air Forces and Army Ordnance contract. This study was completed 14 May 1945, and the Army Ordnance then contracted with the Bell Telephone Laboratories for research and development leading to the design of the proposed missile. This project has been called "Nike".

4. On 15 May 1945, the Army Air Forces contracted for the Boeing Aircraft Company to analyze the results of the Bell Telephone Laboratories study and all other guided missiles projects in the United States and to recommend a program for the development of a ground-to-air pilotless aircraft. The results of this study were presented verbally to representatives of the various laboratories of ATSC in a meeting held in the conference room of the Aircraft Laboratory on 19 September 1945. Copies of the nine reports submitted by the Boeing Aircraft Company were furnished your laboratory.

5. Negotiations are currently underway on the contract for the second phase involving research and development of component systems including aerodynamics, propulsion, guidance, launching, ordnance, and associated equipment. This phase will include laboratory development and testing of these systems and also the construction of various types of test vehicles for the purpose of flight testing the components systems.

6. It is requested that your laboratory follow the development of components for the ground-to-air pilotless aircraft throughout the progress of this contract. The Boeing Aircraft Company will be permitted to subcontract for portions of the development with the prior approval of the ATSC. In such cases, the laboratory concerned will be requested to evaluate the proposed sub-contractor prior to this approval.

Charles W. Guy
for GEORGE E. PRICE,
Colonel, Air Corps,
Chief, Aircraft Projects Section,
Service Engineering Subdivision,
Engineering Division.

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2 Incls.
#1. Military Characteristics of Guided Missiles.
#2. Cy. of ltr. from Boeing.

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Auth: C. G. AMC
Initials: cwt
Date: 14 JUNE 1946

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201-46 V-7

THE DEVELOPMENT OF GUIDED MISSILES

APPENDIX D

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Auth: C.G. A.M.C.
Initials: [illegible]
Date: 14 June 1946

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Auth: C.G. AMC
Initials: CLM
Date: 14 JUNE 1946

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Initials: [illegible]
Date: 14 JUNE 1946

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C O N T E N T S

APPENDIX D
Photographs

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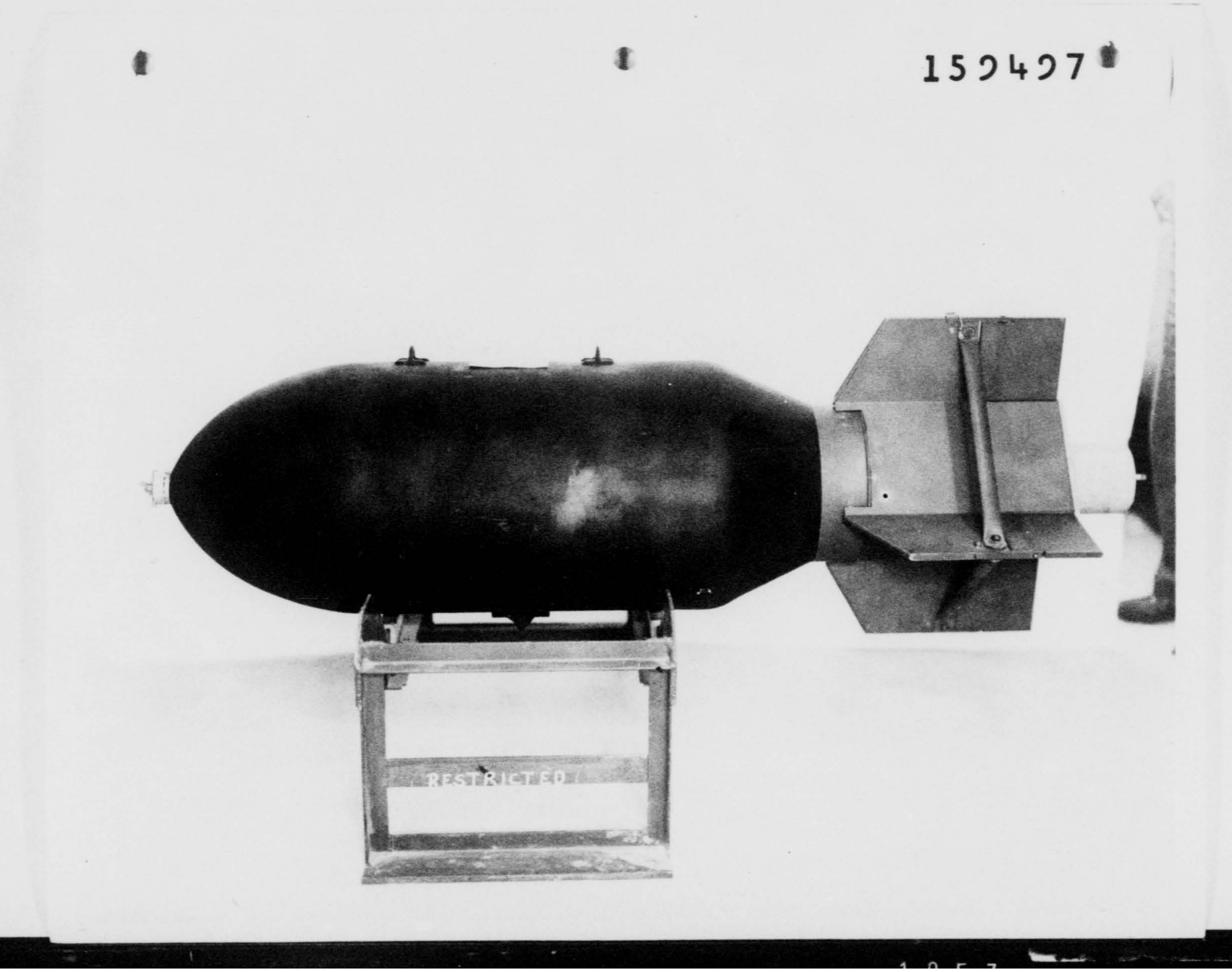
1. Azon (VB-1)



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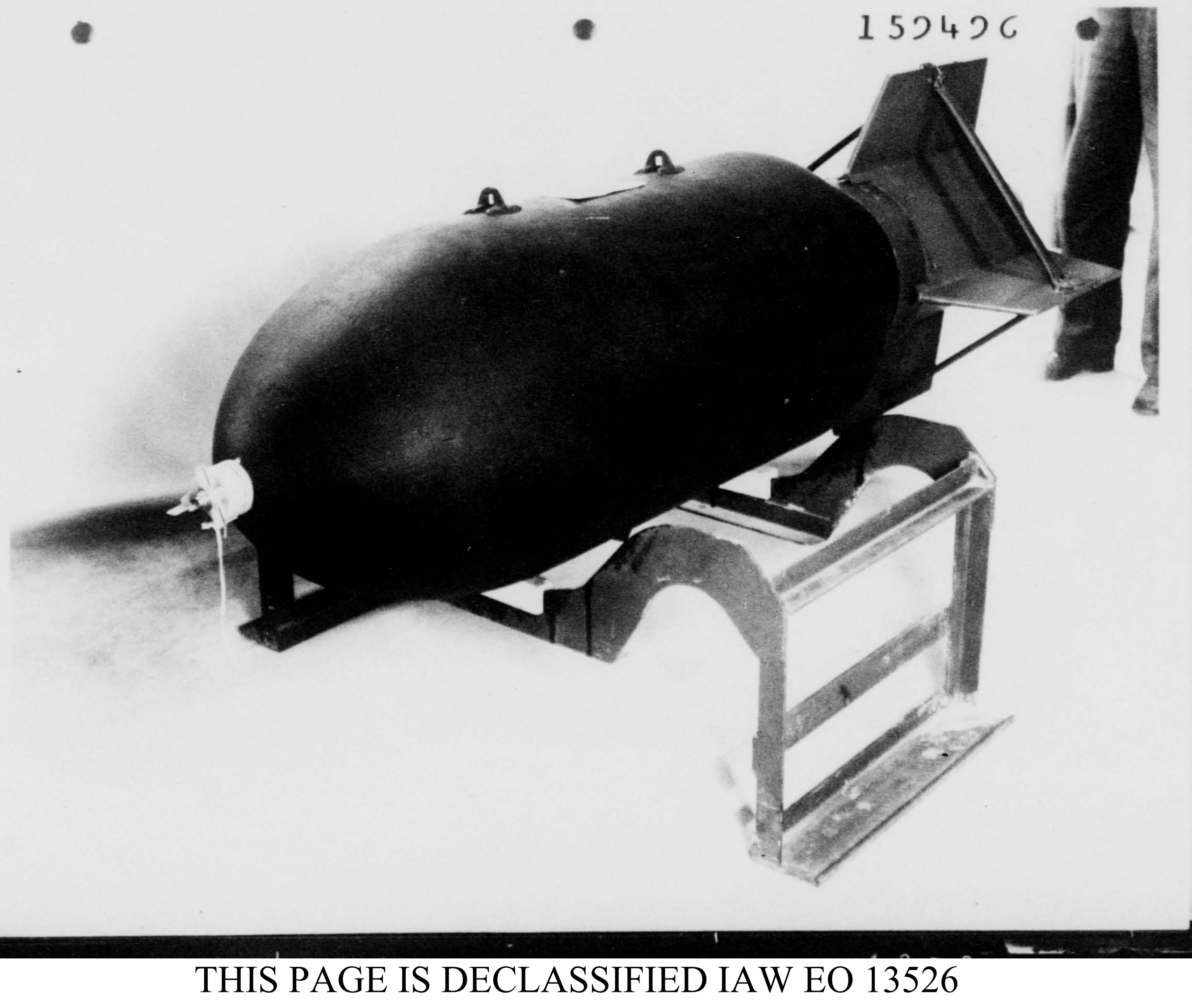
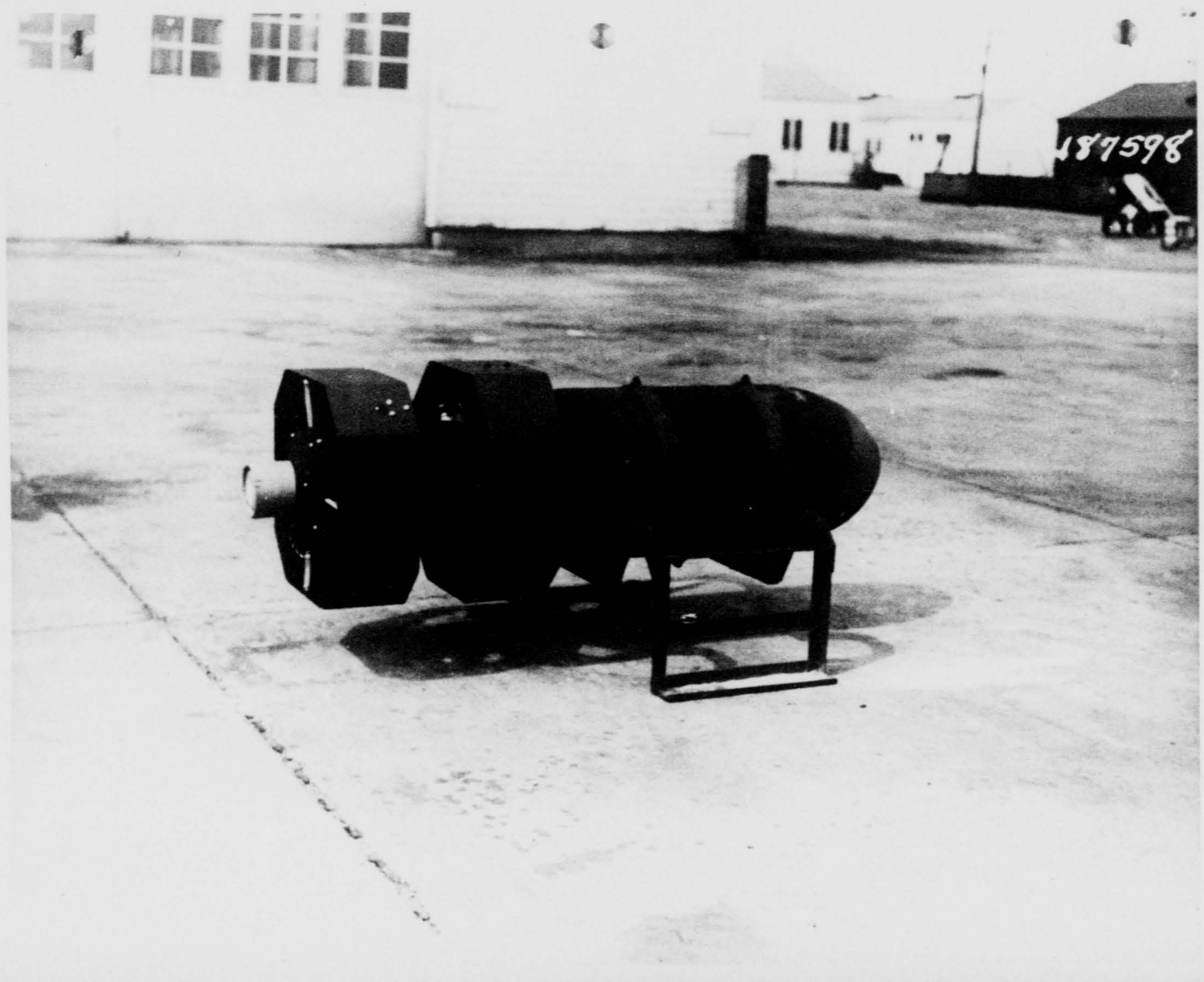
2. Azon (VB-1)


159496

3. Side view of Razon (VB-3)



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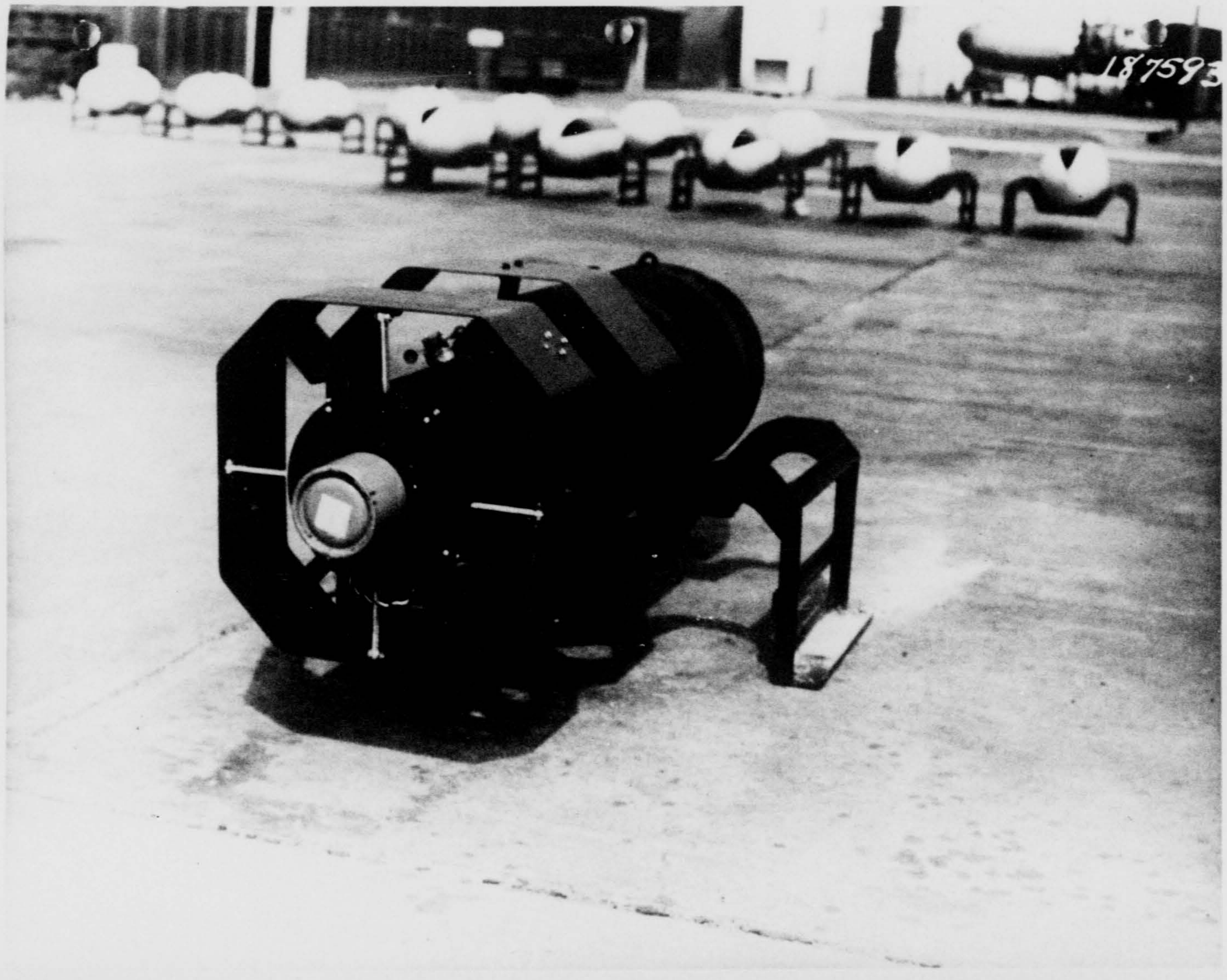
4. Rear view of Razon tail section



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5. Rasons in the bomb bay

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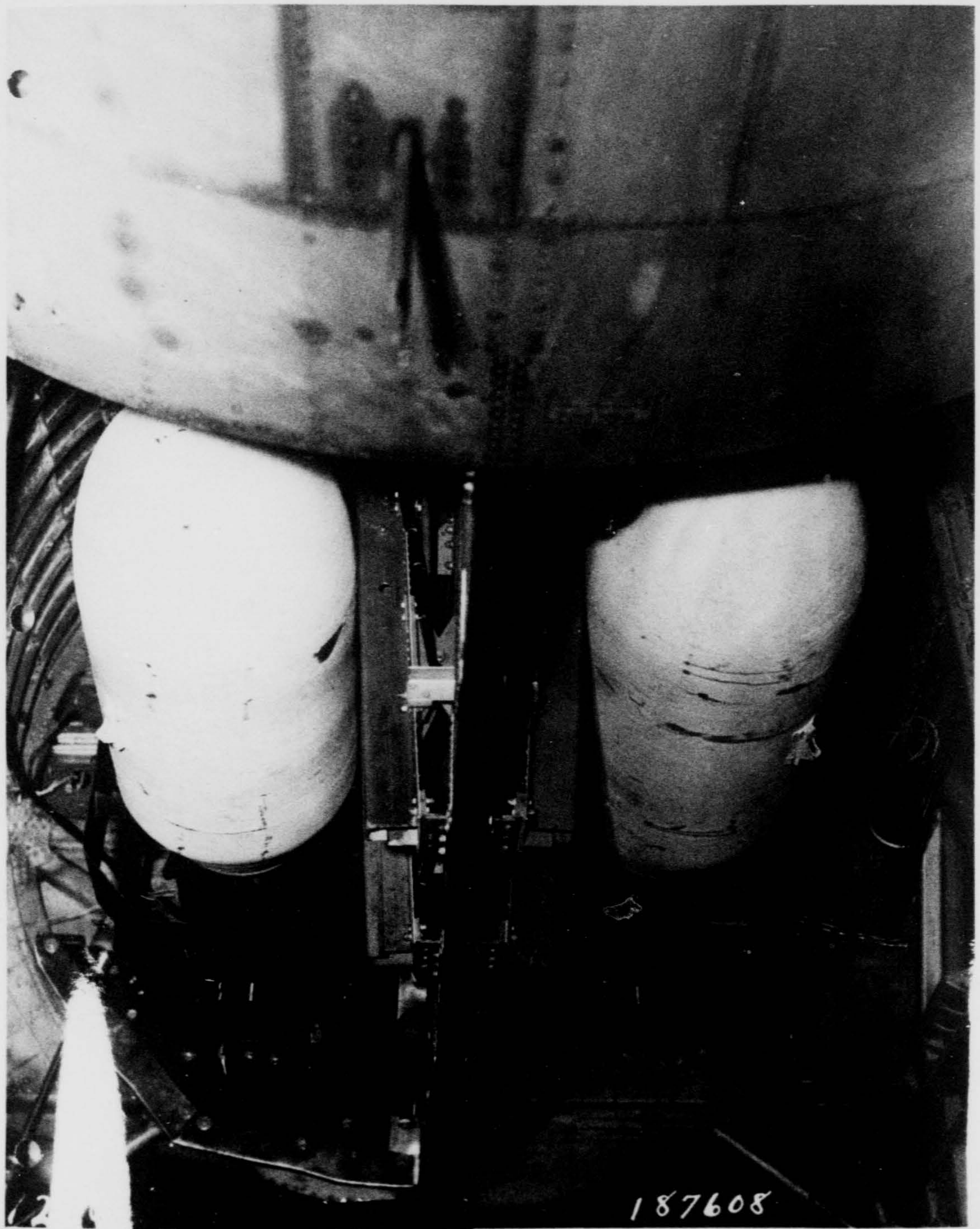

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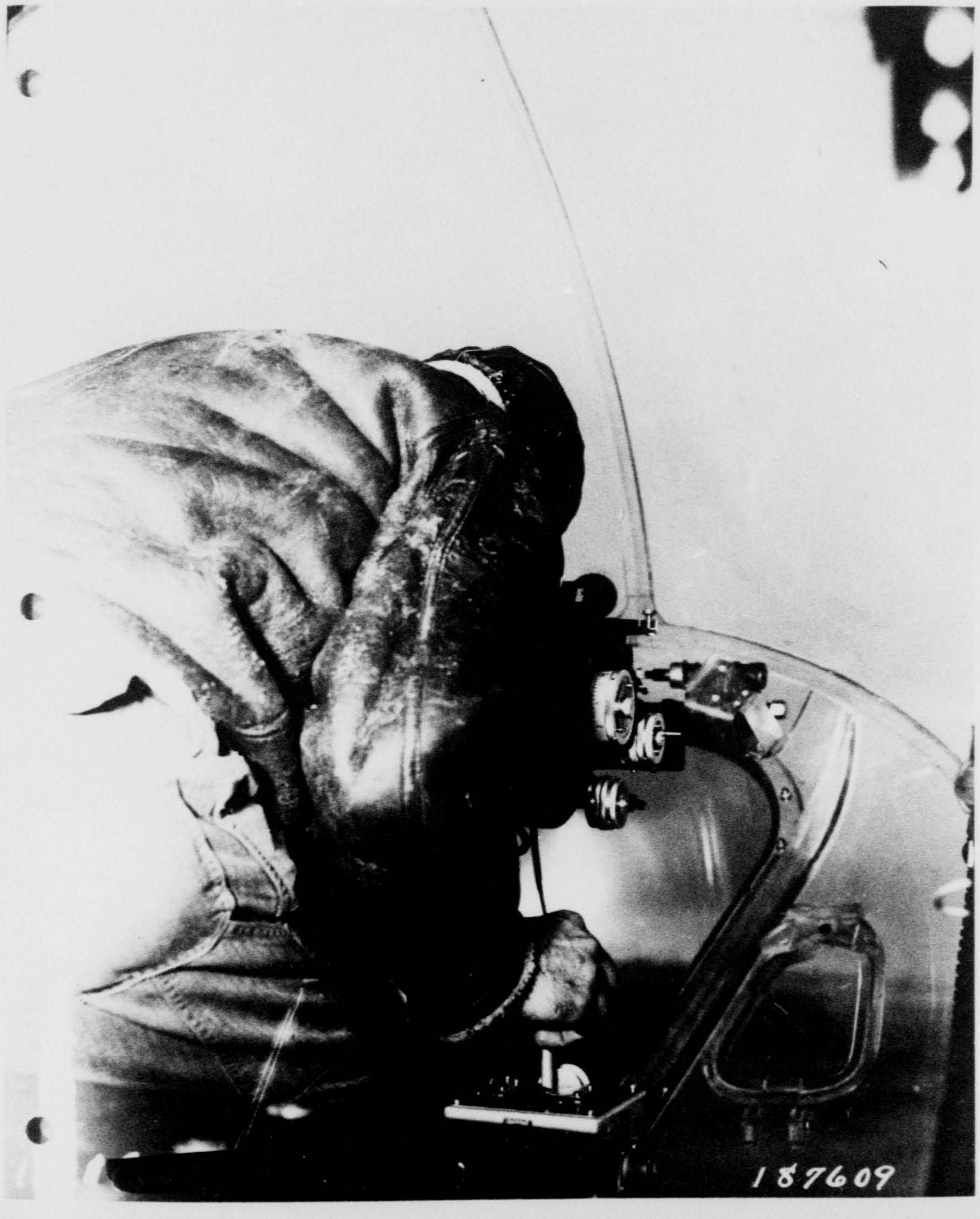
6. Bombardier controlling Razon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7. Felix (VB-6)

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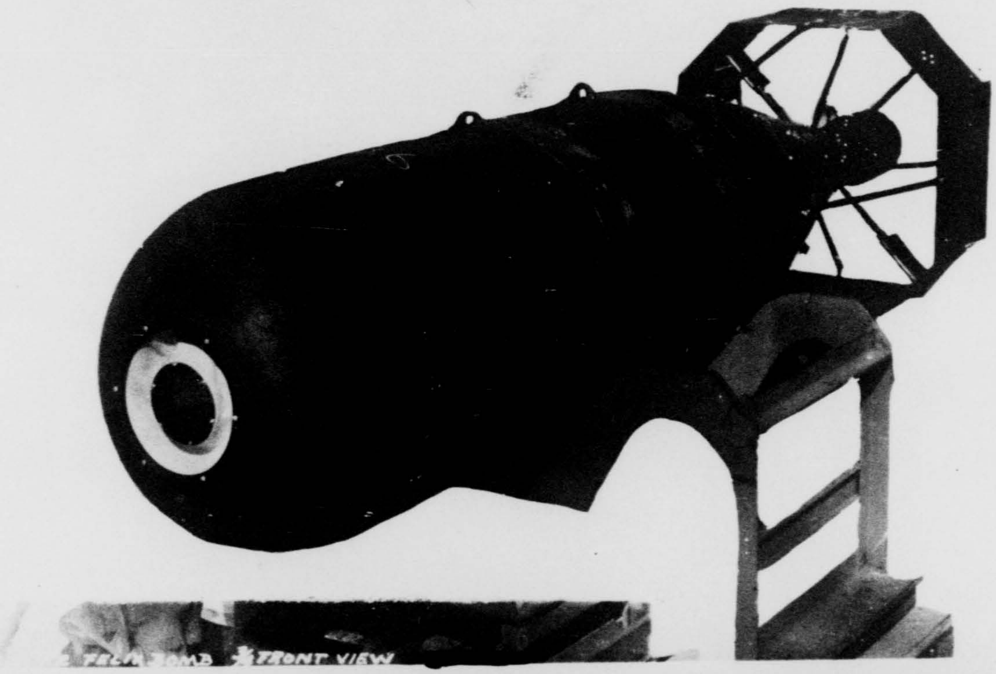

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S. Felix (VB-6)

1071

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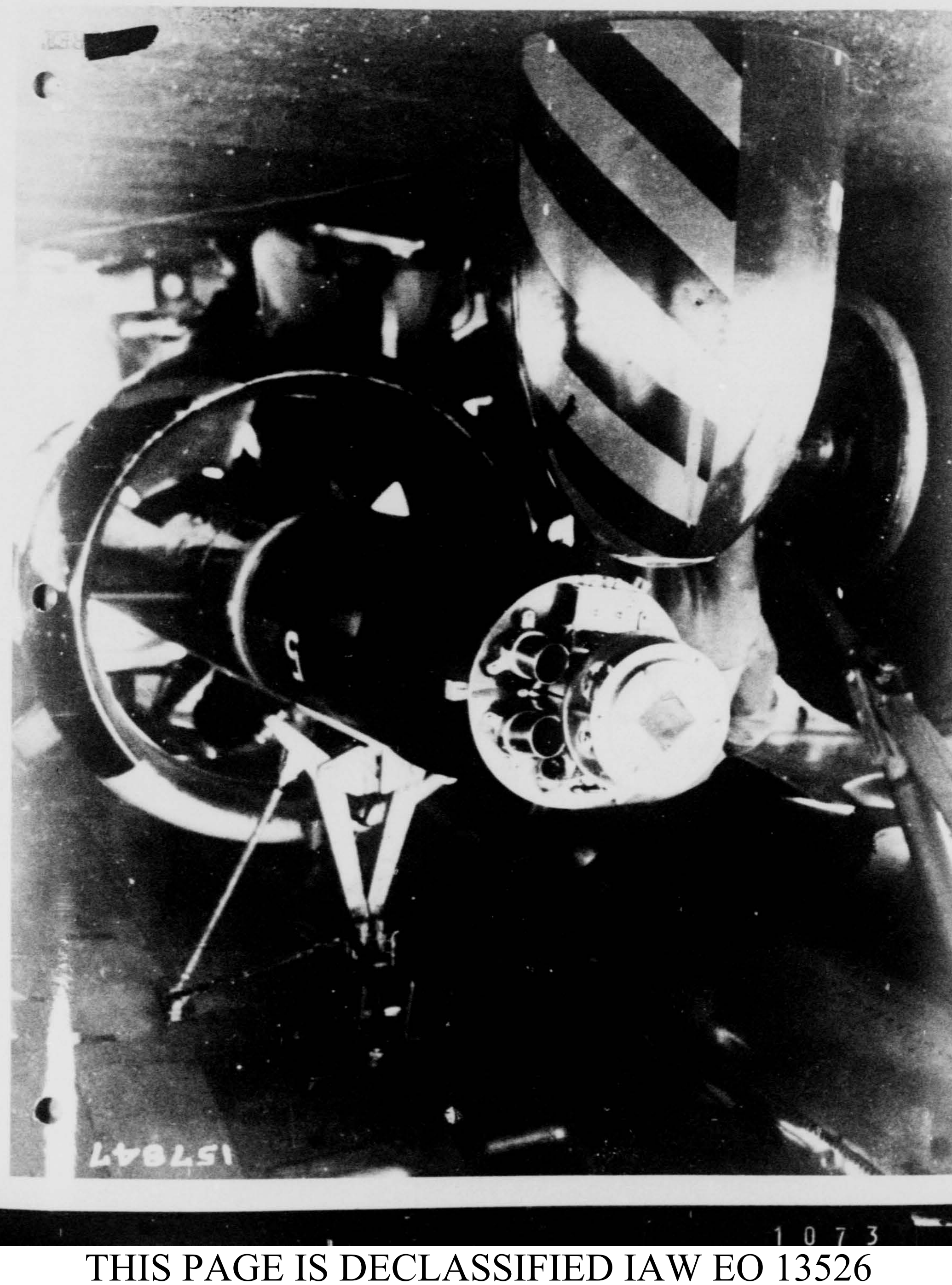
9. Roc (VB-10) showing television equipment



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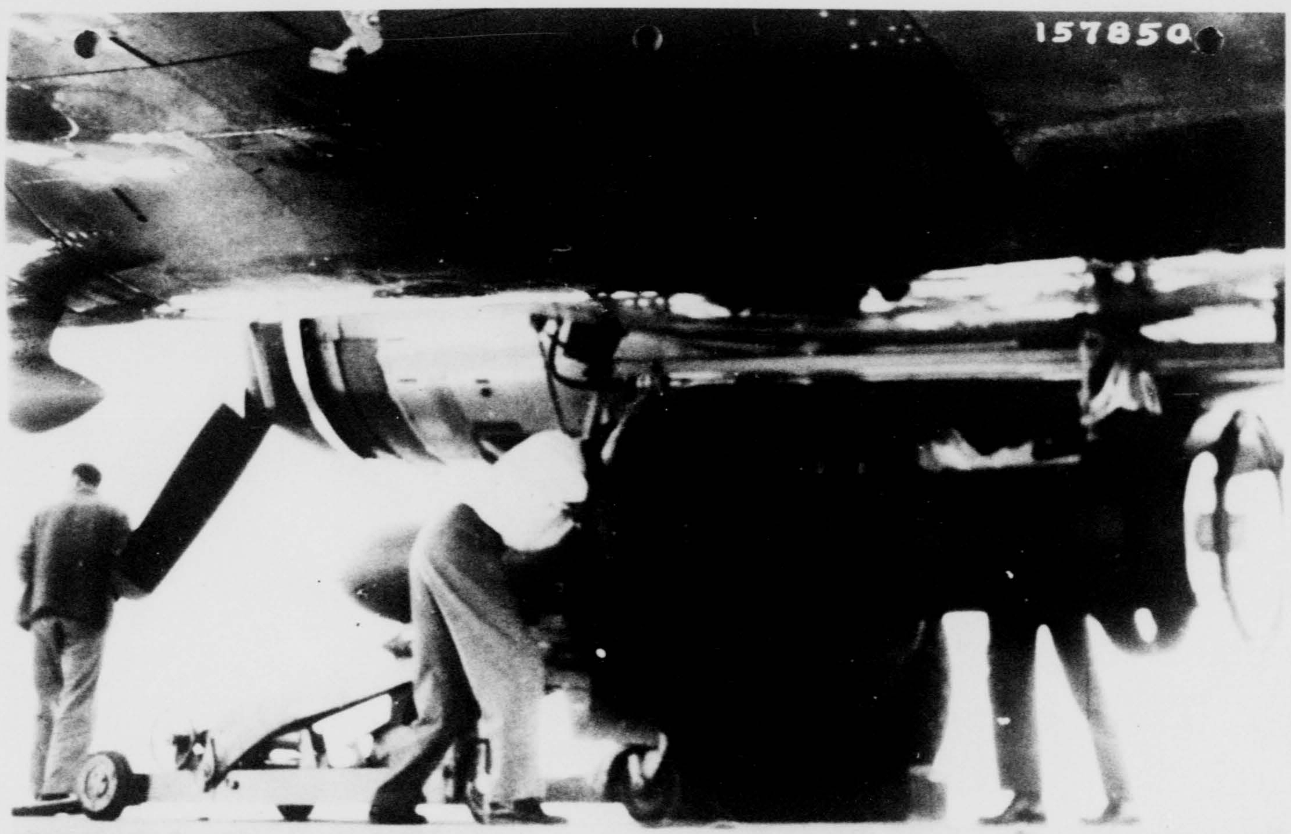
10. Roc being attached
under a B-17 wing



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11. Rocs on a B-17

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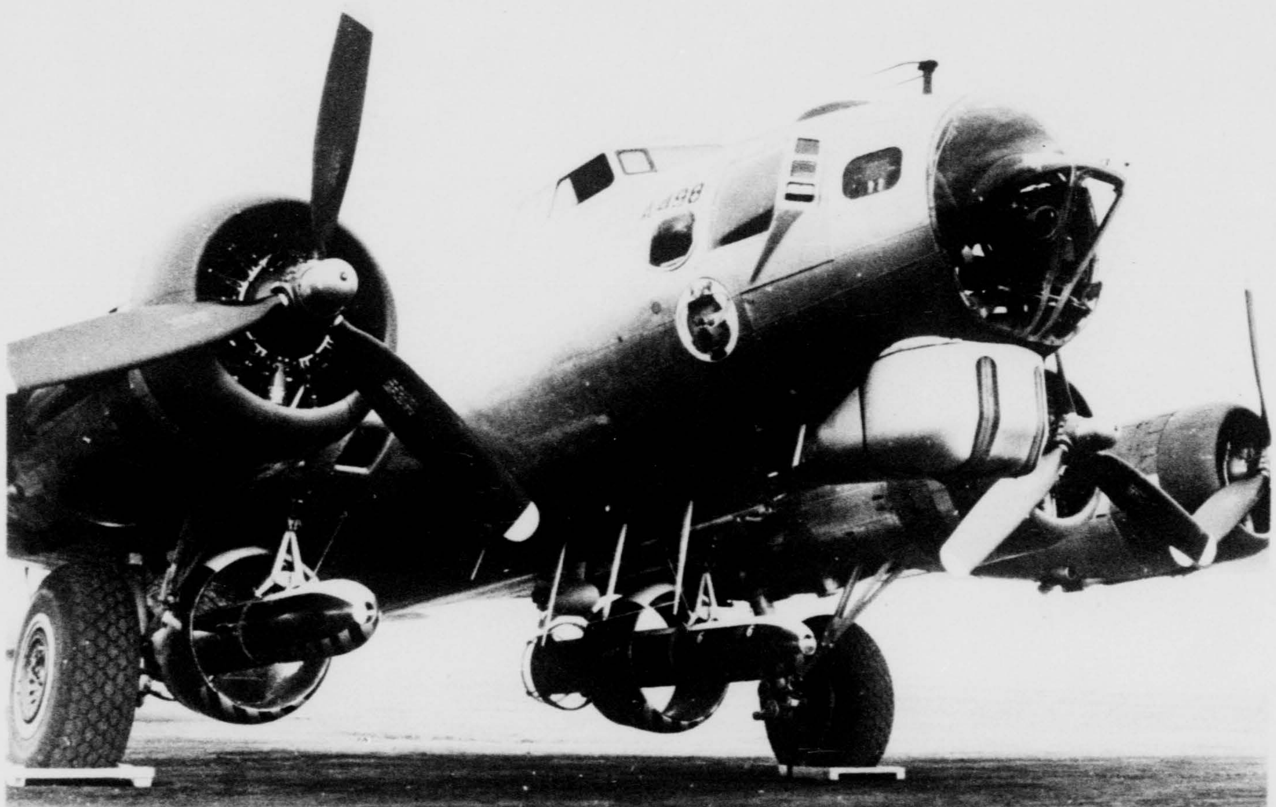

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12. See photograph

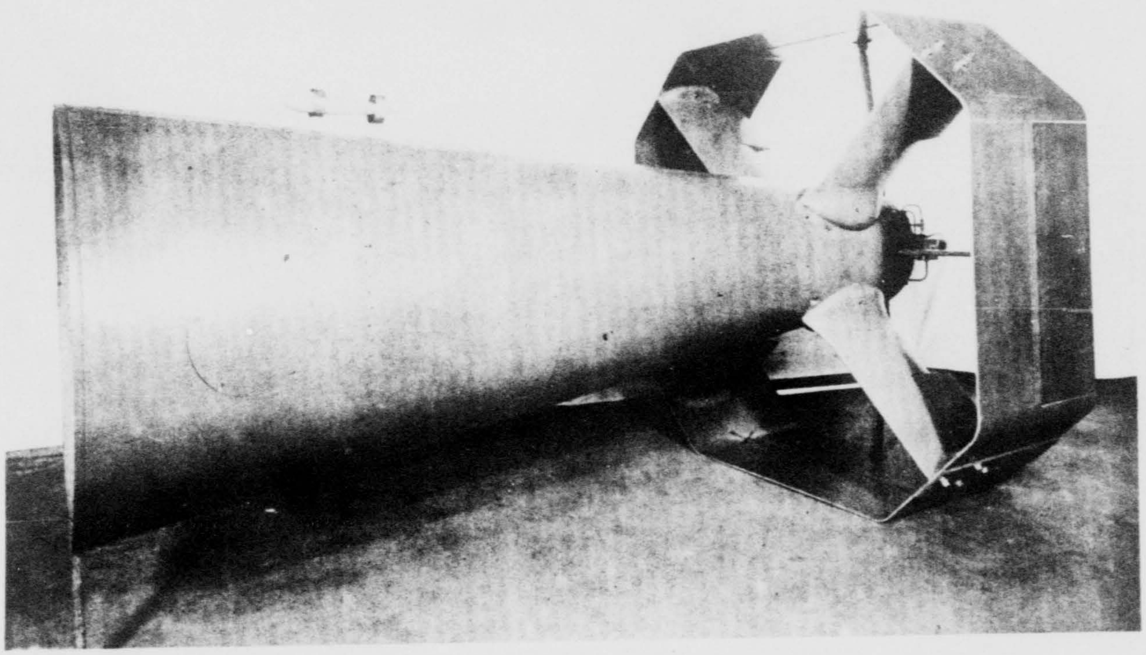

FIG. 4 - VB-13 TARZON TAIL ASSEMBLY WITHOUT FINAL CONE

ALSO SCALE MODEL OF COMPLETED BOMB

13. See photograph

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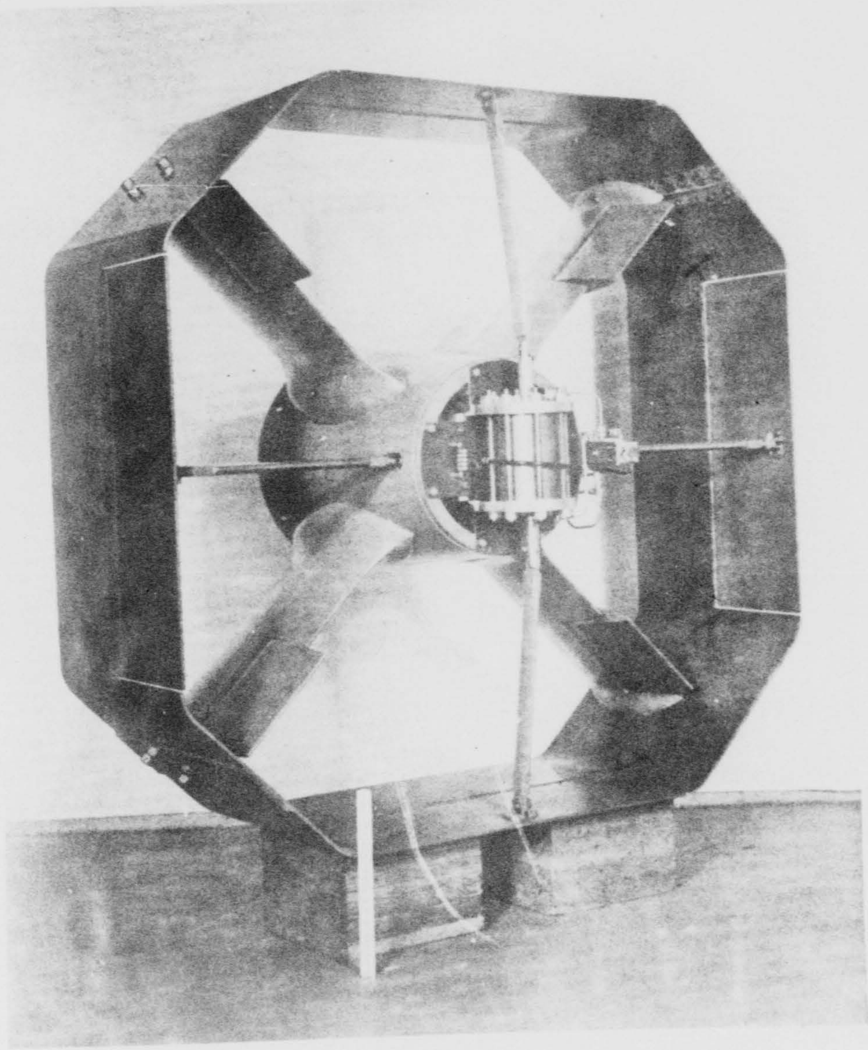

FIG. 5 - VB-13 TARZON CONTROL SHROUD SHOWING PNEUMATIC ACTUATORS

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14. GT-1 model in flying position

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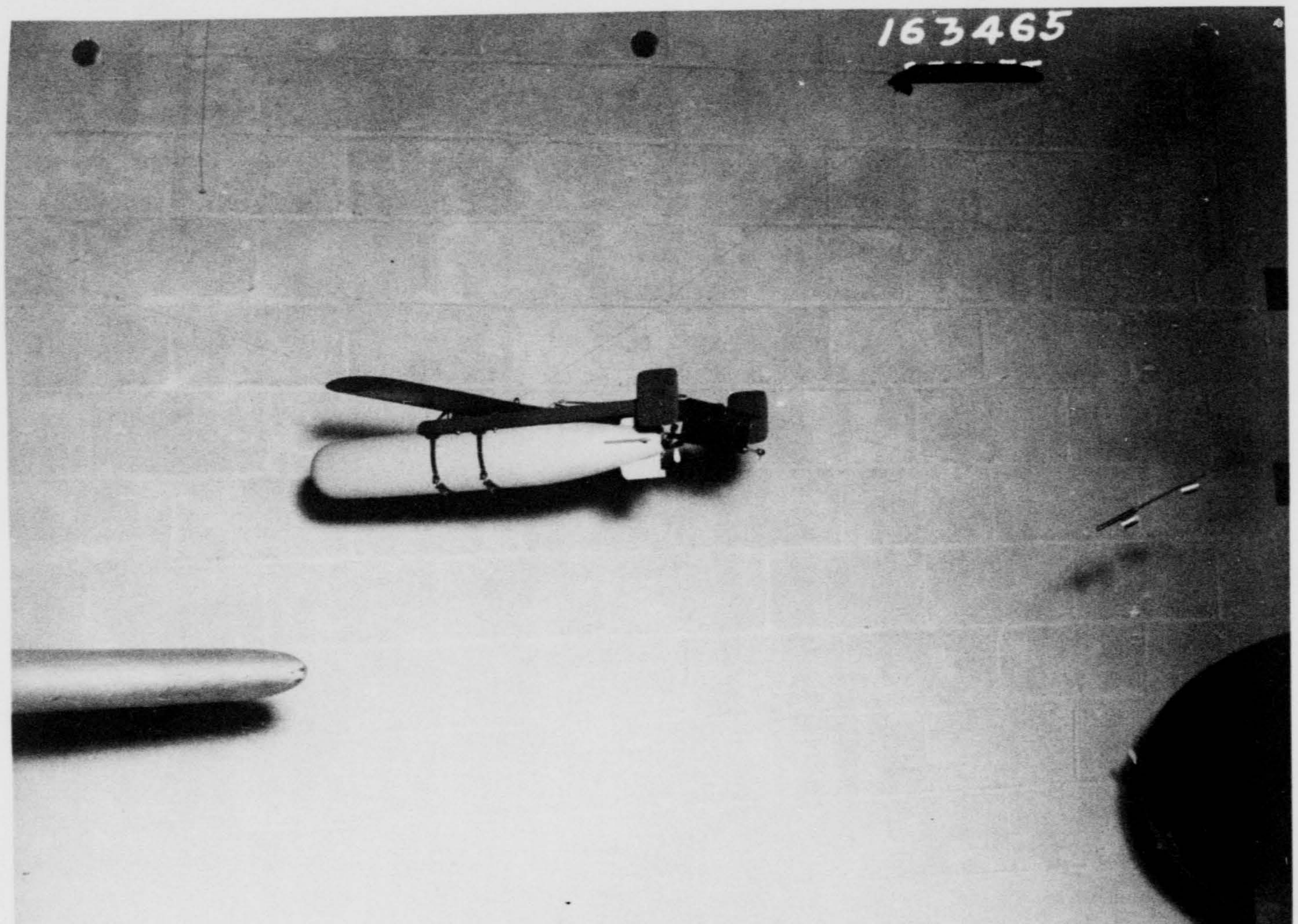

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15. GT-1

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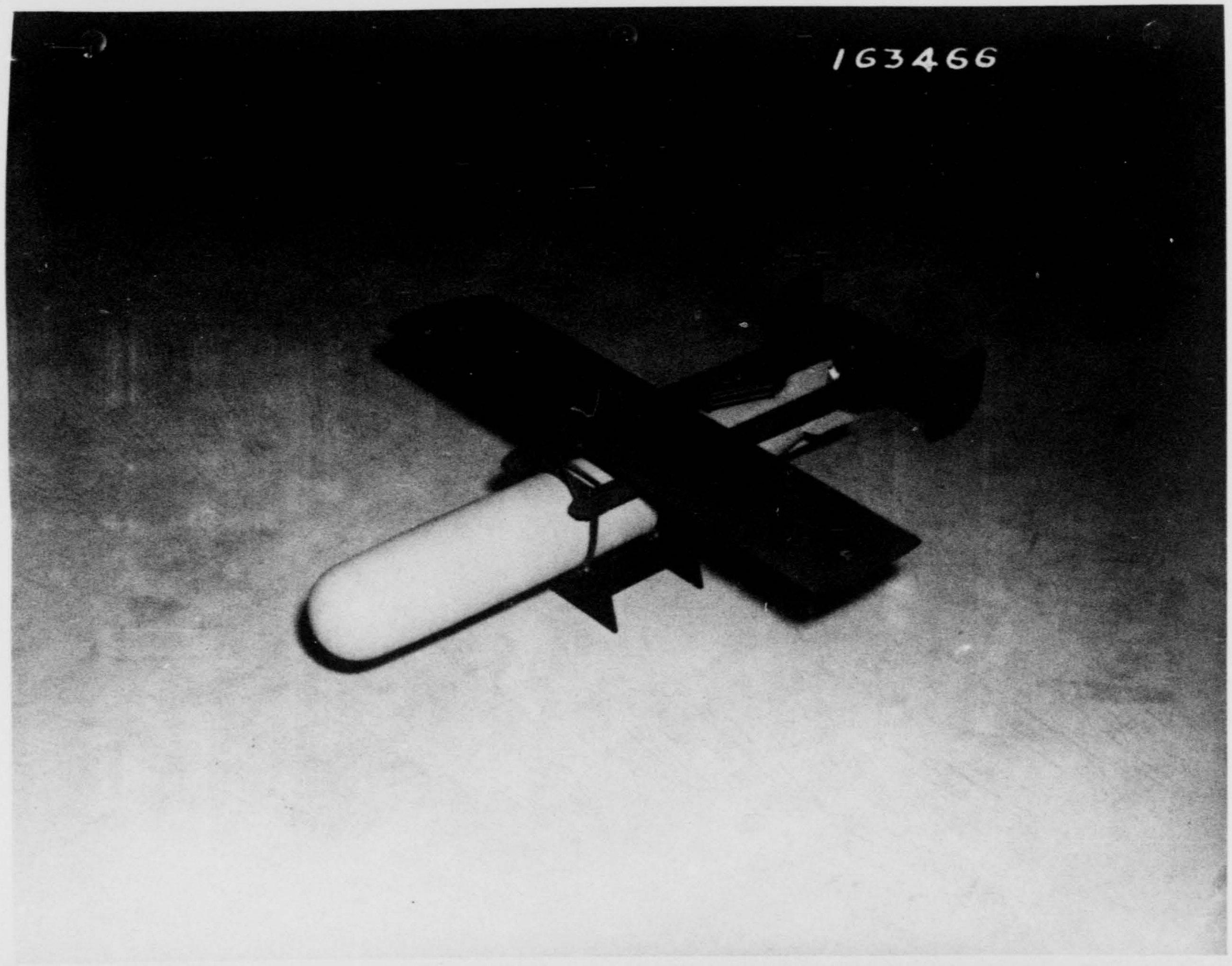

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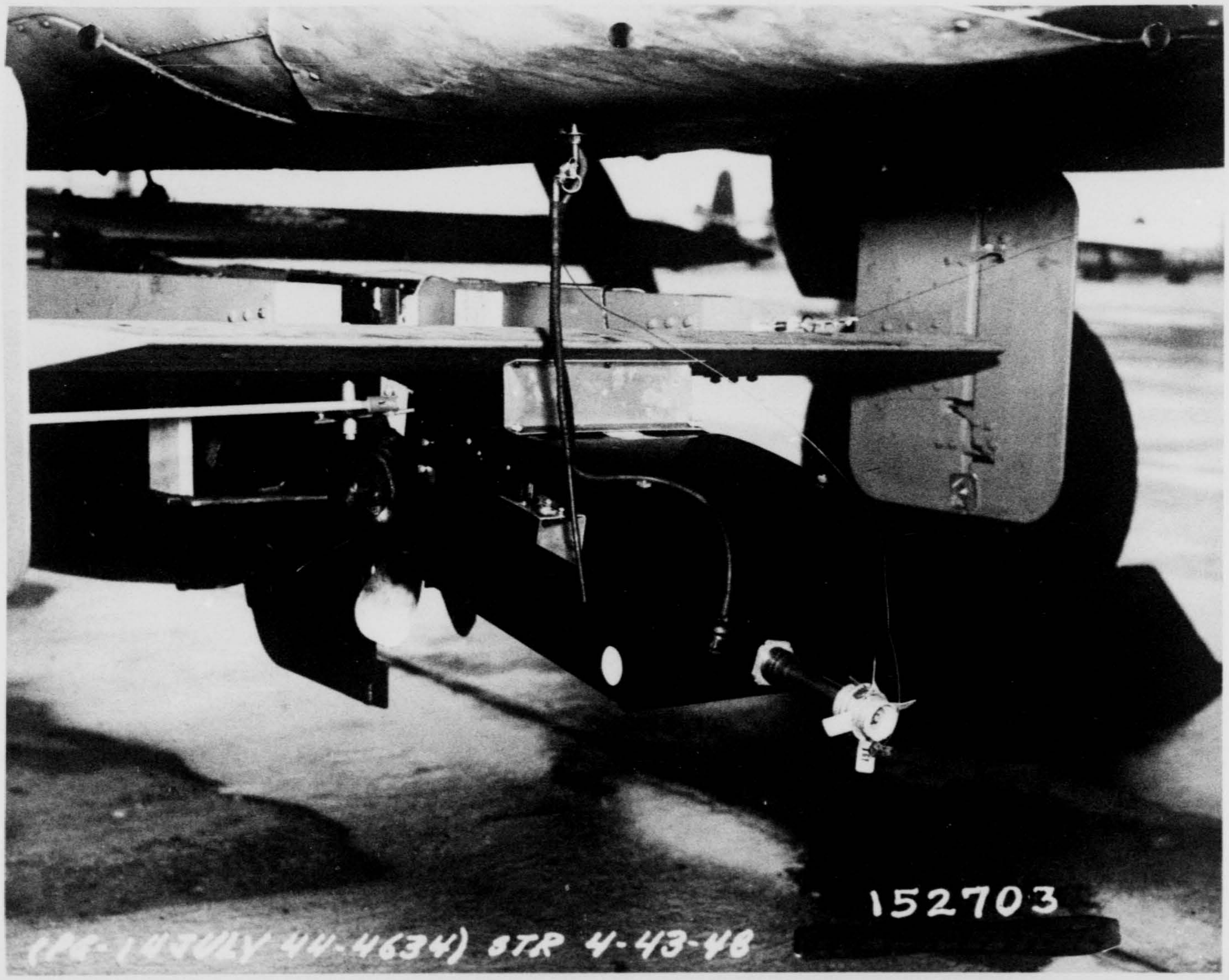
16. GB-1 servo installation in a B-25



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17. GB-1 dropped from a B-17

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18. GB-4

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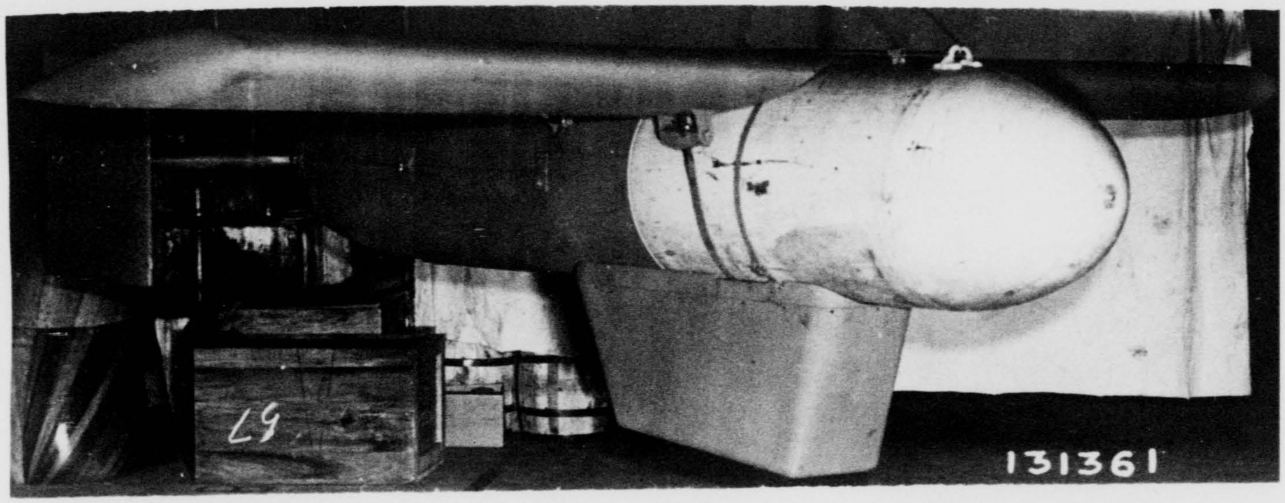

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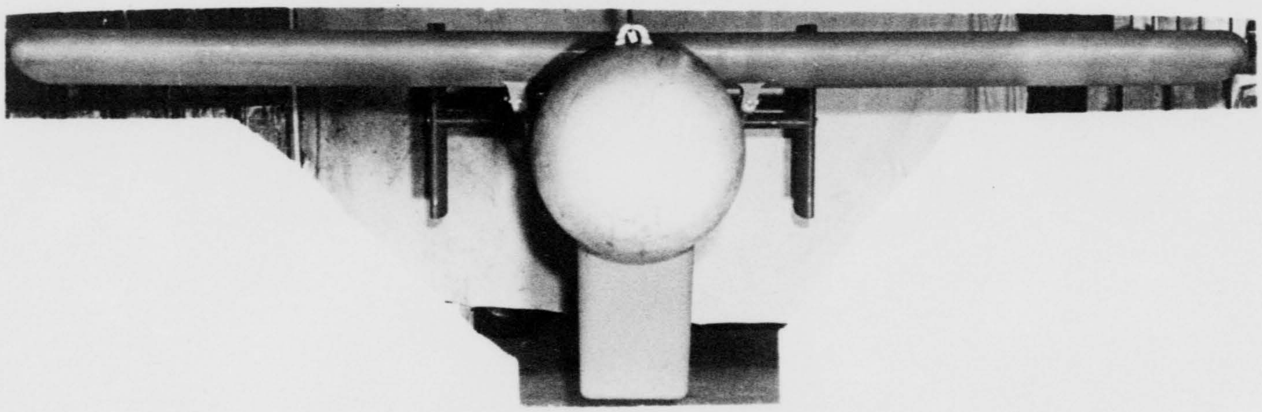
19. GB-4



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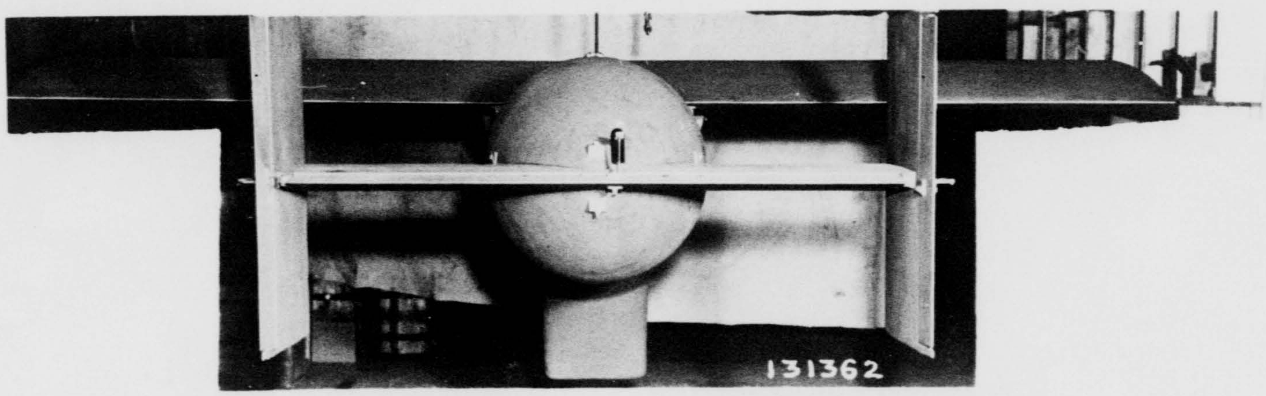

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21. GB-6

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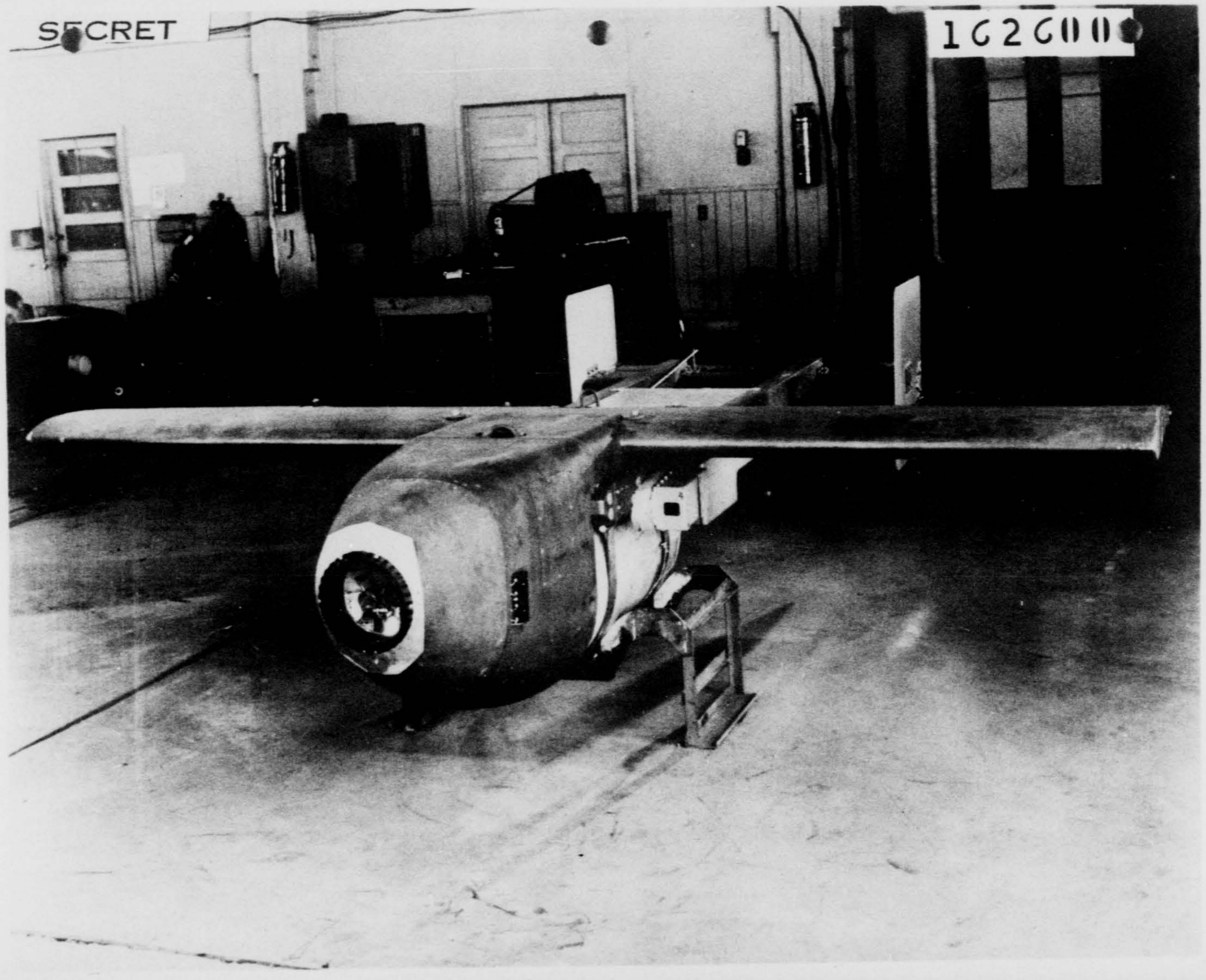
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22. GB-6

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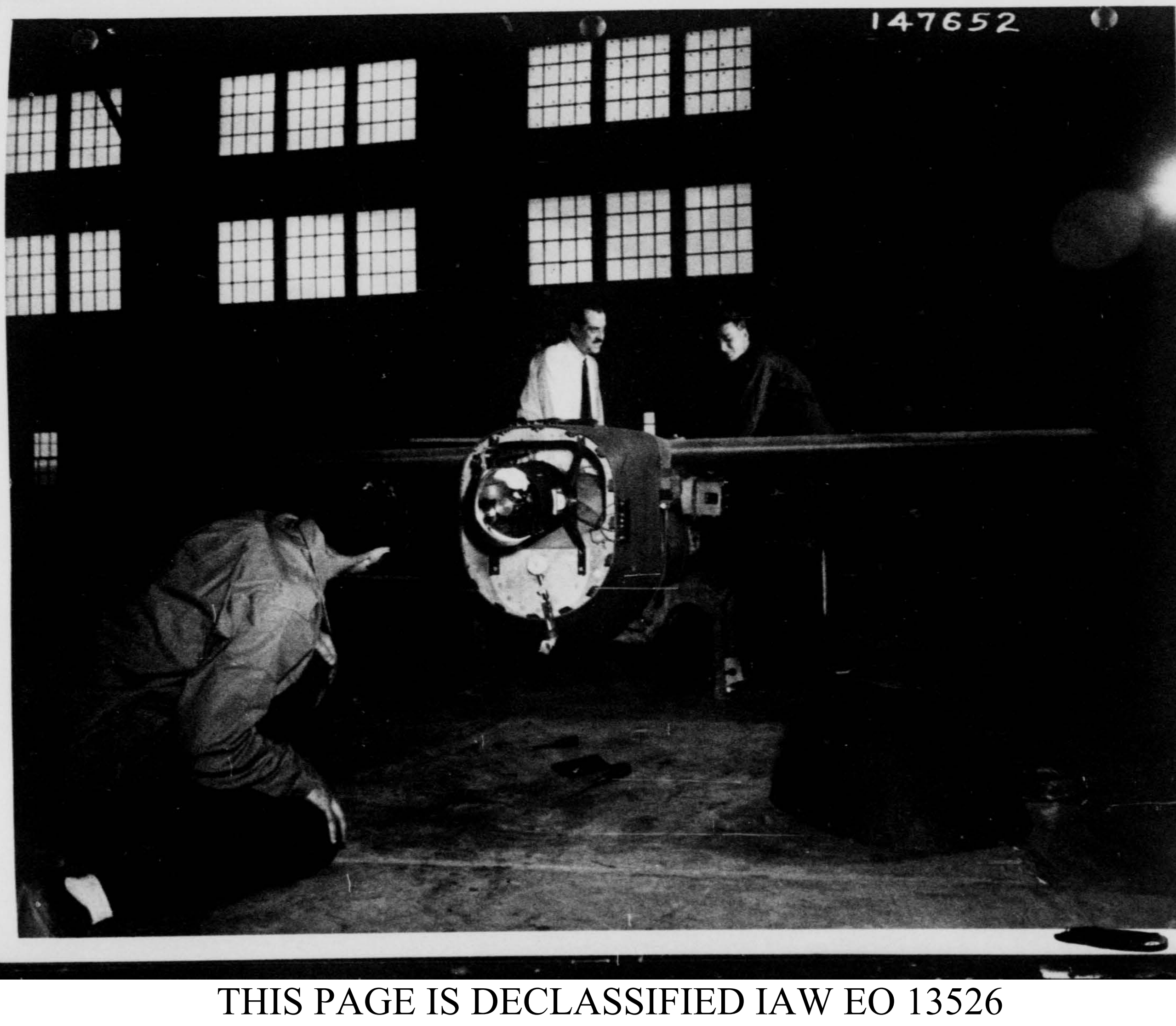

23. GB-7B radar seeking bomb
with SRB intelligence

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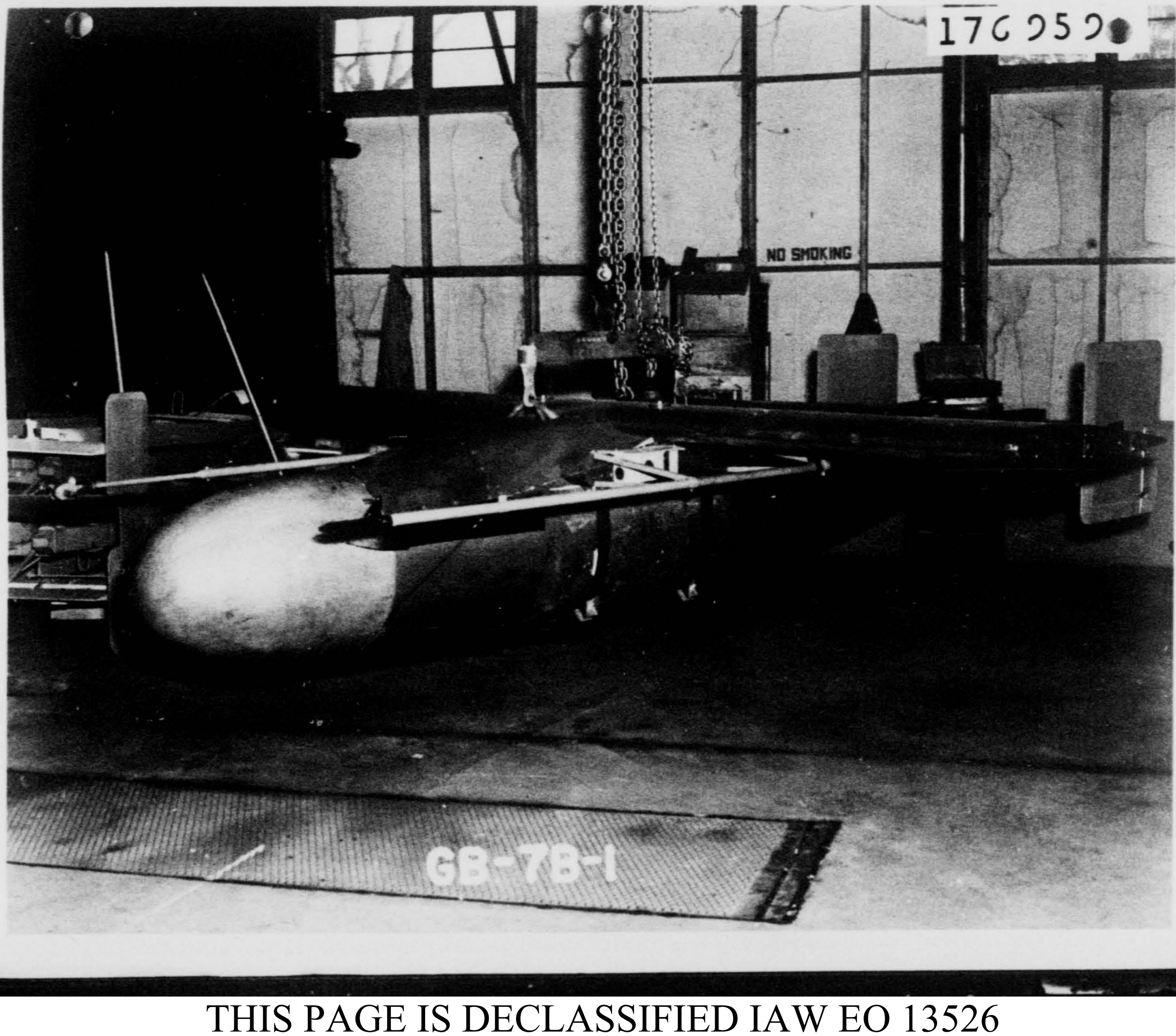

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24. GB-7B

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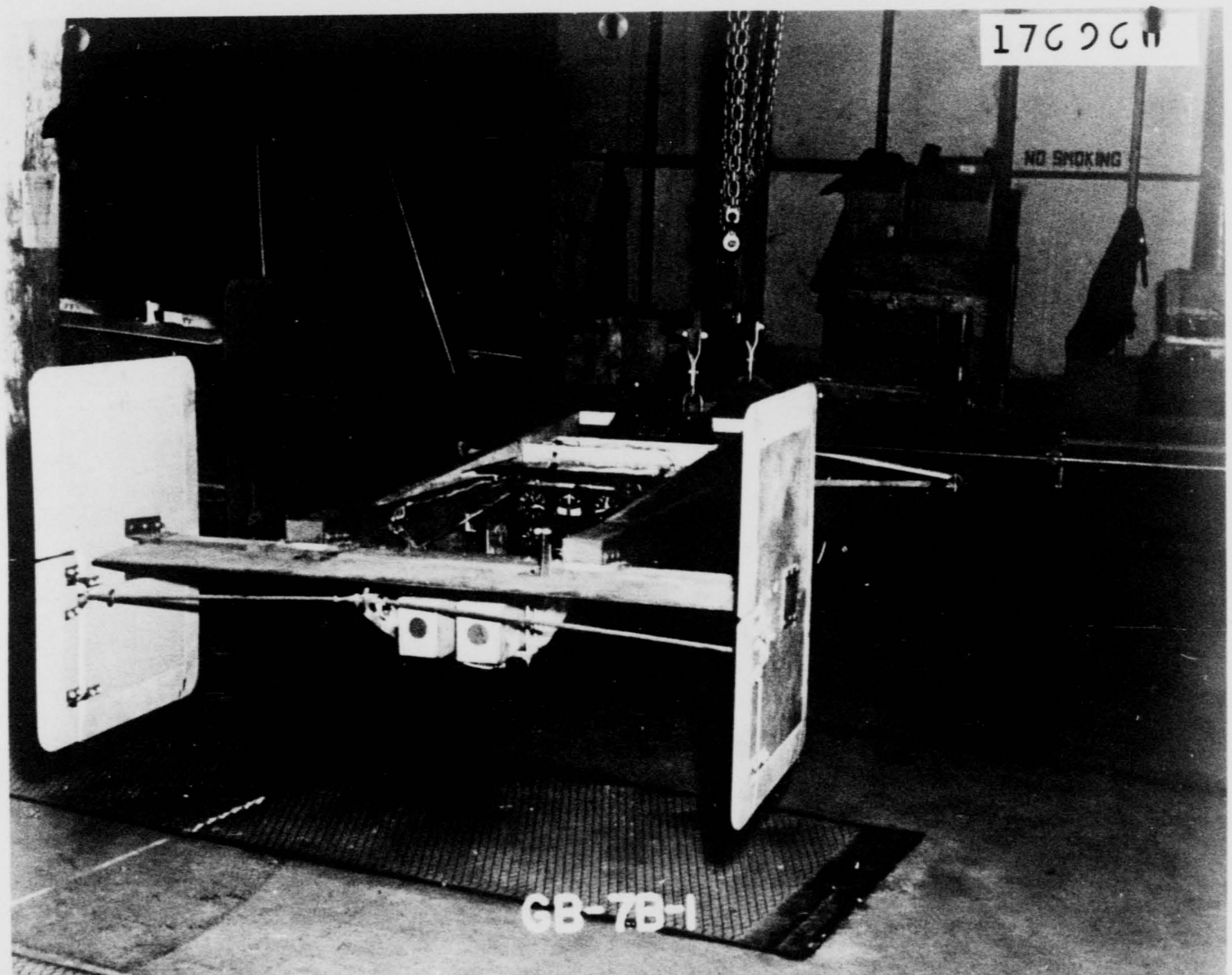
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NO SMOKING
GB-7B-1

25. GB-8

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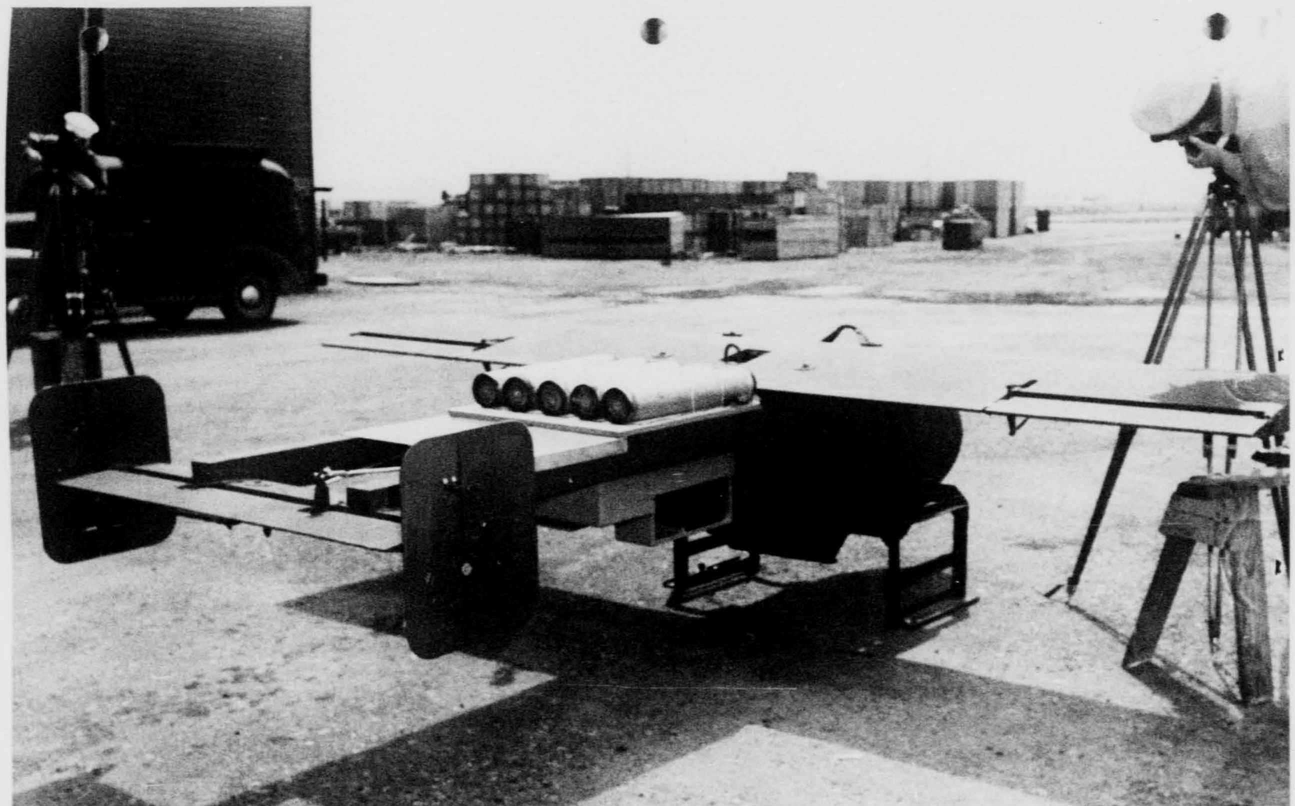

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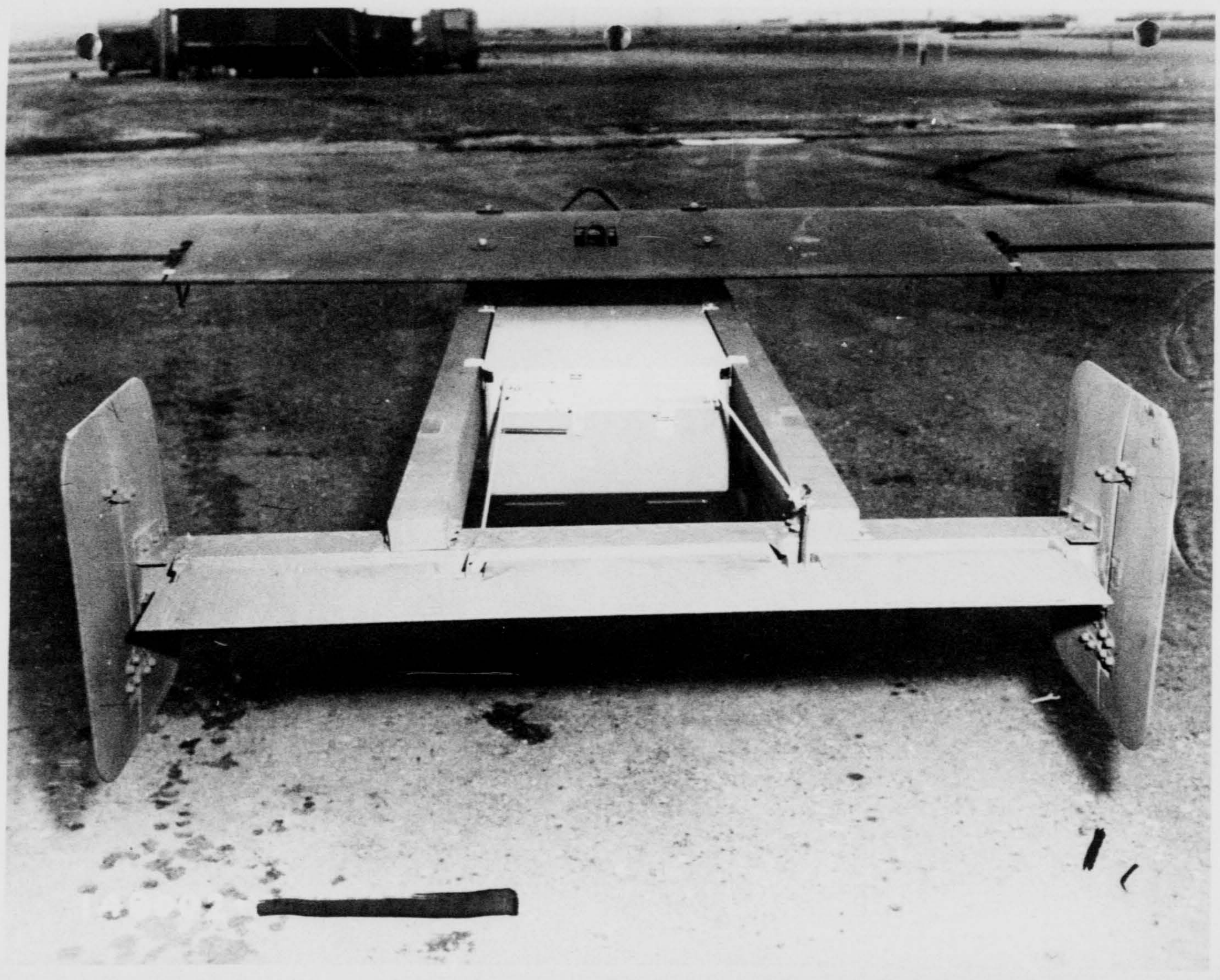
26. GB-8 - rear view without flares



27. GB-8

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28. GB-8 head

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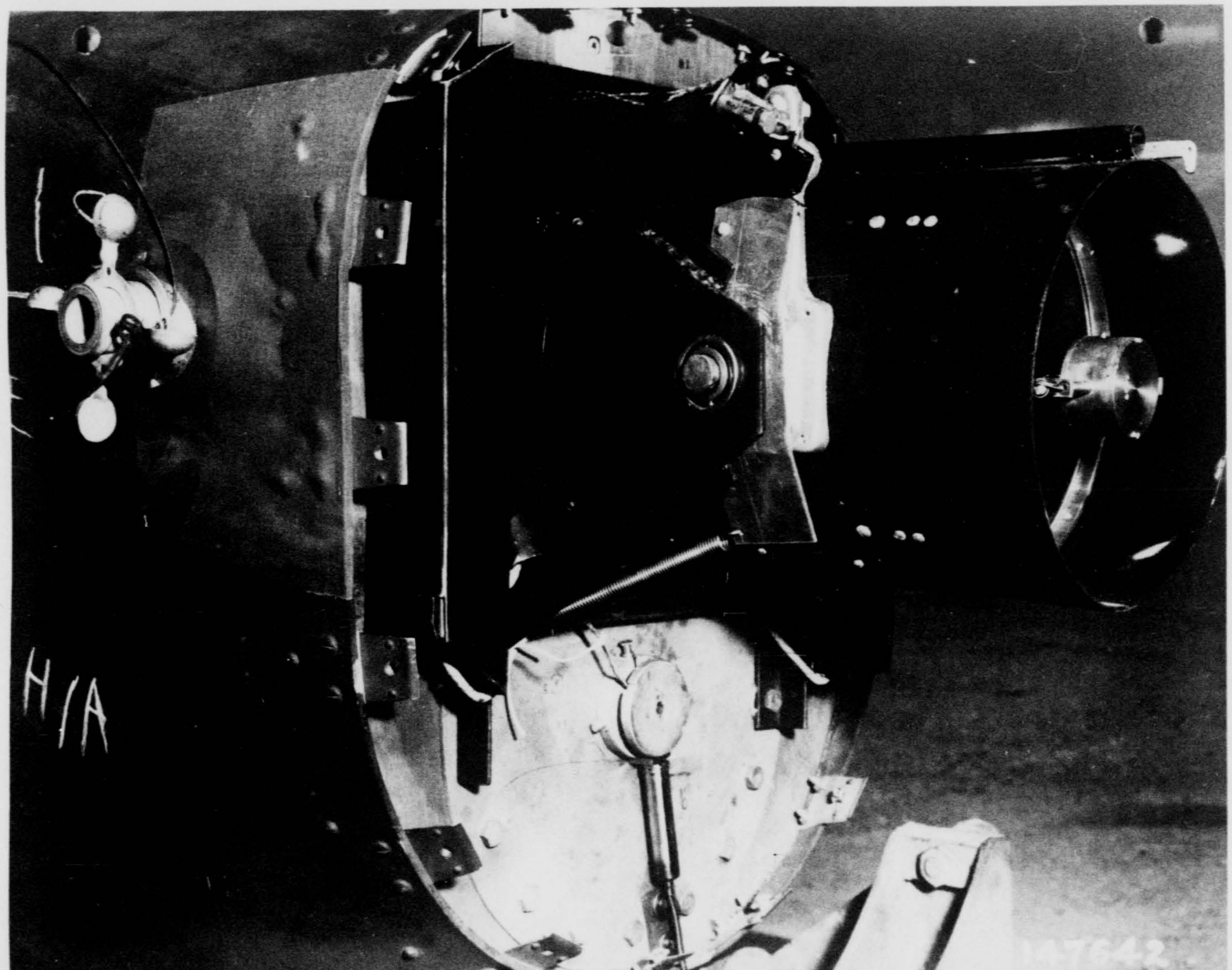
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29. GB-8 on a B-17 external rack

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30. GB-13

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31. GB-14

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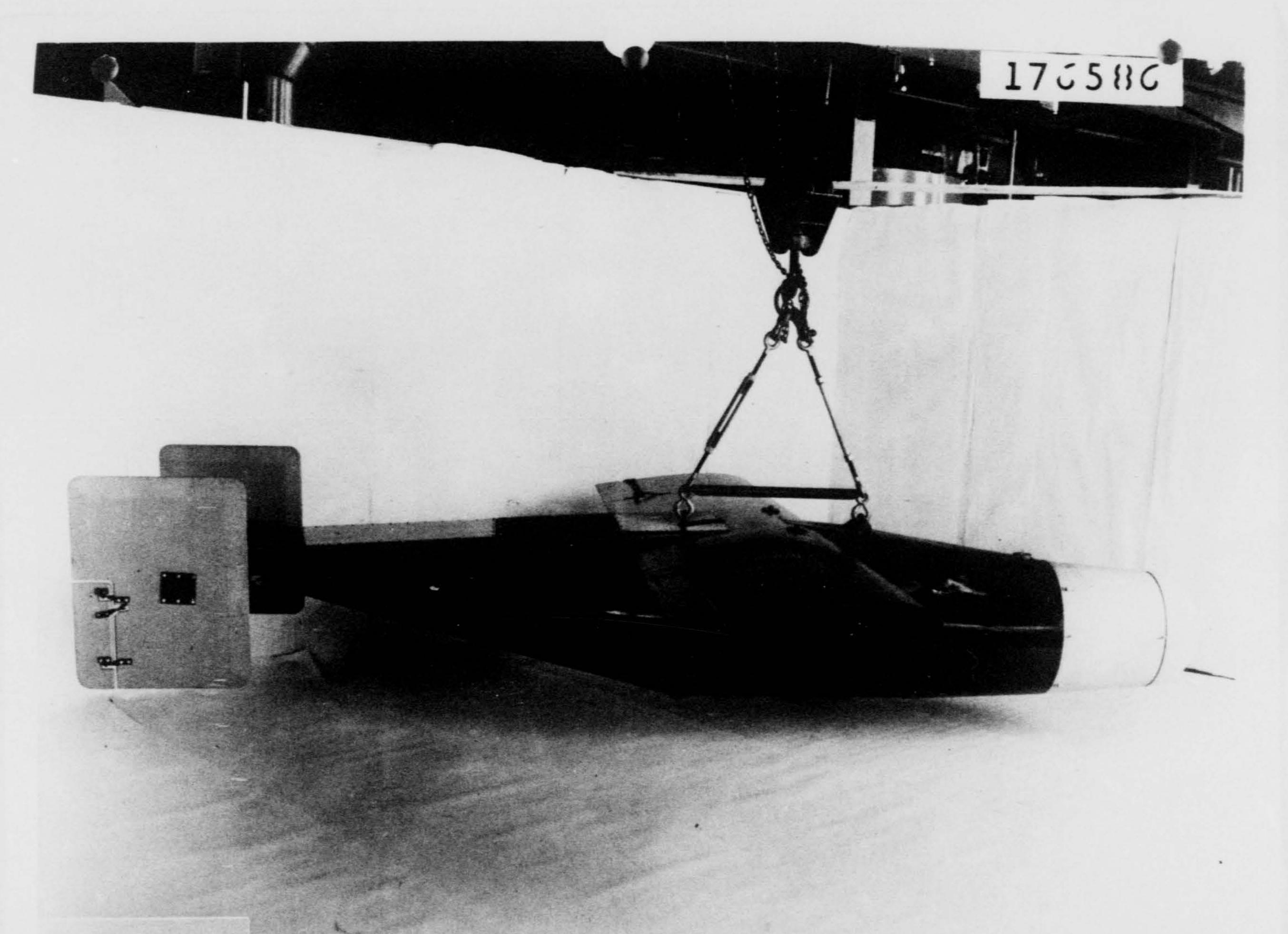

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32. GB-14

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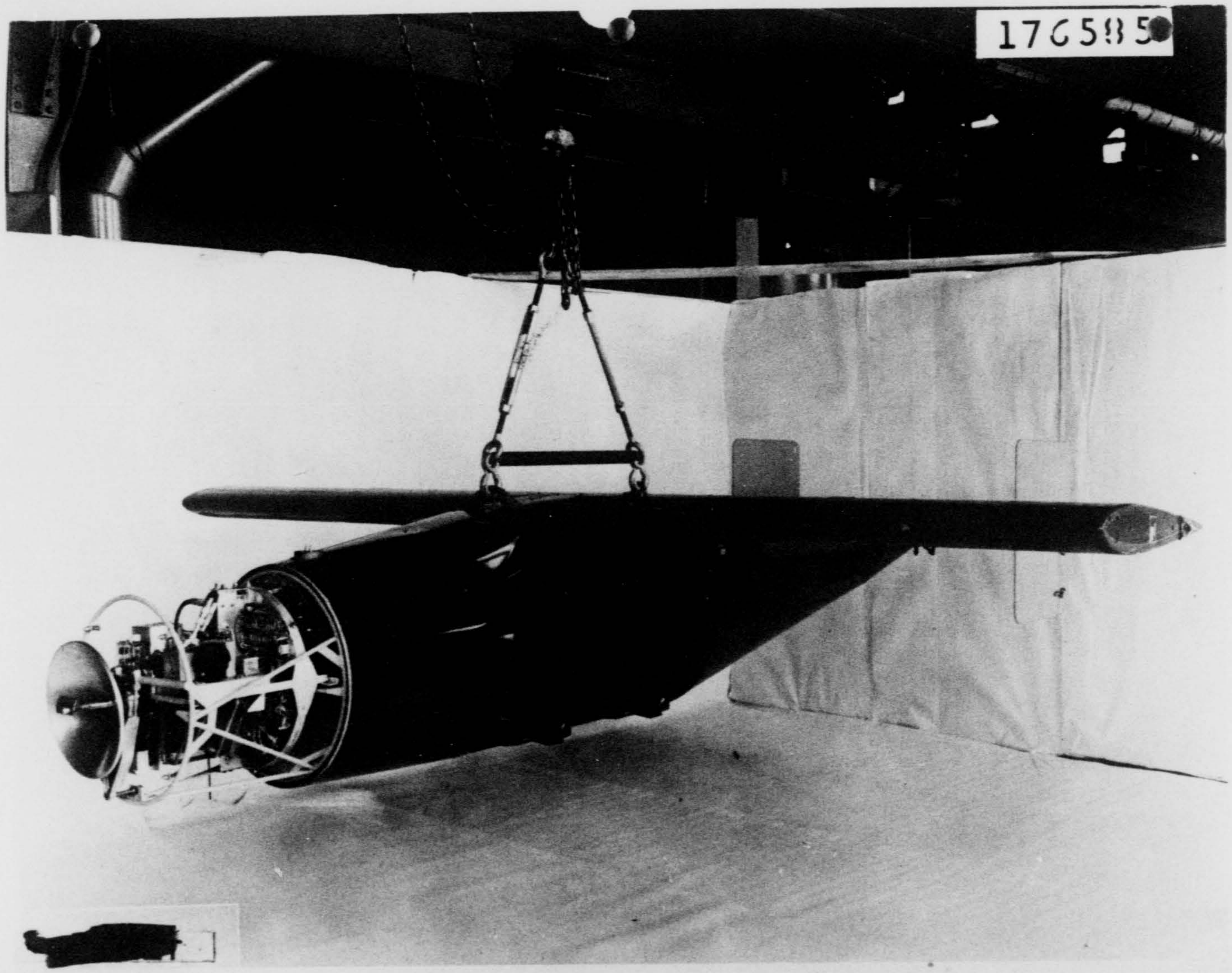

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33. Glide bomb approaching a target

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34. Outboard wing brace for
a glide bomb on a B-17F

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35. JB-1 on horizontal ramp

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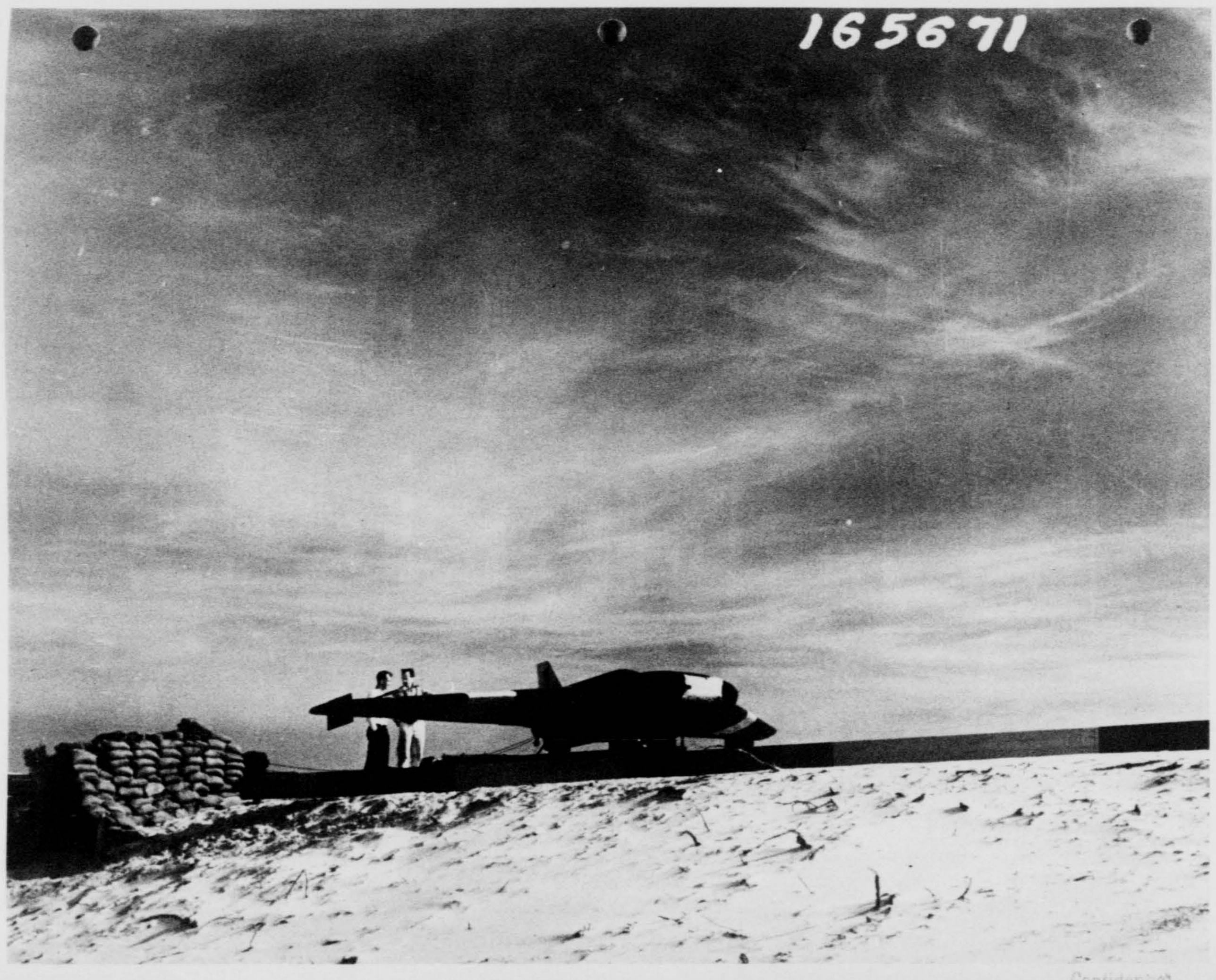
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36. JB-1 on launching ramp

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37. Parts of a German V-1 "Buzz Bomb"

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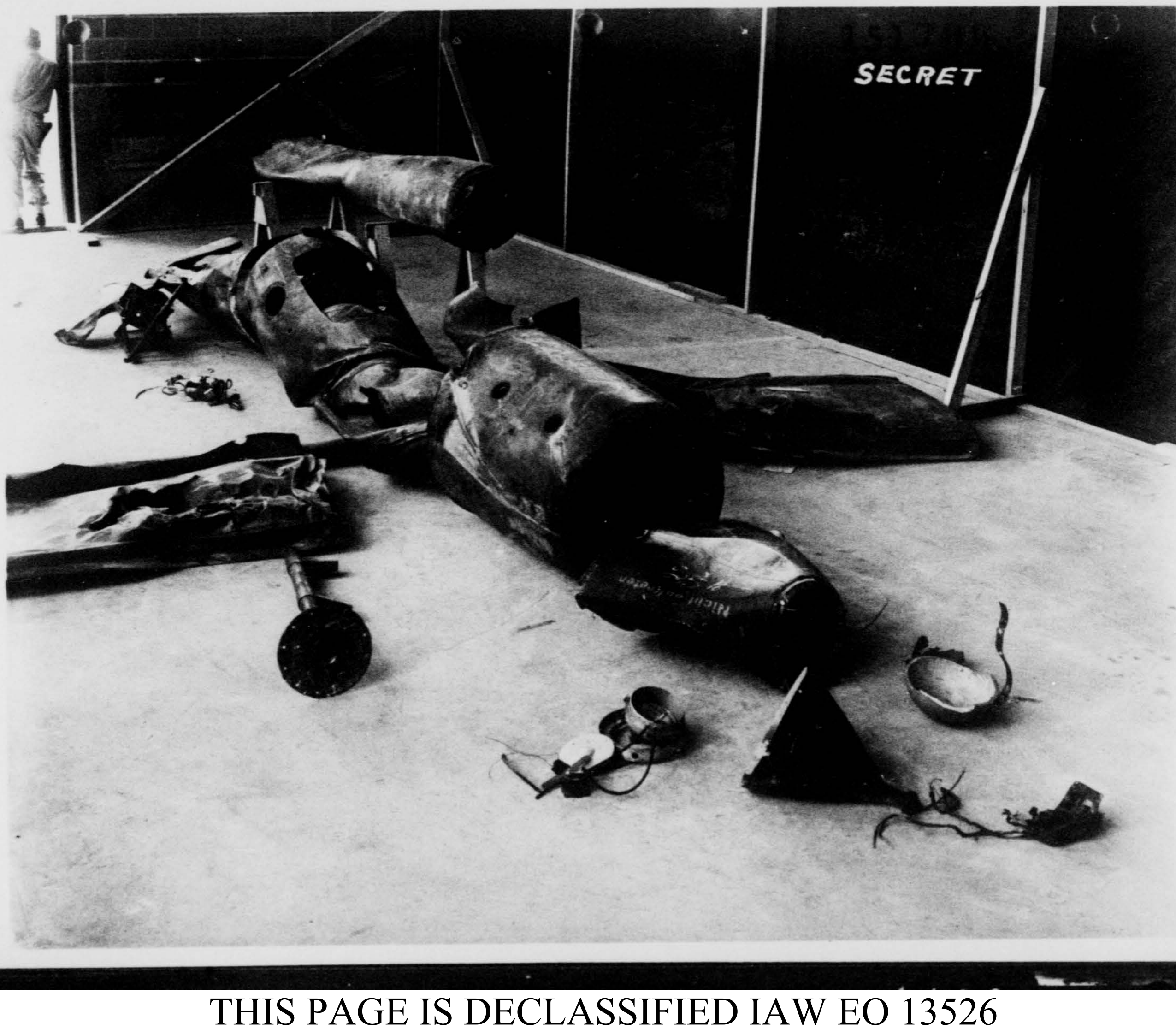
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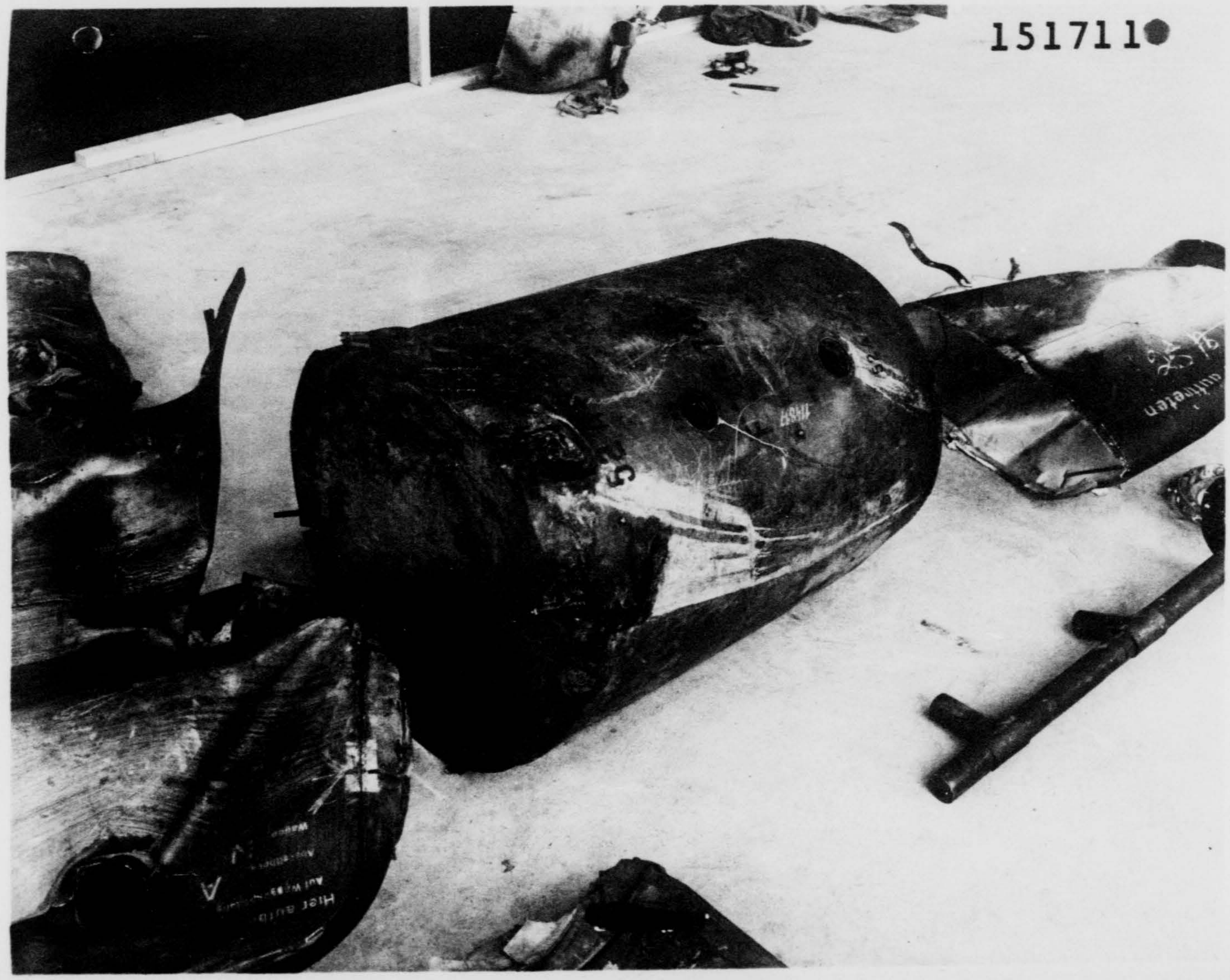
38. V-1 buzz bomb exploder
tube and warhead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39. JB-2's mounted on a B-17 airplane

40. Cutaway of JB-2

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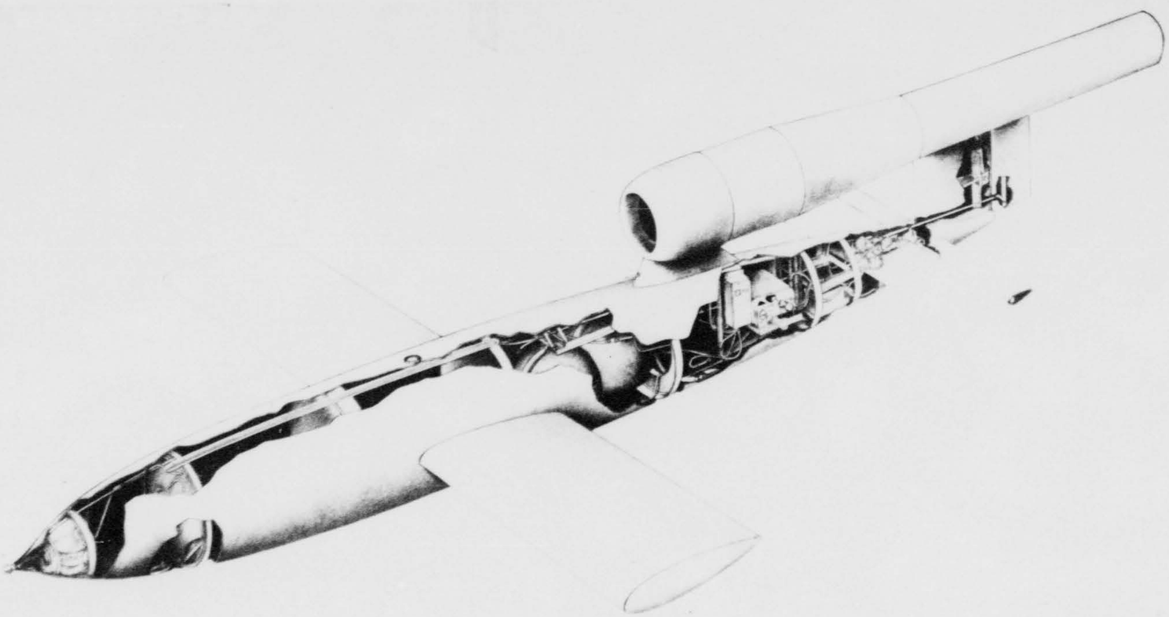
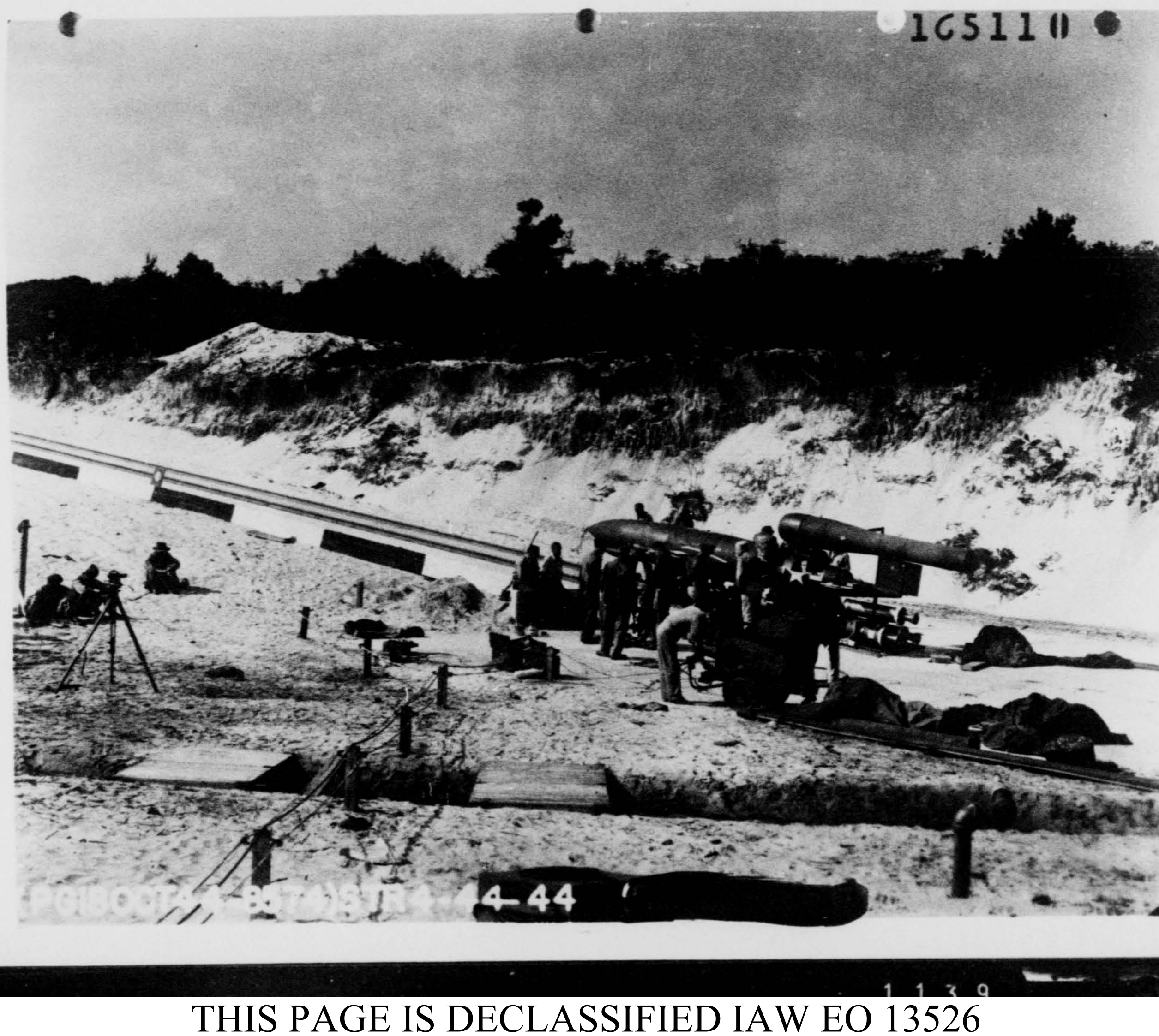


41. JB-2

42. JB-2 on launching ramp.
Distance scale on the left



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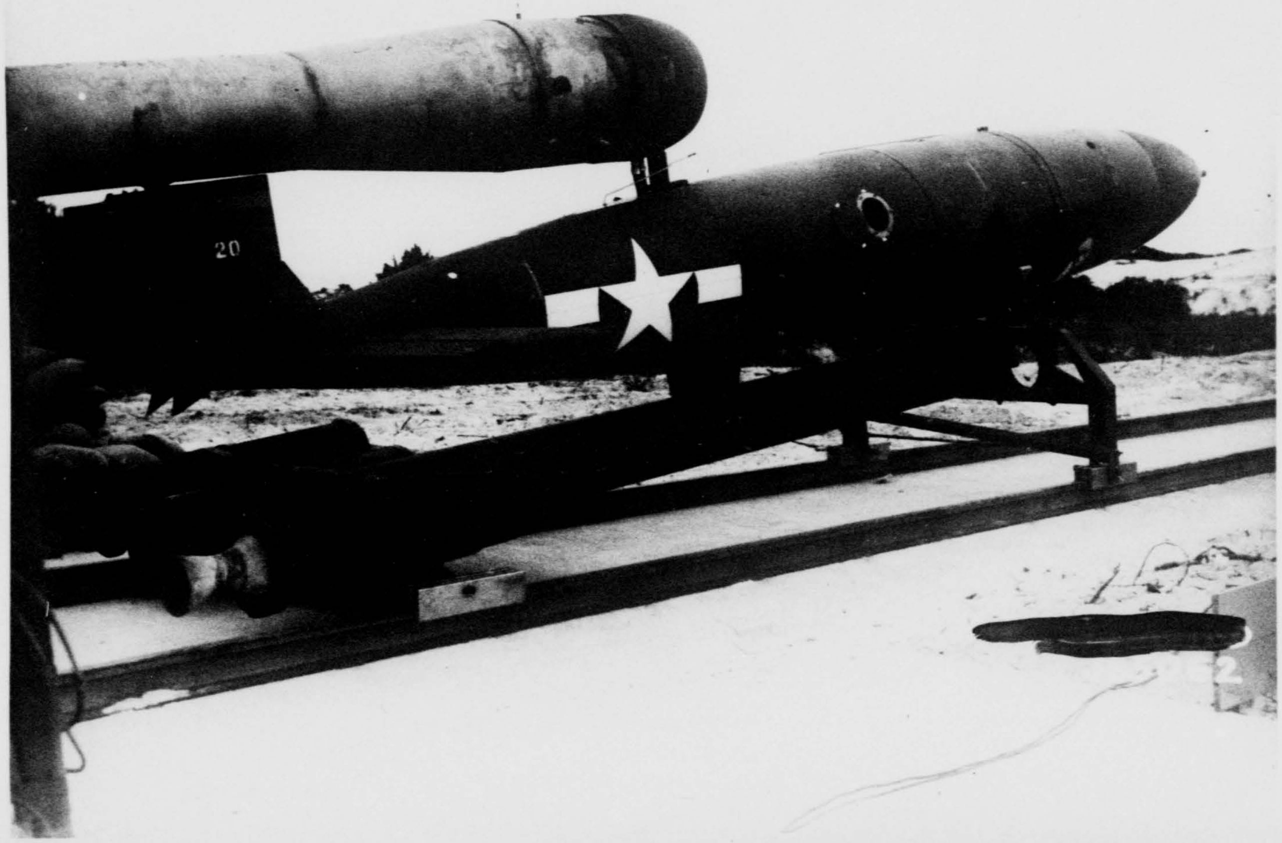
43. JB-2 at Eglin Field



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44. JB-2 at Eglin Field

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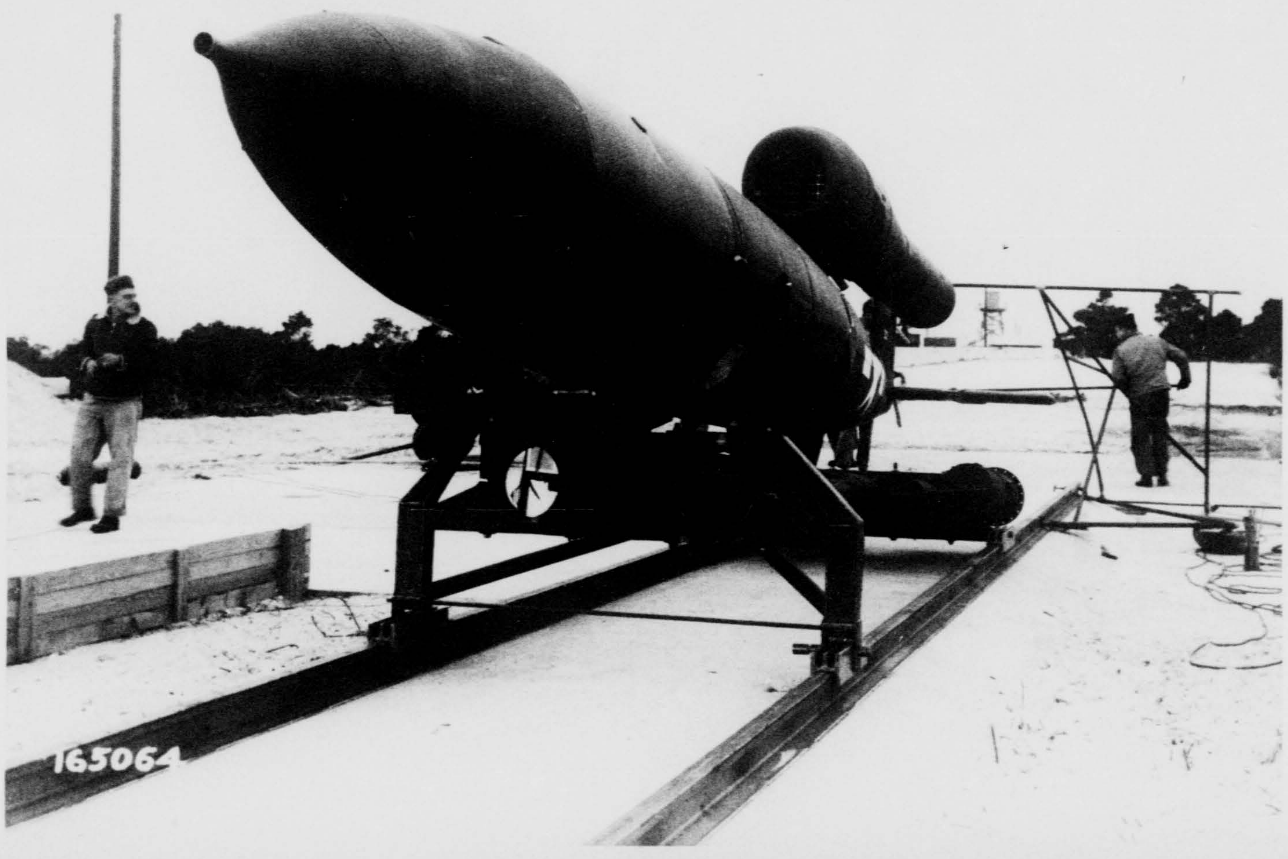

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45. JB-2 at Eglin Field

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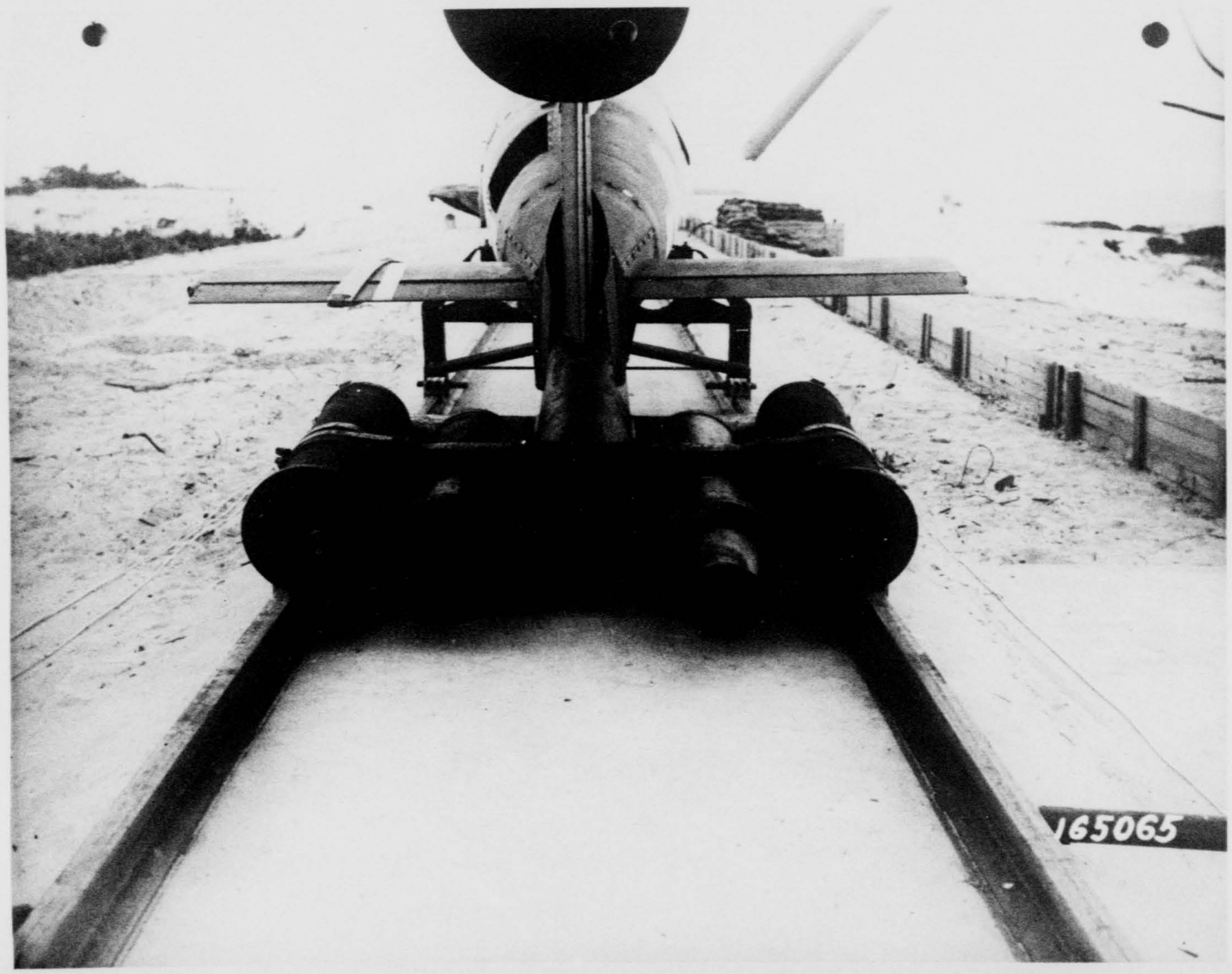

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46. JB-2 leaving ramp

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47. JB-3

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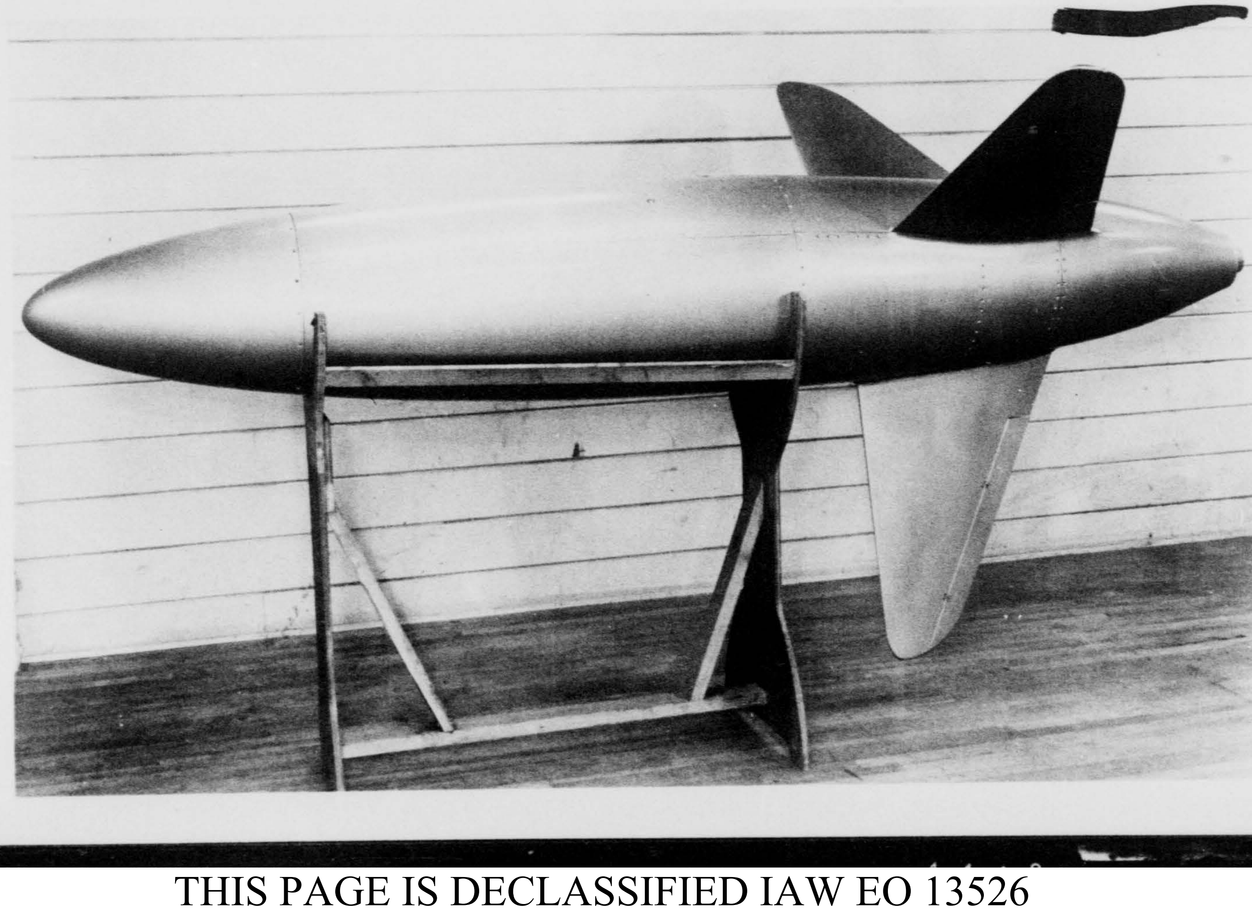

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48. JB-3

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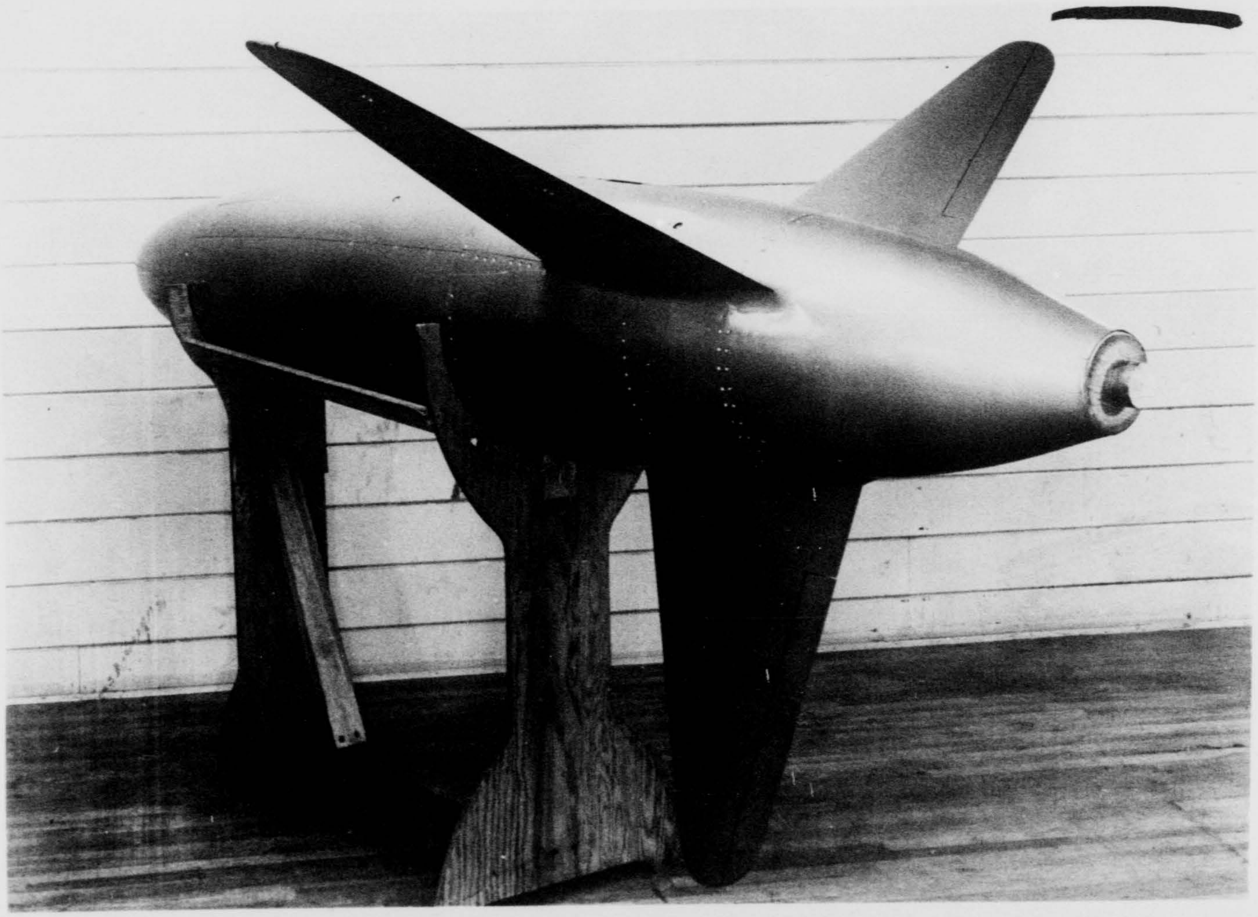

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49. JB-4

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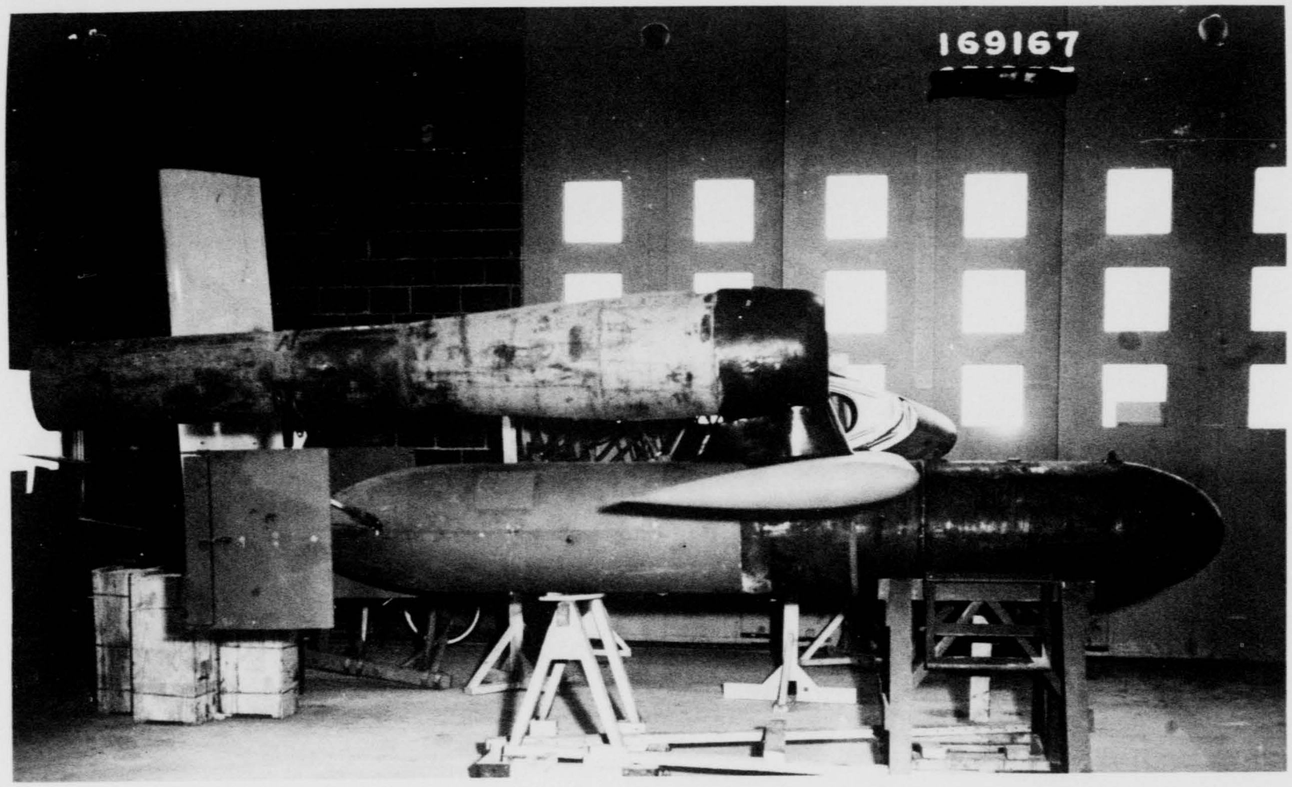

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50. JB-10

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51. JB-10

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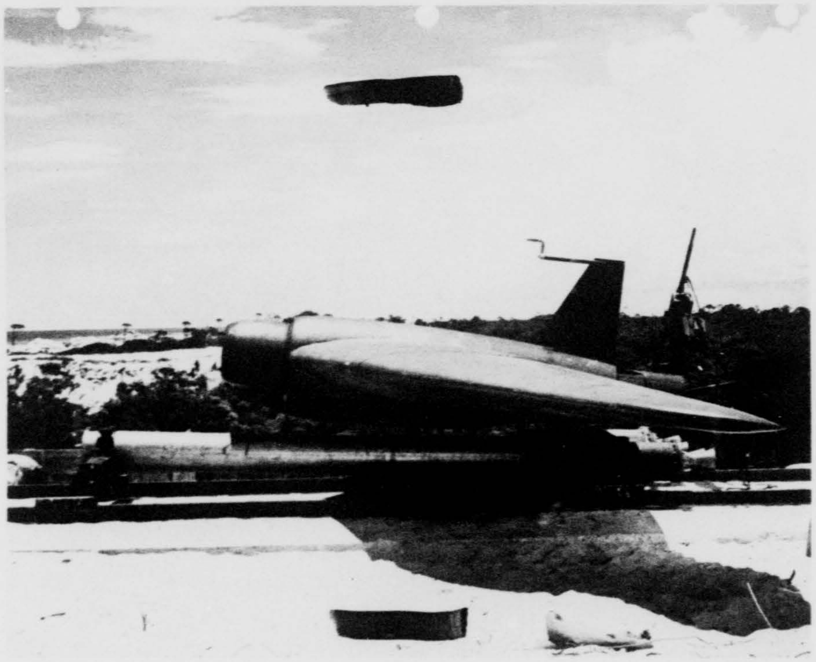

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Auth: C.G. AMC
Initials: CMT
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THE DEVELOPMENT OF GUIDED MISSILES

APPENDIX E

Pertinent Documents not Cited Specifically in the Text

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[redacted]

C.G. AMC
Cmt
14 June 1946

[redacted]

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Document No.	Date	Content
1	22 March 1939	Early history of Army and Navy radio controlled target airplanes.
2	26 June 1939	Status report of Air Corps power driven aerial targets projects.
3	5 June 1943	WF requested to make a study of countermeasures against special weapons.
4	13 July 1943	Army-Navy cooperation on radar operated target seeking devices.
5	3 Sept. 1943	Possibility of enemy use of guided missiles against our bomber formations. Possible countermeasures.
6	5 Nov. 1943	Army rocket program.
7	25 April 1944	Organization of the AAF rocket test unit at Dover, Delaware.
8	12 May 1944	WF collaboration with NDRC guided missiles program.
9	5 July 1944	Navy views on Offner target seeking devices. Differences of opinion among various bureaus.
10	7 July 1944	Guided missiles program planning. Important place should be accorded Materiel Command and AAF Proving Ground.
11	11 Aug. 1944	Memo by Dr. Edward Bowles concerning controlled and long range missiles. German weapons and countermeasures.
12	15 Sept. 1944	Description of German buzz bomb attacks on England.
13	18 Sept. 1944	Question of Army-Navy cooperation on NDRC-Polaroid Corporation infra-red seeker project.

[redacted]

[redacted]

14	6 Oct. 1944	Design and development of German V-1 bomb. Its construction, propulsion unit and controls described in detail.
15	11 Nov. 1944	Press release concerning AAF duplication of the V-1 robot bomb.
16	30 Nov. 1944	Army guided missiles program. Need expressed for closer liaison within the Army, a joint AAF-AGF testing range, and closer coordination of Army and Navy programs.
17	4 Dec. 1944	Policy on development and procurement of rocket propellant powder.
18	7 Dec. 1944	Recommends centralized procurement of guided missiles items by Aircraft Sub-Section, Glider and Miscellaneous Br. or a Guided Missiles Br.
19	9 Dec. 1944	Press release concerning buzz bomb construction at the Willys-Overland plant.
20	15 Dec. 1944	NACA facilities and program for guided missiles research.
21	28 Dec. 1944	Delineation of guided missiles responsibilities of AC/AS, OC&R and the Air Communications Officer.
22	21 Jan. 1945	Need for more expeditious transfer of AAF funds to OSRD.
23	5 Feb. 1945	Major command responsibility for operational use of guided missiles.
24	5 Feb. 1945	Responsibilities of the Chief Signal Officer concerning countermeasures for enemy guided missiles.
25	6 Feb. 1945	Major command responsibility for operational employment of guided missiles.
26	12 Feb. 1945	Continued need for more expeditious transfer of AAF funds to OSRD.
27	20 Feb. 1945	Delineation of responsibility concerning development of rocket propulsion devices.
28	28 Feb. 1945	AAF guided missiles program.

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29	16 March 1945	AAF & Navy guided missiles projects at Muroc, Wendover, Inyokern, and CIT.
30	30 March 1945	Problems involved in procurement of JB-2.
31	27 April 1945	Description of Japanese piloted suicide bomb.
32	5 May 1945	ASF-AAF rocket propulsion program.
33	11 May 1945	Chart on GB and VB projects.
34	15 May 1945	AAF surface to air missiles projects.
35	21 May 1945	Possibility of developing a rocket-propelled bomb similar to the Navy's Tiny Tim.
36	1 June 1945	Responsibility for the operational employment of guided missiles.
37	2 June 1945	Information on guided missiles committees.
38	13 June 1945	Delays in transfer of AAF funds to OSRD.
39	15 June 1945	German missiles. Proximity fuse development.
40	5 July 1945	Postwar rocket research.
41	7 July 1945	Use of controllable bombs.
42	14 July 1945	Status of development of control equipment for guided missiles.
43	14 July 1945	AAF-BuAer coordination on guided missiles research, development and production.
44	15 July 1945	Use of guided missiles for close support of ground troops.
45	15 July 1945	NDRC contracts and personnel which might be of interest to AAF.
46	9 Aug. 1945	Description of AC/AS-3 Guided Missiles Division.
47	11 Aug. 1945	AC/AS-3 Guided Missiles Division.
48	16 Aug. 1945	Countermeasures against German V-2 missiles.

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49	20 Aug. 1945	Ordnance missiles.
50	23 Aug. 1945	Countermeasures against guided missiles.
51	27 Aug. 1945	Division of Army responsibility on guided missiles research and development.
52	29 Aug. 1945	AAF policy for post-war air defense.
53	6 Sept. 1945	Extracts from President Truman's message.
54	6 Sept. 1945	The role of guided missiles in the future.
55	6 Sept. 1945	Facilities producing guided missile components.
56	12 Sept. 1945	Signal Corps program for defense against guided missiles.
57	15 Sept. 1945	Recommendation that AAF be sole responsible agency for future guided missiles program.
58	18 Sept. 1945	Need for AAF to formulate long term guided missiles program.
59	18 Sept. 1945	Five-year postwar research and development program for guided missiles.
60	20 Sept. 1945	Special Projects Branch, ACC.
61	21 Sept. 1945	Guided missiles of the German A-9 and A-10 type.
62	1 Oct. 1945	Report on the Ordcit program.
63	8 Oct. 1945	Peacetime development budget for the Army will not permit competitive guided missiles programs.
64	8 Oct. 1945	The AAF has the basic experience on guided missiles development.
65	9 Oct. 1945	Need for a firm plan for future guided missiles programs
66	15 Oct. 1945	Countermeasures against German V-2 missiles.
67	24 Oct. 1945	NACA five-year program for guided missiles research.
68	25 Oct. 1945	Recommended overall program for military research and development.
69	29 Oct. 1945	Controls for series of heavy bombs.

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70	2 Nov. 1945	British V-2 firing tests.
71	5 Nov. 1945	NACA views on an overall program of military research.
72	8 Nov. 1945	ASF guided missiles program.
73	16 Nov. 1945	Ordcit projects.
74	28 Nov. 1945	Navy BuAer and BuOrd guided missiles projects.
75	6 Dec. 1945	Need for adapting atomic warheads to pilotless aircraft.
76	11 Dec. 1945	Assignment of guided missiles launching system and warhead development to ASF.
77	26 Dec. 1945	Guided missile development. Need for quantity procurement.
78	4 Jan. 1946	Defense against V-2 type missiles.
79	4 Jan. 1946	German activities in the field of guided missiles.
80	9 Jan. 1946	Evaluation of radar for use in guided missiles countermeasures.
81	10 Jan. 1946	Summary of AAF pilotless aircraft program.
82	14 Jan. 1946	Difficulty encountered in effort to obtain a V-2 from Ordnance.
83	23 Jan. 1946	Request for allocation of a V-2 to the AAF.
84	23 Jan. 1946	Military characteristics of an air defense system.
85	24 Jan. 1946	Guidance and launching of supersonic missiles.
86	25 Jan. 1946	German research in supersonic flow.
87	29 Jan. 1946	British guided missiles projects.
88	31 Jan. 1946	ATSC analysis of guided missiles facilities (production and testing) and a proposed plan for the manufacture and use of guided missiles.
89	25 Feb. 1946	BuAer pilotless aircraft development program.

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90	March 1946	Research and development responsibility of War and Navy Departments in the field of guided missiles.
91	4 March 1946	Recommendations concerning War Dept. policy on research and development of guided missiles.
92	6 March 1946	Guided missiles progress. Recommendations for future organization of the program.
93	27 March 1946	Responsibilities for air defense.
94	2 Apr. 1946	Guided missiles in Arctic warfare.
95	4 Apr. 1946	Defense against guided missiles.
96	22 Jan. 1943	CTI-1138. Development and Design of Aerial Torpedoes.
97	11 Oct. 1943	CTI-1471. Test of glide bombs.
98	29 Oct. 1943	CTI-1350, Add. 1. High Angle Controllable Bomb in Azimuth.
99	20 Jan. 1944	CTI-1560. Ground Skimming Bomb Project.
100	20 March 1944	CTI-1641. Countermeasures Against Controllable Missiles.
101	17 June 1944	CTI-1350, Add. 5. Procurement of Azon Tails for 1000 lb. Bombs.
102	19 June 1944	CTI-1471, Add. 4. Simple Radio Controlled Glide Bomb.
103	26 July 1944	CTI-1788. Aeropulse Jet Propulsion Power Plant.
104	14 Aug. 1944	CTI-1350, Add. 7. Additional Procurement of Azon Tails.
105	21 Sept. 1944	CTI-1350, Add. 9. Cancellation of Azon Tails.
106	14 Oct. 1944	CTI-1563, Add. 2. Procurement of SRB (Bat) Units.
107	17 Oct. 1944	CTI-1796, Add. 1. Project Campbell.

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108	13 Nov. 1944	TI-2003. Ground to Air Remotely Controlled Missile.
109	13 Nov. 1944	TI-2003, Add. 1. Ground to Ground Remotely Controlled Missile.
110	13 Nov. 1944	TI-2003, Add. 2. Air to Ground Remotely Controlled Missile.
111	13 Nov. 1944	TI-2003, Add. 3. Air to Air Remotely Controlled Missile.
112	17 Nov. 1944	TI-2003, Add. 4. Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs.
113	4 Dec. 1944	TI-2003, Add. 6. Air to Ground Remotely Controlled Missile.
114	4 Dec. 1944	TI-2003, Add. 7. Medium Range Ground to Ground Remotely Controlled Missile.
115	3 Jan. 1945	TI-2196, Add. 1. Project Campbell.
116	10 Jan. 1945	TI-2003, Add. 10. Radar Homing Bomb.
117	2 March 1945	TI-2003, Add. 22. Procurement of VB-1 Azon Assemblies.
118	10 April 1945	TI-2003, Add. 25. Procurement of Radio Set AN/APW-1A for JB-2 Buzz Bomb Control.
119	25 April 1945	CTI-1802, Add. 3. Transfer of Procurement of Rocket Motors for JB-2 Guided Missiles to Ordnance.
120	8 May 1945	CTI-1802, Add. 4. Transfer of Procurement of Rocket Motors for JB-2 Guided Missiles to Ordnance.
121	18 May 1945	TI-2003, Add. 29. Procurement of VB-1 Azon Assemblies.
122	21 May 1945	TI-2224, Add. 1. Development of a Television Set for High Altitude Reconnaissance Rocket.
123	17 July 1945	TI-2003, Add. 41. Necessary Improvement in Accuracy and Consistent Performance of the JB-2.
124	24 July 1945	TI-2003, Add. 43. Modification of JB-2 Guided Missiles in Storage at the 829th Specialized Depot, Gadsden, Alabama.

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125	22 Aug. 1945	TI-2003, Add. 46. Procurement of VB-1 and VB-3 Assemblies.
126	12 Sept. 1945	TI-2196, Add. 13. Project Javaman.
127	12 Sept. 1945	TI-2003, Add. 50. Countermeasures Against Guided Missiles.
128	5 Oct. 1945	TI-2003, Add. 51. Guided Missiles of the German A-9 and A-10 Type.

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WAR DEPARTMENT
AIR CORPS
MATERIEL DIVISION
OFFICE OF THE CHIEF OF DIVISION

ADDRESS REPLY TO
CHIEF, MATERIEL DIVISION

452.1

WRIGHT FIELD, DAYTON, OHIO
March 22, 1939

REPORT TO THE OFFICE, CHIEF OF AIR CORPS

SUBJECT: RADIO CONTROLLED TARGET AIRPLANE

1. In compliance with verbal instructions from The Chief of the Air Corps, the following preliminary report is submitted. The formal engineering report covering a complete development program will be submitted at a later date. Included in this report are recommendations for a program for the immediate procurement of radio controlled target airplanes.

2. DISCUSSION: During the fiscal year 1937-1938, negotiations were entered into by the Air Corps with the Navy Department for the procurement of one radio controlled target airplane, one gound control equipment and one control airplane. In a letter to the Office, Chief of the Air Corps from the Bureau of Aeronautics, Navy Department, subject, "Radio Controlled Target Airplane," dated April 19, 1938, the estimated cost of the complete equipment, less the standard radio sets to be furnished by the Army, was $31,82[illegible].00. In this same letter it was estimated by the Navy Department that the then present radio controlled target airplane would be ready for active service test in the fleet by July 1, 1938. It was further believed by the Navy Department that the final form of the equipment would be so influenced by operating technique developed in the service test that it would prove beneficial and economical to the Army to await the results of those tests before initiating the conversion of equipment for a parallel project. In a letter to the Chief of the Bureau of Aeronautics, Navy Department, from the Office, Chief of the Air Corps, dated April 26, 1938, subject, "Radio Controlled Target Airplane," it was stated that in consideration of a statement contained in the above quoted letter from the Navy Department and with short time remaining for obligation of fiscal year 1938 funds the Air Corps concurred in the suggestions that this project await the results of Navy service tests. It was further requested that, at such time as the development promised immediate practical utility for anti-aircraft fire, the Navy Department would again afford the Air Corps an opportunity to procure the necessary equipment for Army test.

The Navy Department recently indicated that the equipment was now in a usable form and that anti-aircraft gunnery tests were to be conducted at Guantanamo Bay, Cuba. The Navy Department invited Air Corps personnel to witness these tests on March 16 and March 17, 1939, and further stated that should the operation and functioning of the radio controlled target airplane

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appear satisfactory to the Air Corps observers, the Navy Department would be agreeable to reopening negotiations with the Air Corps for the purpose of supplying the Air Corps with one of these complete equipments.

The Air Corps observers questioned the responsible Navy Department personnel regarding future improvements on this equipment with particular reference to the adaptation of the controlling equipment to an airplane equipped with the conventional type landing gear rather than with tricycle type gear now used on the target airplanes. The unanimous opinion of all Navy personnel connected with the design and use of these targets was that extreme difficulty will be experienced in controlling airplanes with the conventional type landing gear and that the immediate conversion of later type Navy airplanes to target airplanes would employ the tricycle landing gear. These Navy Department personnel further stated that, although a limited number of airplane targets using the conventional type landing gear had been built by the British, the percentage of casualties had been extremely high. The statements made by these Navy Department personnel are concurred in by the Air Corps observers. Experimental tests are being conducted, however, by the Navy Department with the hope of eventually obtaining a control system which will satisfactorily control a target airplane equipped with a conventional type landing gear.

Use of this target in actual gunnery practice has shown that trained control groups are essential. These groups consist of the pilots, trained in controlling and landing the target airplanes, the radio personnel and the airplane mechanics. It is understood that special control squadrons are to be set up by the Navy Department which will consist of two or three independent control groups. The present group consists of twenty-one men and officers and is considered the minimum that can operate independently.

The Fleet gunnery officer stated that the target airplane, although slow in speed, had been invaluable in their gunnery practice. This gunnery officer stated further that the practice on this type target had necessitated a complete change in Naval anti-aircraft gunnery technique and would influence a change in a large part of the gunnery equipment.

3. CONCLUSIONS: It is concluded that:

a. The present radio controlled target airplane as developed by the Navy Department functions in a satisfactory manner. Further, that, although the speed and service ceiling characteristics of this target are less than that desired, the target will fill a definite need in anti-aircraft gunnery practice until such time as radio controls can be adapted to airplanes which will meet the desired speed and service ceiling requirements. These conclusions are based on the observations made during the anti-aircraft gunnery practice conducted by the Navy Department at Guantanamo Bay.

b. Negotiations should be initiated by the Office, Chief of the Air Corps, with the Bureau of Aeronautics, Navy Department, for the immediate procurement of one radio controlled target airplane (N2C-2 type), one ground control equipment, and one control airplane (TG-2 type), less standard Signal Corps radio equipment to be furnished by the Air Corps.

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c. The following standard Signal Corps radio equipment should be allocated for this project:

(1) Three SCR Radio Sets plus two sets transmitting components only of the SCR 183 Radio Set and one set receiving components only of the SCR 183 Radio Set to be installed as follows:

(a) Airplane Target:- One SCR 183 Radio Set for communications purposes and one set receiving components only of the SCR 183 Radio Set for radio control purposes.

(b) Controlling Airplane:- One SCR 183 Radio Set for communications purposes and one set transmitting components only of the SCR 183 Radio Set for radio control purposes.

(c) Ground Control Station:- One SCR 183 Radio Set for communications purposes and one set transmitting components only of the SCR 183 Radio Set for radio control purposes.

(2) One light truck in which the ground control equipment will be installed.

d. A development program should be set up and funds allocated immediately by which standard Air Corps airplanes of an obsolescent character may be converted into radio controlled target airplanes. This should include the necessary auxiliary control equipment.

e. Necessary standard equipment needed for this project, such as radio equipment, airplanes and trucks, should be allocated to this project.

f. Necessary funds should be allocated to the Research and Development Section of the Signal Corps for the design and fabrication of the radio control equipment needed for this project.

g. Temporary engineering personnel consisting of at least one assistant engineer and three machinists should be employed and assigned to this project in order that its completion to a satisfactory article may be expedited.

h. An expression of the importance placed on this project should be made by The Chief of Air Corps in order that proper priority may be assigned to it by the Materiel Division.

4. RECOMMENDATIONS: It is recommended that:

a. Negotiations be initiated by the Office, Chief of the Air Corps with the Navy Department for the immediate purchase of one radio controlled target airplane (N2C-2 type), one ground control equipment, and one control airplane (Tg-2 type), less standard Signal Corps radio equipment to be furnished by the Air Corps. The estimated cost is itemized below:

[redacted]

[redacted]

Cost of modifying Army furnished radio equipment and installing in N[illegible]C-2 type airplane - - - - - - - - $[illegible],196.[illegible]

Cost of mechanical modifications to N[illegible]C-2 type airplane, including $5,000 for overhaul - - - - - - 14,5[illegible].00

Cost of modifying Army furnished radio equipment and installation in T[illegible]-2 type airplane - - - - - - - 2,[illegible].00

Cost of mechanical modifications to T[illegible]-2 type airplane, including $8,000 for overhaul - - - - - - 9,5[illegible]

Cost of field control set, using Army furnished radio equipment - - - - - - - - - - - - - - - - - - - 2,[illegible]

GRAND TOTAL - - - $31,[illegible]

These estimates are based on the proposal submitted by the Navy Department in April, 1936. The present cost may be somewhat less as the Navy Department has indicated that there would now be no charge to the Air Corps for the obsolescent Navy airplanes used.

b. Three SCR Radio Sets plus two sets transmitting components only of the SCR 183 Radio Set and one set receiving components only of the SCR 183 Radio Set be allocated for use on these Navy equipments and furnished the Navy Department for modification and installation as outlined in Paragraph 3c(1).

c. One light truck, in which the ground control equipment is to be installed, be furnished the Navy Department for this installation.

d. Complete drawings of the Navy Target Airplane, Controlling Airplane and Ground Control Station be obtained at the earliest possible date from the Navy Department and furnished the Materiel Division.

e. Funds be allocated and a development program be initiated by which obsolescent Air Corps airplanes may be converted into radio controlled target airplanes. The Government equipment needed for the initial stages of this project are listed below:

(1) Four BT-2 type airplanes, two to be used for control airplanes and two to be used as target airplanes.

(2) One light truck in which the ground control equipment will be installed.

(3) Five SCR 183 Radio Sets plus three sets transmitting component only of the SCR 183 Radio Set and two sets receiving component only of the SCR 183 Radio Set to be installed as follows:

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(a) In each of the two Airplane Targets:- One SCR 183 Radio Set for communications purposes and one set receiving component only of the SCR 183 Radio Set for radio control purposes.

(b) In each of the two Control Airplanes:- One SCR 183 Radio Set for communications purposes and one set transmitting component only of the SCR 183 Radio Set for radio control purposes.

(c) In the one Ground Control Equipment:- One SCR 183 Radio Set for communications purposes and one set transmitting component only of the SCR 183 Radio Set for radio control purposes.

[illegible]. Funds in the amount of $[illegible] be allocated for the purpose of design and fabrication the radio and control equipment, the modification of [illegible] type airplane to a target airplane, and the preparation of necessary [illegible] of the above equipment. An estimate of the cost analysis is given below:

(1) Modification of two [illegible] airplanes to target airplanes to include the installation of a [illegible] tricycle landing gear, hydraulic control system and changes in flight characteristics, such as dihedral and tail surface changes -$30,000.00

(2) Design and fabrication of mechanical control equipment for these two target airplanes - - - - - 10,000.00

(3) Allocation to the Research and Development Section of the Signal Corps for the design and fabrication of necessary radio control equipment - - - - - - - - - - - - - - - - - - - 10,000.00

GRAND TOTAL - - - - -$50,000.00

These estimates are based on information received from the Navy Department on the cost of [illegible] radio control equipment to any type of airplane for which these controls have not been previously designed and fabricated.

g. Necessary engineering personnel, as outlined in Paragraph 3g, be employed temporarily and assigned to this project.

h. The desired priority to be given this project be expressed by The Chief of the Air Corps.

G. V. Holloman

G. V. HOLLOMAN,
Captain, Air Corps.

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WAR DEPARTMENT
AIR CORPS
MATERIEL DIVISION
WRIGHT FIELD, DAYTON, OHIO

ENGINEERING SECTION MEMORANDUM REPORT GvH/hc
ON
Status Report on Aerial Targets,
Power Driven.

P. P. Contract No. ____________ Date June 26, 1939.

Expenditure Order ____________ Serial No. I-54-1410

1. Object

To report on the status of the Aerial Target, Power Driven, project as of this date.

2. Discussion:

a. This report is submitted giving the status of the Aerial Target, Power Driven project as of this date. There are four (4) types of targets covered under this one project and the status of each will be treated separately.

b. (1) Aerial Targets, Power Driven, Type A-1 - Two each targets of this type have been purchased from the following Companies:

(a) Fleetwings Inc.
(b) Vega Airplane Co.
(c) DeSoto Airplane Co.

(2) These targets have a wing span of 20 ft. and are non man-carrying. Ground control equipment only is provided. The delivery dates are as follows:

By G. V. Holloman, Capt., Air Corps

Approved,

James A. Woodruff, Major, AirCorps
Acting Chief, Equipment Branch

F. O. Carroll, Major, Air Corps
Chief, Exp. Engineering Section.

Distribution:
cy Chief, Exp; Engrs.
___ Chief, Procurement Section
____________ Branch
____________ Branch
____________ Branch
cy. A. R. L.

______ Recommendations
______ Record Only
______ As Amended

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PROJECT NO. M-34-39

FILE
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(a) Fleetwings Inc. - 1st article February 17, 1940
2nd " April 17, 1940

(b) Vega Airplane Co. - 1st & 2nd articles Sept. 20, 1939

(c) DeSoto Airplane Co. - 1st article August 21, 1939
2nd " October 21, 1939

It is believed the dates given in (2) (b) and (c) above are somewhat optimistic.

c. Aerial Targets, Power Driven, Type A-2

(1) These targets have a wing span of 12' and are non man-carrying. Ground control equipment only is provided. The three (3) targets purchased were manufactured by the Reginald Denny Industries, Inc., Hollywood, Calif., satisfactorily passed acceptance test and were delivered on May 4, 1939. Since that time one of the three targets purchased has been flown 1 hour and 46 minutes in 10 flights, the tests being conducted at Patterson Field. Several difficulties of a minor nature have been encountered in the operation of these targets, although these troubles have now been largely overcome.

(2) It is not believed these targets will be satisfactory for Coast Artillery anti-aircraft gunnery practice due to the limited range at which the target would be visible, and the guaranteed service ceiling (5000 ft.). However, these equipments are believed to be suitable for several definite missions which are listed below.

(a) Aerial Target, Power Driven, for Infantry and Cavalry ground machine gun practice. It is expected that casualties will be extremely high on a mission of this type and therefore an inexpensive target should be provided. The range of the machine guns used is such that the service ceiling of these targets will be adequate.

(b) Aerial Target, Power Driven, for aircraft machine gun fire (both 30 and 50 caliber) at restricted ranges. Again the casualties on this type of mission may be expected to be high and an inexpensive target should be provided. The service ceiling, as well as the range at which this target would be visible, is considered sufficient for this mission.

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PROJECT NO. E-54-39

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E.S.M.R. #I-54-1410

(c) Aerial Target, Power Driven, for the aerial bombing of aerial targets; that is, the practice of bombing aircraft from other aircraft, which has been proposed by Pursuit Aviation. Still again the casualties may be expected to be extremely high which would require an inexpensive target. The service ceiling and visibility of this target are considered to be adequate for this mission.

(d) Aerial Target, Power Driven, for anti-aircraft artillery fire at short ranges (possibly Field Artillery equipment of a smaller caliber than that used by the Coast Artillery Corps). This target is considered to have satisfactory service ceiling and visibility characteristics for this type of mission.

(3) Upon the approval of the Chief, Experimental Engineering Section, Chief, Materiel Division and The Chief of the Air Corps, it is planned to request that a Board of Officers be appointed consisting of at least one (1) member each of the Infantry Board, Cavalry Board, Field Artillery Board and the Air Corps Technical Committee to be convened at the Materiel Division, or some other suitable point, for a demonstration of the Type A-2 Target. This Board will then be asked to determine the suitability of this type of target for the missions mentioned in Par. 2 c (2) above and to reach a decision as to the number which should be purchased for each of the above Branches for Service Test. This will be covered more fully in a later report to The Chief of the Air Corps.

d. Aerial Targets, Power Driven, Type A-2

(1) This target is being manufactured by the Naval Aircraft Factory, Philadelphia, Pa. The total equipment consists of one aerial target, power driven, one control airplane and one ground control equipment. The following equipment is being furnished by the Army to the Navy Department for installation in these equipments:

(a) Necessary radio equipment

(b) 50 ampere generator and control panel

(c) One ½ ton panel delivery truck forthe installation of the ground control equipment.

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E.S.R.R. #1-54-1410

(2) A Purchase Order, #39-6015, was placed with the Navy Dept., Bureau of Aeronautics, Washington, D. C., on May 18, 1939, in which was included the following equipment:

(a) 1 ea. Modify, adapt and equip one radio controlled aerial target, (N2C-2 type with old style control equipment) including installation of Army furnished radio equipment.

(b) 1 ea. Ground control set less truck and radio equipment.

(c) 1 ea. Adapt controlling airplane (TG-2 type) including installation of Army furnished radio equipment.

(3) Through verbal conversation with responsible personnel of the Naval Aircraft Factory it was learned that the Aerial Target, the controlling airplane and the ground control equipment was about complete and awaiting the radio equipment to be furnished by the Army for installation. In the 2nd and 3rd paragraphs, and inclosures thereto, of the 4th Indorsement to letter from the Materiel Division to The Chief of the Air Corps dated April 11, 1939, Subject: Allocation of standard Signal Corps radio equipment to the Radio Controlled Aerial Target Project, the radio equipment necessary for the Type A-3 Aerial Target project was listed and it was requested this equipment be forwarded to the Naval Aircraft Factory for this purpose. Through verbal conversation with representatives of the Office, Chief Signal Officer it is indicated that all the above mentioned radio equipment will be shipped to the Naval Aircraft Factory at an early date after July 1st. Arrangements are being made to send the ½ ton panel delivery truck and 50 ampere standard Air Corps generator with control panel to the Naval Aircraft Factory immediately. This, with the radio equipment, constitutes all the equipment which is required to be shipped to the Naval Aircraft Factory for this project. From further conversation with responsible personnel from the Naval Aircraft Factory it is estimated that the complete equipments should be delivered at least by October 1, 1939.

e. Aerial Targets, Power Driven, Type A-4

(1) These targets will consist of converted BT-2 type airplanes equipped with tricycle landing gears. Two of these targets are being fabricated

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E.S.M.R. #I-54-1410

at the Materiel Division, and in addition, two BT-2 airplanes are being converted into control airplanes. The remainder of the equipment to be fabricated will be the ground control stations which will be installed in the ½ ton panel delivery truck.

(2) In paragraphs 4 and 5, and the inclosures thereto, of the 4th Ind. to letter from the Materiel Division to The Chief of the Air Corps, dated April 11, 1939, Subject: Allocation of standard Signal Corps Radio Equipment to the Radio Controlled Aerial Target Project, was given a list of the radio equipment necessary for this project and it was requested that this equipment be forwarded to the Materiel Division for this purpose. From conversation with personnel of the Office, Chief Signal Officer, it is indicated that this equipment will be shipped soon after the 1st of July.

(3) Certain items of special radio equipment on this project are to be fabricated by the Aircraft Radio Laboratory and satisfactory progress is being made.

(4) The design of a tricycle landing gear forthe BT2 airplane has been completed and turned over to the Engineering Shops Branch for fabrication. The first of 3 of these landing gears is about 90% complete and the first of the BT-2 airplanes, to be so equipped, is being sent to the Final Assembly Hangar for the installation of this type of landing gear this date.

(5) In a P. O., #39-6015, placed with the Navy Dept., Bureau of Aeronautics, Washington, D. C., dated May 18, 1939, is included:

(a) 3 ea. Compact units, including the manufacture of valve control solenoids.

These compact units will be used in the BT-2 airplanes converted into Aerial Targets. The Naval Aircraft Factory had already built quite a number of these units, had complete drawings and jigs and were tooled up to go into immediate production of these units. Therefore, this order was placed with the Navy Department in order that time might be saved.

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E.S.R.R. #1-54-1410

(6) The purchase of these compact units required that the Navy Dept. be furnished certain items of equipment to be included in these units. Therefore, the following equipment was shipped from the Materiel Division to the Naval Aircraft Factory for this project:

(a) 3 ea. Type C-3 Flight Indicators.

In addition to these indicators, the following equipment was purchased from the Sperry Gyroscope Co. Inc., Brooklyn, N. Y. and ordered shipped to the Naval Aircraft Factory:

(a) 3 ea. Tanks, sump

(b) 12 " Valves, balanced oil

(c) 3 " Filters, oil

(d) 3 " Regulators, oil pressure

(e) 3 " Trap, oil drain

(7) It is estimated these control units will be completed and shipped to the Materiel Division by August 1, 1939. It is further estimated that these type A-4 aerial Targets, Power Driven, being manufactured by the Materiel Division, will be completed and in-operation before October 1st. This estimate, of course, is predicated on the availability of the Engineering Shops Branch for necessary shop work and the promised delivery dates of the necessary items of equipment for this project.

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ADDRESS REPLY TO
HEADQUARTERS OF THE ARMY AIR FORCES
WAR DEPARTMENT
WASHINGTON, D. C.

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

June 5, 1943

SUBJECT: Counter-Measures Against Special Weapons

13261

TO: Commanding General, Materiel Command,
Wright Field,
Dayton, Ohio.

ATTENTION: Brig. Gen. F. O. Carroll

1. It has occurred to this office that since we are prosecuting vigorously the development of special weapons, the enemy quite likely is carrying on the same sort of development. We should, therefore, be giving considerable thought to the development of counter-measures to use against such weapons, when and if they are ever used against us.

2. The types of weapon or instrument in mind are, for example:

Arm & Elect.   a. Rockets - various kinds of fuses

Equip   b. Controlled bombs - various methods of control

Arm   c. Bombing of bomber formations by fighter units.

Arm / AEL   d. Instrument bombing - radar, radio directed, etc., etc.

Are we doing anything along this line ourselves?

3. It is requested that a survey be made of the field of special weapons and a study be made of the field of counter-measures we might effectively use against such weapons.

4. It is realized that no explicit, tangible directive can be issued as to the form such study would take. This office would appreciate being advised from time to time as to what your thoughts are on this matter.

By Command of General ARNOLD:

Classification cancelled
or changed to
AUTH: CP 3506
By
Signature and Grade
Date 12-1-45

B. W. CHIDLAW, BRIG. GEN., U.S.A.,
Chief, Materiel Division,
Office, Asst. Chief of Air Staff,
Materiel, Maintenance & Distribution.

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Auth: A.C.M.D.
Date: 13 JUL 1943
Initials: T.A.S.

Address reply & ENVELOPE to:

Commanding General,
AAF Materiel Command,
Wright Field, Dayton, Ohio

[redacted]
XXXXXX COMMAND

ARS:ms:54
Wright Field, Dayton, Ohio.
13 JUL 1943

Navy Radio and Radar Operated
Target Seeking Devices.

The Bureau of Ordnance,
Navy Department,
Washington, D. C.
Attention: Comdr. D. P. Tucker.

1. Reference is made to your letter dated 21 June 1943 (Re4f) addressed to the attention of Colonel G. V. Holloman, concerning designation of an Army Project Officer and the inclosed memorandum of facts concerning the Pelican project.

2. Lt. Arthur R. Swanson of the Equipment Laboratory, Engineering Division, Materiel Command, Wright Field, has been designated the project officer in charge of the application of various radio and radar target seeking devices to the Army Air Forces controllable missiles, and the liaison officer in connection with other Navy radio and radar homing development projects, including the "Pelican". Lt. Swanson will be assisted by Lt. Milford S. Coon, Aircraft Radio Laboratory, who will act in a consulting capacity in connection with the radio and radar elements of these developments.

3. This Office is deeply appreciative of efforts made by you to give the complete background of the negotiations and relations between the War Department and the Navy Department regarding the "Pelican". With the appointment of definite liaison personnel on these projects, who will be supplemented by additional personnel as it becomes necessary, it is felt that extremely close coordination between the Bureau of Ordnance, Navy Department and the Army Air Forces can be expected in the future.

4. Further, this Office desires to assure you that any assistance that your Department feels may be supplied by the Army Air Forces on these projects will receive immediate attention by this Office. Information on designs, tests to be conducted, new development, and any other pertinent information to be forwarded to or requested from the Army Air Forces on the projects pertaining to your Bureau, should be addressed to the Equipment Laboratory (Dept. 54-7) Engineering Division, Materiel Command, Wright Field. In this manner all necessary coordination of these activities with the Army Air Forces will be accomplished through Lt. Swanson.

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The Bureau of Ordnance,
Navy Radio and Radar Operated Target Seeking Devices.

13 JUL 1943

5. Copies of two letters forwarded to the Commanding General, Army Air Forces, designating Lt. Swanson as Liaison Officer for these projects are attached hereto.

CHESTER ... ETTENBERG
Major, Air Corps,
Ass't Technical Executive

2 Incls.
Incl. 1 - Cy.Ltr.dtd.6/29/43 to C.G., A.A.F.
Incl. 2 - Cy.Ltr. to C.G., A.A.F. subj. as above.

14 JUL 1943

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Enemy Action Against U. S. Bomber Formations.

General Arnold 3 September 1943

General Schols 2

RCW/ah/6716

1. In compliance with Comment 1, I have given considerable thought to enemy capabilities directed against our bomber formations. I also have given full rein to my imagination, as you will note, for some of my ideas represent possibilities only and are by no means imminent threats. It is my opinion that there is more than a mere possibility that the enemy may introduce new methods of attack in an effort to break up our heavy bomber formations, and therefore I cannot agree fully with Dr. Bush's feeling that, "The chance of this occuring is less than it was some time ago." I am inclined rather to the belief that as the enemy is pressed harder and harder he will be forced increasingly to rely upon his ingenuity.

2. It is felt that the longer our formations of heavy bombers are flown over enemy territory and those forced down are made available to the enemy for study, a better knowledge of our capabilities and weaknesses will result. The information thus gained will certainly result in the introduction of new defensive tactics and an effort to produce new defensive weapons, either or both of which may in turn be expected to reduce the effectiveness of our attack.

3. There follows a list of possible weapons and techniques which the enemy is capable of developing for employment against our heavy bombardment formations:

a. Radar:

(1) Radar Ranged and Directed Anti-Aircraft Fire. Development work in the United States is proceeding rapidly on radar anti-aircraft fire. It must be assumed that it also is developing with equal rapidity in enemy countries. According to the latest reports the enemy anti-aircraft fire is accurate up to 32,000 ft. It must be accepted that in the future his radar anti-aircraft fire will become even more accurate, will reach to higher altitudes, will employ ordnance of heavy caliber and will be installed in larger numbers.

As a possible defensive measure it is suggested that "ferret" planes can be dispatched to seek out enemy radar sighting stations to reconnoiter the frequencies used and enable our planes to jam his installations. Jamming is only partially effective but can be supplemented by careful intelligence work resulting in the destruction of his radar anti-aircraft installations by bombing.

(2) Radar Directed Search Lights. While the field of the search

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Enemy Action Against U. S. Bomber Formations.

General Arnold — 3 September 1943

General Echols — 2 (Cont.)

RCW/ah/6716

light appears to be limited at present, possible future developments must not be ignored. Search lights can be so accurately directed by radar as to eliminate the effectiveness of evasive tactics. Search lights are continuously being improved and those of the future may take advantage of some of the other parts of the spectrum, such as the infra-red band, in order to guide missiles along their beams. It is not beyond the bounds of possibility that the illumination of targets might be made strong enough to direct missiles that are directed to a source of radiation.

Radar directed search lights are subject to jamming and to destruction by bombing and strafing. The development of a light glide bomb that would seek out a source of light or radar waves is an indicated counter-measure.

(3) Radar Directed-Remotely Controlled-Aircraft Flown to Collision. The techniques of flying aircraft without personnel are well known and already in use. The quantity production of cheap airplanes capable of being remotely controlled and having a sufficient capacity to carry moderately heavy explosive loads and fly relatively long distances is well within the bounds of possibility. Such planes could be equipped with relay radar by means of which observers on the groundor in other aircraft 80 to 100 miles away could see the scope on the remotely controlled plane and steer it into targets such as bombers in formation, ships or shore installation. The techniques of relay radar have already been established and are not in actual experimental use. Through a series of relays it will be possible actually to use remotely controlled planes at considerable distances - perhaps as much as 400 or 500 miles.

Radio and radar jamming will be an effective instrument against such remotely controlled aircraft. Such aircraft, too, not having the benefit of a pilot actually at the controls, would be vulnerable to attack from the air and the ground. Development along these lines has proceeded far enough so that it is not beyond the realm of possibility that remotely controlled planes using relay radar and similar devices could be countered by other remotely controlled aircraft similarly equipped.

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(4) Radar-Self Directed-Bombs Dropped from Other Aircraft and Having Proximity Fuses. An elaborate program of laboratory research has already developed effective methods of manufacturing target seeking bombs of several varieties. It is to be assumed that this development in the near future, both here and in the enemy countries, will reach a stage where such missiles will actually be encountered in operations. They may be expected to range all the way from a light fragmentation or gas releasing bomb to an aerial torpedo having airplane wings and aerial mines of super-block-buster proportions. The development of proximity fuses has already reached an advanced stage in this country, and, since such a weapon is an obvious need, the enemy probably also has such fuses.

Some protection against target seeking bombs is afforded by radar or radio jamming but this is by no means sufficient. In the first place, target seeking bombs could be manufactured to use many different frequencies and to protect the formation of bombers, it probably would be impracticable to have a sufficient number of jammers going at the same time to give more than a small percentage of protection. In the second place, all target seeking bombs do not use radar techniques and some of the other methods such as infra-red, television, photo electric cells, etc. are not susceptible to jamming in the same sense. Intensive research work is indicated into the possibility of causing target seeking missiles to explode before their mission is accomplished, and of setting up false targets so that the apparatus will be diverted from real targets. Proximity fuses may employ a variety of methods such as the use of a light source, the use of radar or radio or techniques dealing with other parts of the spectrum not yet explored, or if explored, unknown to the writer. Methods of causing pre-detonation are obviously indicated.

(5) Radar Ground Controlled Interception. The use of radar search systems to provide accurate data on approaching aircraft as to azimuth, range, elevation, course and speed has already been highly developed by both ourselves and the enemy. The development includes apparatus capable of picking up aircraft at ranges of 200 miles and more and keep them constantly in sight with a continuous and complete flow of data on their movements and positions. The devices employ frequencies from the longest radar waves to the highest frequency of the radar band. These sets, in the future, may be expected to provide more precise data at longer ranges and to provide a much more complete coverage of the country to be defended.

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Ground interceptor stations are susceptible to jamming and because of the relative permanence of the installations reconnaissance can often result in rendering them ineffective or in their destruction. Thorough investigation of the territory through which bomb formation will have to pass by ferret planes, photographic planes and other means of ascertaining enemy frequencies and the location of interceptor stations, is the most effective preliminary to defense.

(6) Radar Equipped Night Fighters. The modern night fighter - as effective in overcast or in heavy haze, as at night - already has equipment which provides complete information on approaching bomber formations. The night fighter's equipment of the near future may be expected not only to give him even more complete and more accurate information at longer ranges, but it will serve to range and sight his guns far more accurately than this job can be done by present radar devices and optical methods.

Once more radio and radar jammers provide one means of defense against the night fighter but not a very effective one. The night fighter of the immediate future will probably have a variable frequency radar device against which jamming equipment would have to be so heavy as to be impracticable for bombers - already loaded with fuel and bombs to carry. In any event, the jamming mechanism itself gives the night fighter a point source on which he can home with his detection equipment. Other devices against night fighters would include formations of long range high speed defensive planes carrying equipment similar to the night fighter, including long range cannon firing shells with proximity fuses, etc.

(7) Radar Ranged and Directed Guns on Other Aircraft or Balloons. The development of radar automatic gun laying has undoubtedly proceeded a pace in the enemy countries, perhaps even faster than here where development has been slow. Such guns having computers to take care of factors affecting the relation of missile and target, may be expected in the future to obtain a degree of accuracy never yet encountered. This includes every caliber of gun that can be mounted on an aircraft or in a balloon and dirigible. The enemy already has planes equipped with heavy cannons - about 75 mm. caliber - and it is suspected that these cannons are ranged and aimed by radar. If they are not, then they soon will be.

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Enemy Action Against U. S. Bomber Formations.

3 September 1943

General Arnold

2 (Cont.)

General Nichols

HCW/ah/6716

This is another case where jamming is in part effective but the most efficient defensive measure will be to outrange the enemy with similar apparatus. This calls for the most intensive development work and the concentration on this problem of a great deal more talent having a higher priority as to materials and assistance than is now the case.

(8) Balloon Barrage - Radio Equipped - To Cause Fragmentation or Incendiary Explosives or Gas Release. The British have already experimented with a device which they called "Mutton". It was, in effect, a huge aerial mine suspended from parachutes and designed to cause bomber formations to avoid it by a great distance, thus providing protection to a large area beneath it. This device was not regarded as satisfactory; however, it cannot be entirely discarded. It is symbolic of a method of protection against bombers. Balloon barrages or the suspension of aerial mines from parachutes fired from guns can be so equipped as to be deadly to any aircraft coming close to them.

Insofar as radio and radar techniques enter into such a project, jamming will again be partially effective but it is obvious that special measures will have to be taken to break up such barrages in advance of bomber raids. This could be done by a scouting or reconnaissance squadron equipped with guns firing missiles with proximity fuses. Barrages, as of today, are effective only up to moderate altitudes and some defense against them is to be found in using high altitude aircraft. However, there is reason to believe that the barrages of the future may rise to altitudes at which we would be unlikely to fly our bombers.

(9) Jam Radio and Radar Navigational Aids and Radar Bombsights and Altimeters by Use of Radio. The use of jamming against radio and radar has already been highly developed by the enemy for all of the so-called long or medium wave installations. In the near future, he may be expected to come out with jammers that would be effective against the micro-waves. More than that, his technique of jamming may be expected to improve. In common with us, he probably will be able to do simultaneous reconnoitering of frequencies and the jamming of them.

These are under intensive study and development already and this work may be expected to provide effective defenses

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Enemy Action Against U. S. Bomber Formations.

General Arnold — 3 September 1943

2 (Cont.)

General Echols — RCW/ah/6715

against jamming which, of course, goes for the enemy as well as for us.

(10) Rockets, Controlled or Steered by Radar from Plane or Ground. Rocket planes or rocket missiles can be guided by radio or radar against aircraft or other targets. Such devices in the future may be expected to attain great accuracy and to be of almost any dimensions.

The remarks under sub-paragraph (3) apply with equal force to rocket devices.

(11) Gliders - High Flown - To Carry Heavy Explosive Charges Aloft and Activated by Radar or Other Means. Here is a method by which large explosive charges or cylinders or gas could be flown to a high altitude and then controlled from the ground in such a way as to cause them to collide with bomber formations or pass near such formations, in which event, explosives could be touched off by remote control. Since there is the possibility that these gliders could at all times be coordinated with those of the attack bombers by radar, this might provide a most effective offensive weapon against bomber attacks.

The destruction of such remotely controlled gliders by a fighting patrol using radar directed and equally long ranged guns, would be the most effective defense. Jamming of the radio and radar controls would help.

b. The above subject, radar, has been discussed at considerable length since it is a most promising field of development and one in which the Germans are known to be particularly active. The following items being in a more familiar development field, are simply briefed for your information:

(1) Rocket fired parachute bombs.
(2) Heavy armament fighter with long range guns and fire control.
(3) Overhead bombing using special fuses.
(4) "Toss bombing" using special fuses.
(5) Rockets up to 10" in size fired from the front or rear of bomber formations.
(6) Super-size rockets with special fuses fired from the ground.
(7) Chemicals in the form of mustard or other gas, probably phosphorus, possibly explosive, sprayed on aircraft or in the path of bomber formations.

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Enemy Action Against U. S. Bomber Formations.

3 September 1943

General Arnold

2 (Cont.)

General Echols

RCW/mb/5716

(8) Jet propulsion fighter airplanes to defeat our fighter cover. Super-speed jet propelled bombers used as counter air force weapons.

(9) Large mines activated by radio, dropped on our formations.

(10) Radio controlled aircraft loaded with huge explosives which could be flown under control into our formations.

(11) Flame throwers operated under extremely high pressure in
the vicinity of 3,000 lbs. per square inch with a fuel con-
sisting of hydrogen and oxygen gases mixed just prior to
ejection through a narrow orifice venturi, the effective
range of such a flame thrower could possibly be extended to
a distance of 1,000 yds. with a delayed ignition which would
permit the gases to be ignited in the immediate vicinity of
the bomber formation.

(12) Convex condensers for gathering of sunlight and focusing the
rays upon our bomber aircraft. At high altitudes the rarefied
atmosphere permits manifold intensity of light rays and
resulting heat focusing. Flexible turret mounted repeating
rocket dischargers.

(13) The consistent and determined use of a number of the above
forms of attack against our formations. Where any single
form of attack is not capable of destroying formations by
itself the determined use of many of the above methods could
add up to a large overall loss.

O. P. ECHOLS,
Major General, U.S.A.
AC/AS, M.M.&D.

2 Incls.
Incl. 1 - a/c
Added Incl. 2 - Reply to ltr fr
Dr. Bush for sig.
Gen. Arnold.

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MATERIEL COMMAND LIAISON OFFICE

CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena 4, Calif.
November 5, 1943

Lt. Col. D. B. Diehl
Arm. Sect., Engr. Devel. Br.
Room 5D863 Hq. AAF
Pentagon Building
Washington, D. C.

Dear Don:

I very much appreciate your interesting and informative letter of October 25/43. I was particularly glad to have the dope relative to the new Ordnance line up and rocket program and also the new line up with regard to the development of launchers. I agree with you that these are steps in the right direction, but due to the late date at which they were taken I am not as "happy about it" as you are.

With regard to the very tight specifications which the Ordnance is writing to cover rocket developments, I somewhat doubt whether the NDRC will like to work in strait-jackets. The Navy certainly do not operate on that basis with the Caltech rocket group and in my judgment they are getting extremely fine cooperation and rapid results under the system they are following here. With respect to my remarks above relative to the lateness of the date of adopting a new program, I am frank to say that I am in a small way responsible perhaps for the delay in that I backed the wrong horse. For a long time I defended Col. Skinner's administration of the rocket program. I realized all the time that he did not have the administrative experience and broad technical background required to head up this important field, but I did not feel that the time was ripe to start yelling for a change. Suitable men for such assignments are not hanging around on bushes at the present time and one cannot grab a man from another assignment just because one individually feels that a shake-up is due somewhere. I know Col. Trichel and I feel sure that a wise choice has been made.

When I was at Wright Field about a month ago, I had the opportunity to talk to Donicht on the telephone, he being in Washington, and I also talked to his assistants in the Armament Laboratory. I obtained a very definite impression that they all felt they were short-handed. Actually, I have felt for several months that Donicht's section should have been enlarged to take care of the developments which I saw coming and have discussed this with Donicht, and again it seems that the time wasn't ripe. Col. Wolfe did not particularly believe in it and I do not think that some of the people there in Washington had reached the stage where they felt there was much point in worrying about rockets.

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Actually I still feel that we can win this war without a single rocket, as I have stated many times. We have some pretty good machine guns and cannon and planes and pilots and I am convinced we can lick all the Japs and Germans too. I do contigue to advocate, however, that we push our rocket development program with both hands and both feet and everything else we can muster in full motion.

I am sending you a copy of a letter which I am this date addressing to Col. Morgan, the Ordnance officer at Wright Field. My letter to him is generally self-explanatory but contains some observations respecting the Caltech and British rockets which I am sure will be of interest to you. I am inclined to feel that in our relations with the Ordnance Department Col. Morgan's office is our best bet. Certainly they should be in on any revisions of programs respecting aircraft rockets and launchers. In all probability he should have one or two more men in connection with the rapid development of launchers suitable for our aircraft.

In connection with my observations relative to Donicht's section being short-handed, I still feel that your section should have an officer with no other duty than to follow up on rocket developments, reports and tests. In all probability at the present time you need more than one man as it would take one man's full time there in my estimation to keep up with the reports and developments of the British and the Navy and the Caltech programs, excluding the Hickman and Ordnance Department developments which probably should be handled by another officer. I continue to feel that there are tremendous potentialitics in the jet propulsion principle and that in the next war plenty of jet-propelled missiles will be fired on the ground and in the air. We are simply putting blinders on if we do not get all the combat experience we can out of this war with them. In this connection, the Navy are going full blast. I note what you say about the British installations on the P-40 and P-47. I agree with you that those installations are impracticable on any of our airplanes because of their drag and weight. Please note that I say in my letter to Morgan about the superiority of the Caltech rockets and especially launchers to those of the British. Why in the name of heaven we should fiddle around with anything less than the best available stuff is what I cannot grasp. In this connection Donicht has written me nothing whatever in regard to these installations. I have not received a single weekly activity report from him since I have been out here and in fact have received very little from his section. Practically all I know about rocket developments there have come to me from Col. Morgan's office.

A Major Heenan of the BAC was here a few days ago and I had an interesting conversation with him relative to jet power plant developments in England. He intimated that he did not find a very large interest in this field in America. He also said that he understood General Chidlaw and Col. Wilson might be out here before long. I hope very much to see them in case they come as I should like to communicate certain of my views and impressions in person to them. In the meanwhile I should not object if you were to bring this letter to their attention.

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With regard to the weather out here, the sun is shining today, and the only complaint I have is that it is a little too warm. By all means come out and see us "one of these fine, bright days". As a matter of fact I should not like it at all if it were only "one" day. I have too much to show you here for a one-day stay. Best regards to my good friends in the Armament Section.

Sincerely yours,

W. H. Joiner
Col., Air Corps

WHJ:[illegible]

P. S. For some days I have been planning to write a letter to General Carroll somewhat along the lines of the foregoing, and think I shall send him a copy of this letter for general information.

W. H. J.

cc:
Gen. Carroll

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F. O. MEMORANDUM
NO. 20-40A

ARMY AIR FORCES
MATERIEL COMMAND, WRIGHT FIELD
DAYTON 25 APRIL 1944

ORGANIZATION, GENERAL

732nd Army Air Forces Base Unit, Dover, Delaware

F.O. Memorandum No. 20-40, dated 24 April 1944 is amended as follows:

* * *

7. FUNCTIONS: Pursuant to authorization from War Department, Headquarters, Army Air Forces in letter dated 1 April 1944, subject: "Establishment of AAF Accelerated Rocket Development Program", the 732nd Army Air Forces Base Unit is established for the purpose of accelerating the experimental development, the testing and the reduction to practice of all rocket propelled projectile installations in Army Air Forces aircraft. These installations consist of the rocket projectiles themselves, the loading and launching devices for these projectiles, aiming and fire control equipment therefor, and all necessary equipment that is peculiar to an Army Air Forces use of rocket propelled armament. The development program carried out shall be characterized by mutual and sincere cooperation with other agencies of the War Department, other agencies of the Government, and the proper agencies of allied Governments. More specifically, the Commanding Officer of the 732nd Army Air Forces Base Unit shall be responsible to the Commanding General of the Materiel Command for the performance of the following functions:

a. To study, evaluate, develop, fabricate, install and test all likely means of launching and aiming rocket propelled projectiles from aircraft as a means of improving the offensive or defensive fire power of Army Air Forces aircraft.

b. To initiate the military characteristics of rocket projectiles to meet Army Air Forces requirements. Receive from other agencies such as National Defense Research Committee, the Ordnance Department their suggestions as to military characteristics of rocket propelled projectiles that may be possible of attainment, and recommend the establishment of suitable development projects by the Ordnance or by N.D.R.C. for those projects that show promise of having tactical value. Coordinate with the Ordnance and with the N.D.R.C. on rocket projectile development, maintain periodic contact with the progress of projectile development by these other agencies to insure concurrent development by the Army Air Forces of the appropriate launching devices and suitable aiming devices therefor.

c. Recommend the initiation of procurement of such launching and aiming devices or items applicable thereto as may be necessary to carry out an approved development program on rocket propelled aircraft armament.

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d. To test available rocket projectiles furnished by the Ordnance Department, or by the National Defense Research Committee, by the Navy or by Allied Governments to determine their operational characteristics and suitability for launching from aircraft.

e. To supervise and/or conduct all experimental ground and air firing of aircraft rocket armament installations contemplated for use by Army Air Forces.

f. To disseminate data gathered as a result of such firing to the Ordnance Department, National Defense Research Committee, Army Air Forces Board and other authorized agencies concerned.

g. To coordinate with and assist the National Defense Research Committee and the Ordnance Department in regard to the development of rocket projectiles for Army Air Force use in order that maximum progress can be made.

h. To forward to the Army Air Forces Board for service testing and evaluation all experimental equipment developed by this activity to the point of practical application, which equipment shows promise of improving the offensive or defensive fire power of Army Air Forces aircraft.

i. Preparation of an accelerated experimental development program on rocket propelled projectile installations on Army Air Forces aircraft, including the estimate of funds, facilities and manpower therefor for the approval of the Chief, Engineering Division, and the execution of such program when approved subject to the technical supervision of the Chief, Engineering Division.

8. ADMINISTRATION.

a. The 732nd Army Air Forces Base Unit will function under the administrative supervision of the Commanding General, Materiel Command. Initiation and control of projects are assigned to the Chief, Engineering Division.

b. Close liaison must be maintained particularly with the Armament Laboratory of the Engineering Division.

9. COMMUNICATIONS.

a. Communications originating at the 732nd Army Air Forces Base Unit at Dover, Deleware shall be signed in either one of two ways as follows:

(1) By the Commanding Officer, 732nd Army Air Forces Base Unit for matters involving the detailed administration of his post duties, or in making recommendations to the Chief, Engineering Division or the Commanding General, Materiel Command or

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(2) By the Commanding Officer, 732nd Army Air Forces Base Unit for the Commanding General, Materiel Command in dealing with contractors or the Ordnance Department of the NDRC in carrying out the projects on the approved development program.

b. Copies of all communications on technical matters shall be forwarded to Chief, Engineering Division.

10. CONTRACTS.

a. Preliminary negotiations with contractors will be direct with reference to technical details, specifications and requirements. Contractors' proposals will be forwarded to the Armament Laboratory after evaluation by the 732nd Army Air Forces Base Unit, with the necessary recommendations for initiation of procurement.

b. Funds for the procurement of experimental and service test items of rocket propelled equipment shall be as specified by the Chief, Engineering Division and as approved by higher authority.

By Command of Major General BRANSHAW:

ALDEN R. CRAWFORD,
Brig. General, U.S.A.,
Chief of Staff.

OFFICIAL:

J. E. CARWILE,
Lt. Colonel, A.G.D.,
Adjutant General.

DISTRIBUTION:
- Colonel Donicht, Armament Lab., Engineering Division
- Colonel Sims, Deputy Chief of Staff
- Colonel Farr, Deputy Chief of Staff
- Colonel Seftenberg, Technical Executive
- Colonel Delaney, Comptroller
- Chief, Engineering Division
- Chief, Production Division
- Chief, Armament Laboratory
- Chief, Armament Unit, Aero. Equip. Branch, P.E.S. Prod. Div.
- Chief, Fighter Branch, Production Division
- Chief, Budget and Fiscal
- Chief, Traffic and Transportation
- District Supervisor, Eastern Procurement District.

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Address reply & ENVELOPE to:

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Commanding General
AAF Materiel Command
Engineering Division
Reference JHE:hle:54
Wright Field, Dayton, Ohio

AC-36
28-1P
NDRC

12 May 1944

Collaboration with the N.D.R.C.
Guided Missiles Program

Commanding General
Army Air Forces
Washington 25, D. C.

Attention: Development Engineering Branch,
Materiel Division, Asst. C/AS, MM & D.

1. Attached is a list of guided missiles under development by N.D.R.C. to which this Office has tentatively assigned type designations. The type designation "VB" will stand for Vertical Bomb compared to "GB" for Glide Bomb, thus retaining a consistency in nomenclature for all controllable bombs. Upon the acceptance of this nomenclature by the Specification Branch, this Office will in the future refer to the appropriate guided missile by the designation listed, VB-1, VB-2, etc.

2. However, the extent to which this Office is to participate in the development of these items is not clearly defined. To date, this Office has attempted to aid and expedite the development of these items in every way possible, but with the exception of VB-1 which is covered by CTI-1350, it has done so without an explicit directive as to how far it should go in this matter.

3. Therefore, it is requested that authority be granted to this Office to collaborate with N.D.R.C. in the Guided Missiles Program. It is further requested that this authority state specifically which items are to be included and to what extent this Office is to participate.

4. It is further requested that this matter be given immediate attention in order that this Office can officially establish its correct responsibility in this development.

For the Commanding General:

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

1 Incl.
List of Guided Missiles

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VB-1 1000 pound Vertical-Bomb, Visually Controllable in Azimuth Only. Consists of a standard 1000 pound general purpose bomb to which is attached, in place of the standard fin, a special tail fin containing stabilizing equipment, a servo mechanism, and a radio link. (Formerly known as the Azon type AZ-1).

VB-2 2000 pound Vertical-Bomb, Visually Controllable in Azimuth Only. Consists of a standard 2000 pound general purpose bomb to which is attached, in place of the standard fin, a special tail fin containing stabilizing equipment, a servo mechanism, and a radio link. (Formerly known as the Azon type AZ-2).

VB-3 1000 pound Vertical-Bomb, Visually Controllable in Both Range and Azimuth. Consists of a standard 1000 pound general purpose bomb to which is attached, in place of the standard fin, a special tail fin containing stabilizing equipment, a servo mechanism and a radio link. (Formerly known as the Razon).

VB-4 2000 pound Vertical-Bomb, Visually Controllable in Both Range and Azimuth. Consists of a standard 2000 pound general purpose bomb to which is attached, in place of the standard fin, a special tail fin containing stabilizing equipment, servo mechanism, and a radio link.

VB-5 1000 pound Vertical-Bomb, Controllable, Light Sensitive Target Seeking. Consists of a special bomb shell designed to house a seeking device and servo mechanism.

VB-6 1000 pound Vertical-Bomb, Controllable, Heat Sensitive Target Seeking. Consists of a standard 1000 pound general purpose bomb to which is attached a nose containing the seeking device and a special tail fin assembly containing the servo mechanism. (Formerly known as the Felix).

VB-7 1000 pound Vertical-Bomb, Controllable, Radio-Television Controlled.

VB-8 2000 pound Vertical-Bomb, Controllable, Radio-Television Controlled.

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VB-9 1100 pound Vertical-Bomb, Controllable, Radar-Homing. Consists of a special bomb shell having four symmetrically arranged wings of known section and a correspondingly finned tail, with the fins spaced midway between the wings in an X+ arrangement. The structure is designed to contain an 1100 pound armor-piercing bomb with space forward for the radar homing device and aft for power supply. (Formerly known as the ROC).

VB-10 1600 pound Vertical-Bomb, Controllable, Radar-Homing. Consists of a special bomb shell having four symmetrically arranged wings of known section and a correspondingly finned tail, with the fins spaced midway between the wings in an X+ arrangement. The structure is designed to contain a 1600 pound armor-piercing bomb with space forward for the radar-homing device and aft for power supply.

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OFFNER ELECTRONICS INC. CHICAGO U·S·A

PHONE IRVing 7067 5320 NORTH KEDZIE AVE.

July 5
1944

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Commanding General
Army Air Forces
Materiel Command
Wright Field, Dayton, Ohio

Attention: Lt. Col. A. Nyman

Gentlemen:

The following is a report on the activities of the Navy in the T.S. program, with special reference to our T.A.

In accordance with your request I contacted the various organizations in the Navy working on this program. I called Commander Soucheck at the Naval Aircraft Factory, but did not speak to him as he was out. I was informed by Lt. Comdr. Pritchard, his assistant, that all the work on this project was being carried out by Lt. Comdr. Taylor who is working under Commander Soucheck. I had previously spoken to Lt. Comdr. Taylor on several occasions, and as you will remember, I had the impression that little progress would be made under his supervision. However, I called Taylor and asked him how things were coming. To summarize briefly an extended conversation, his statements were as follows:

1- The conception that targets can be located in this manner is erroneous.

2- Our apparatus probably does not work.

3- Even if the above two statements are not true, the Navy has little interest in missiles of this type in any case.

Lt. Comdr. Taylor further stated that he has received five of the units we shipped to the Bureau of Aeronautics; but that these are not being used in any way. At least one of the units has been burned out by mis-connection of the leads. I stated to Taylor that considering the long period of successful use of these instruments by the Army, and the fact that he had never requested any assistance in getting these instruments working, or in attempting to determine the cause of failure to operate in his case, I did not consider that his results or opinions to be of much importance. Taylor emphasized that his chief reason for not giving the units much attention or asking for assistance in getting them working was that the Navy showed no interest in the project, and that therefore he did not consider it worth while to spend much of his or our time in putting the equipment in operation.

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I next contacted Lt. Comdr. Harvey Hall at the Bureau of Aeronautics in Washington. His opinions largely confirmed those of Lt. Comdr. Taylor, except that he did not have such definite opinions as to whether the equipment worked or not, but was more of the opinion that the Navy was only mildly interested in this program, and was willing to let the Army do the experimental work on it.

I next contacted Lt. Comdr. Ballard and his group. The attitude in the Bureau of Ordnance is apparently completely different from the attitude I encountered at the BuAer. As stated in their last report, they obtained excellent results with our equipment. Although Lt. Nolan had not been under the impression that the equipment had performed properly on ships, on going over the data it was determined that no data had been analyzed on single ships which were not adjacent to land, since the apparatus had been made reliably operative in April (around April 18th). They had obtained results on groups of ships, and on ships at dock. While I was there the man who analyzed the data furnished his first analysis on a single ship. This indicated that the apparatus was working very well in this case. They have a large number of other runs on ships, on which they have not yet analyzed the data. I believe that they will find equally good results in almost all cases, as their runs are only made at up to 10,000 feet, approximately, at which distance good results are to be expected.

I also spoke to Lt. Comdr. Lee in Captain Temple's office, the Deputy Chief of Naval Operations. It appeared from talking to him that the Navy does have an active interest in T.S. bombs, including F.I.R., but they have been awaiting the results of the survey being carried out by BuOrd (Ballard's group) and also a survey being carried out by BuAer in a blimp. I don't know what type of equipment they are using in the blimp, although I know that they are not using the T.A.

I tried to see Commander Merrill in BuAer, but he was out; I also tried to see Commander Conrad, the coordinator of research, but he was busy and I could not wait. Lt. Comdr. Ballard introduced me to Commander Tucker who is in charge of the program for BuOrd, and I had a short talk with him concerning the various problems encountered.

The primarly impression I obtained from speaking to all these various departments of the Navy with the widely divergent opinions, was that the program, so far as the Navy is concerned, is extremely poorly integrated, and that no one seems to know just what the Navy's interest is in the program, nor what use is intended to be made of the various devices.

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Commanding General
Attention: Lt. Col. A. Nyman -3- July 5
1944

However, all persons contacted were interested in following the progress being made by the Army in this program, and wanted to learn the results of any tests. Harvey Hall stated that he would like to go to Tonopah to witness tests on the T.A. when the target has been set up. I think it would be better, however, if we were to wait until a few successful drops are made before having tests witnessed by the Navy.

Very sincerely yours,

OFFNER ELECTRONICS INC.

Franklin Offner

President

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HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

[illegible] JUL 1944

MEMORANDUM FOR THE CHIEF OF AIR STAFF.
THRU: AIR COMMUNICATIONS OFFICER

SUBJECT: Development of Large Bomb.
(Reference R&R dated 30 June 1944, from Chief of Air Staff to OC&R, copy to MM&D, and Comment No. [illegible] [illegible] from OC&R)

1. The following information is to bring up to date the information contained in recent communications on guided missiles generally, and measures taken in connection with the German robot bomb and the development of a flying bomb of our own in particular.

2. Development is already under way at the Materiel Command on many of the items necessary to enable the construction of the missile described and extensive studies have been made and are continuing on the remote control and homing devices necessary to control such a missile.

3. As the result of a conference of Major General Meyers, Brigadier General Gardner, Brigadier General Carroll, Colonel [illegible] Phillips, and others at Wright Field, Tuesday 4 July 1944, representatives of Republic, Northrop and Bell aircraft met at Wright Field the following day. An engineer from each company is proceeding to the European Theater to bring back necessary information on which to go ahead with reproduction of the German robot bomb.

a. These three (3) companies are to be given letters of intent to go ahead with:

(1) Reproduction of ten (10) copies of the German device and arrange to produce it in quantities if necessary.

(2) Adaptation of the best of the German components to our own glide bombs.

(3) Design and construction of a new flying bomb superior in range, accuracy and pay load to the German article.

4. As the result of teletype conference with ETO Wednesday, 5 July 1944, attended by Major General Henry, Brigadier General Gross and Dr. [illegible] Bowles on this side, and by General Anderson's military and civilian advisers on the other, an adequate flow of technical information, drawings and recovered bombs to this country is assured.

[illegible]

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Memorandum for the Chief of Air Staff

Thru: Air Communications Officer

[illegible] control equipment has already been flight tested [illegible] fit into "war weary" -- or new, for that matter [illegible] be loaded with [illegible],000 pounds or more of explosives. The [illegible] plane must stay within [illegible] miles of the missile airplane, but the [illegible] may be fitted into a fighter, a "dressed up" [illegible], for [illegible] advantage may be taken of evasive tactics and speed [illegible] missile plane carries a television [illegible] to the control plane a picture of what the missile "sees."

[illegible] July 1944 fifteen (15) missile airplane equipments [illegible] airplane equipments will be shipped [illegible] carried over by a B-17 and a B-24 [illegible] model for installations in the theater.

[illegible] Materiel Command has made arrangements [illegible] plane equipments and [illegible] missile plane equipments [illegible] under high priority.

[illegible] has been previously hampered at the Materiel Command [illegible] statements of operational requirements for the [illegible] lack of facilities [illegible] development possibilities.

[illegible] has been established [illegible] of [illegible]

[illegible] have been prepared for [illegible] for all other [illegible]

[illegible] Materiel Command and the Army Air Forces [illegible] on many similar projects [illegible] with Materiel Command on the above mentioned [illegible]

[illegible] has also been prepared, concurred in [illegible] and forwarded to your office [illegible] Command facilities and personnel [illegible] guided missiles program [illegible]

[illegible] alternate development program [illegible] the Materiel Command, it is recommended that:

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11 August 1944.

MEMORANDUM FOR: General Marshall.

SUBJECT: Controlled and Long-range Missiles

The interest in long range missiles without the military as well as within has grown in intensity as more and more has become known of the German plans against us. Any consideration by us of a program in the field of long range missiles necessarily involves an examination of current techniques of our own, those in use by the enemy and of any others available to us, together with a rational extrapolation into the remaining period of the war, before one can venture a considered opinion as to what should and what should not be done by way of specialized high priority effort. The military position of the Germans dictates the use of certain special weapons and techniques, and the same may be said of our own position. We have had to make certain broad decisions, implicitly relegating certain development to the post war period. The measures to be taken must be in terms of the instrumentalities now at our disposal, the enemy's problem and our own.

We have intelligence to indicate that, in addition to the pilotless aircraft with which the enemy is now bombarding England, there exists, either in a highly developed state or even ready for use against us, a large rocket-type projectile of potentially much greater destructive power. The maximum range of the pilotless aircraft in its present embodiment appears to be of the order of 150 miles. The range of the rocket weapon is, no doubt, intended to be well in excess of that obtainable with the current pilotless weapon. So far as I am aware there is as yet no reliable estimate of what this range may be, but it is reasonable to assume that when first the rocket is used it will be at ranges at least as great as the estimated 150 mile maximum of the present pilotless aircraft. The war head of the pilotless aircraft carries of the order of one ton of explosive, whereas the new rocket projectile, in its initial form, may carry as much as 5 or 6 tons in what is thought to be the larger of two types. Thus far there is nothing conclusive to indicate that the enemy has available for combat use any vastly superior explosive. Nevertheless, even missiles carrying such a quantity of ordinary explosive, if they can be used in quantity, will be capable of doing very great damage.

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Up to the present time the German pilotless aircraft have been used in much the same manner as artillery shells. In other words, when launched, they are preset with directing information and can no longer be controlled. Within a short interval after take-off the control information they now contain places them on a direct route to the target area. Some also carry means for transmitting radio signals which enable their courses to be followed. In this way an initial projectile may be registered on a target area much as is done in artillery fire and the courses of subsequent ones corrected in accordance with this information. Using a very accurate air-log mechanism the range may be preset so that after a given distance of travel the missile dives to the target. These are the only controls now in use; there is no evidence of remote control by radio or radar. There is, however, reliable evidence that the new rocket missile will be remotely controlled in transit by radio or even radar means and such control is a natural addition to the pilotless aircraft.

To date pilotless aircraft have been used primarily against London and its environs and to an extent against other areas in England. In our initial invasion effort, including the taking of Cherbourg, we were spared what might have been a very potent additional blow from these missiles launched from the Cotentin Peninsula. As the effectiveness of their air force is increasingly reduced, the Germans will be driven more and more, as a last resort, to the use of remotely launched weapons such as pilotless aircraft and large rockets against military objectives in forward areas. In my opinion radio or radar control may be introduced to increase somewhat the precision and flexibility of these devices and to permit their use for this purpose. The effectiveness of these weapons against military targets will, I believe, be largely dependent on good air reconnaissance. Without this, hits on military concentrations will be fortuitous and these weapons will have mainly a harrassing value. Within their range they may grow to threaten not only our field operations but our associated harbors and their contents.

The principal countermeasures against the pilotless aircraft, once they have been launched, have been fighter interception, anti-aircraft fire and barrage balloons. Of the total number launched to 8 August, 26.8% were brought down by fighters, 12.9% by anti-aircraft fire and 2.4% by barrage balloons. Recently anti-aircraft fire has proven much more effective. During the week of 1 - 8 August, it accounted for 21.3% of the pilotless missiles launched, while fighters and balloons accounted for 5.8% and 5.8% respectively. This marked improvement has been due to the introduction of improved equipment in the form of the SCR-584 gun-laying radar and influence fuses, and to improved techniques. There is a limit to the number of barrage balloons which can be used, and therefore it is doubtful if much more can be expected from this countermeasure. Should the enemy increase the speed of his pilotless aircraft by as much as 10 or 15 percent the efficiency of interception will drop materially unless there is some aircraft better for the purpose than the Tempest which is now being used effectively. Against the large controlled rockets, once they are launched, we may resort to jamming of their radio or radar controls. Steps are now being taken to learn about these controls that we may prepare adequate countermeasures to them.

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Against the launching sites air bombardment has been used with some effect, but at the cost in diversion from other bombing activities disproportionate with the effect produced. In attacks on the rocket sites the probability of success, even with 12,000 pound bombs, appears to be very small. In other words, the diversion of air for this purpose warrants serious consideration. A study is therefore being made to determine whether other methods of attack, direct and indirect, can yield better results. It appears that harassing bombardment, as for example by the use of assorted long time-delay fused bombs, may do much to reduce the efficiency of the sites and delay transport along roads to and from them. The use of incendiaries such as NAPALM, a sort of gasoline jelly, may also have possibilities.

Our strategic bombardment program has certainly had its effect on the pilotless aircraft activity from fortuitous damage to specific production facilities as well as from any direct attacks which may have been successful. Had it not been for this interference we have every reason to believe that the pilotless aircraft offensive would have begun as much as six months earlier. Judging from the results of the attack to date, into which the Germans were doubtless forced before they were ready, there is every reason to believe that without this factor of delay the attack on England would have had serious effects on our invasion program.

In the midst of our countermeasures effort, sight must not be lost of the fact tha t the best antidote is conquest of the territory occupied by the launching positions, and cognizance must be taken of the offensive implications of these instrumentalities together with the future techniques they portend for use by us.

By groups working both here and in the UK, the development of the German pilotless aircraft defensive has been comprehensively followed. The personnel have comprised both those with outstanding military experience and those, including representatives of the OSRD, who are outstanding as professional scientists. These same men have also analyzed the intelligence on the large rockets. Since the invasion, pilotless aircraft launching sites, as well as what are believed to be two of the large rocket launching sites, have been examined. The pilotless aircraft sites in the captured area were only partially fitted and gave little new data on the exact details of launching. A substantially complete pilotless aircraft is now in this country and is being examined in detail by military, industrial and scientific authorities. The Army Air Forces are engaged in a program in which these pilotless aircraft are being copied for operational study and possible application under radar control. The novel impulse propelling unit should, if nothing else, give us a lesson in simplicity and objectivity.

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The two large sites, which appear to be a part of the German rocket program, are only partially completed and add little to the knowledge we already possess. Both the pilotless aircraft and the rocket sites in captured enemy territory were examined by individuals of outstanding military and scientific qualifications for the particular job, including representation from OSRD. More recently the Army has dispatched one of the leading authorities on rocket propulsion along with other eminently qualified military and scientific personnel to Sweden to examine the remains of a German rocket which recently landed there. Preliminary reports, including photographs, have already reached this country and have been put in the hands of the appropriate military and scientific personnel.

There is upon us, beyond doubt and speculation, an era to be marked by the application of homing and guided missile techniques. The simplest of these missiles is, perhaps, the bomb dropped in the conventional way and guided to its target by radio control, a weapon now in combat use. Another form is a bomb capable of homing on its target by radar, television or heat seeking means. These are in a high state of development. Winged editions of these devices, with and without self-propulsion, are the next stage. Perhaps the most readily available form of this strategic weapon is a remotely controlled ordinary aircraft in which armament, crew and gas for the return to base are replaced by an equivalent weight of explosive. The Navy drone is another example of such a weapon. The German pilotless aircraft, however, is the outstanding example of an expendable missile expressly designed for this application. Next comes the rocket missile which in its simplest form is supplementary to artillery and aircraft fire power, and in its more complex embodiment is complementary to strategic air operations. It is in the latter form that the rocket weapon is evidently receiving a great deal of attention by the Germans.

There is no question as to our military responsibility for the active pursuit of an over-all program in the field of controlled and homing missiles launched from aircraft and of powered airborne and rocket missiles launched from the ground, whether for tactical or strategic purposes. Having had before us a program of offensive warfare of unprecedented magnitude and geographic scope, demanding the utmost in flexibility and maneuverability, we chose to build for superior strength in tactical and strategic air. We have achieved and maintained this goal; they are our current stock in trade. Our main reliance must be on them and we must with unremitting effort give our primary attention to those factors which will enhance their effectiveness. More specifically it is upon our strategic air force strength that we must and can depend for the bulk of our long range air effort in this war. And it is upon our medium and light bombers, fighter bombers and fighters that we must and can depend for tactical air operations. Our program has therefore emphasized those missiles which will operate to increase directly the efficiency of our air effort. This has led to the development and use of guided and homing missiles to increase the percentage of hits when launched from piloted aircraft. The next step toward enhancing the efficiency of this piloted air force is being taken and involves adapting radar means so as to make the pilot independnent of weather and darkness. This technique

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is just being explored, principally in combat on the continent and with full military support at high level. At present the range is of the order of 50 miles; within about six months it will be extended to more than 100 miles. This support of ground operations has been deemed the problem most urgently in need of immediate attention.

It is predominantly the considered opinion of qualified individuals in both military and scientific fields that, taking all factors into account, there was and is little to be gained, in fact, something to be lost, from an intensive contemporary program in the field of strategic or long range rockets. Such a program appears to be neither essential to the success of our immediate war effort nor achievable as an effective operational contribution in the estimated time we have left, regardless of how lavish we might be in providing funds and human effort. Neither our material nor our scientific resources are unlimited. Consequently a limiting decision had to be made precluding an intensive program on strategic missiles.

We would be derelict in our duties on the other hand, were we not to undertake a comprehensive long range program dealing with controlled rocket and other types of missiles, for in time these will assume a commanding place in the field of strategic weapons, in fact they promise to become dominant. An initial program is under way and is being modified as circumstances dictate. In its formulation it was necessary to give serious consideration to the allocation of effort, military, scientific and technological. The success of our present air activity stands in pragmatic support of this decision. But this success can only be partial if it does not spur us on to cultivate the very instrumentalities which are destined first to complement and subsequently to outmode the strategic air weapon of today. No effort, however vigorous, it is safe to say, would give us before the end of the war, a remotely controlled strategic weapon sufficiently precise and dependable to approach competing with our present piloted strategic airplanes.

Edward L. Bowles,
Expert Consultant to
The Secretary of War.

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THE FLYING BOMB

From "The Engineer" - Sept. 15, 1944

On Thursday, September 7th, an informative and detailed statement on the flying bomb attacks on this country was made by Mr. Duncan Sandys, M.P., Chairman of the War Cabinet Committee on operational countermeasures against the flying bomb.

Mr. Sandys said that in April, 1943, four rather vague reports from secret agents suggested that the Germans were developing a long-range bombardment weapon of some novel type. With the assistance of the intelligence machinery of the Services and the advice of leading engineers and scientists, an investigation was set on foot, and reconnaissance photographs showed that at Peenemunde there appeared to be a large experimental station where the new weapon was being developed. Photographing was continued at frequent intervals from May, 1943, and one photograph revealed a tiny blurred speck, in which close expert examination revealed the shape of a miniature aeroplane sitting on what appeared to be an inclined ramp fitted with rails. From this and other information it was deduced that the object must be a pilotless, jet-propelled aircraft. Later, in November, 1943, it was discovered that the Germans were building along the French coast, from Calais to Cherbourg, a series of concrete structures which had certain features in common with those seen at the experimental station on the Bltic. It was furthermore noticed that these sites were almost all oriented in the direction of London. Eventually over 100 of these firing points were discovered, and throughout the winter and spring they were repeatedly attacked by British and American Air Forces until every one of them was destroyed. Round about last March the Germans abandoned these launching sites altogether and began the construction of a new series of firing points in which most of the buildings, including the conspicuous storage accommodation for bombs and fuel were eliminated. These new points took about six weeks to build and were camouflaged in such a way that it was practically impossible to detect them on air photographs until they had actually fired.

Paying a tribute to the work of the intelligence services and the British and American Air Forces, Mr. Sandys said that the successive series of delays imposed upon the enemy enormously reduced the weight and duration of the attack when it eventually came. But for this interference there could be little doubt that the bombardment would have started in the early months of this year, as not only engineers, but actual flying bomb firing units were already on the French coast waiting to begin operations in January.

During the eighty days of the bombardment the Germans had launched over 8000 bombs, or about 100 a day and of these some 2300-29 per cent - got through into the London region. Those figures did not include the many bombs which came to grief in France, and about 25 per cent. of the bombs successfully launched were inaccurate or erratic. Many dived into the sea of their own accord and others strayed as far as Norfolk and Northampton. At the beginning of the attack there was on an average one death for everybomb launched, but at the end three bombs had to be launched to kill one person. For five days in July a light-scale attack was made upon Portsmouth and Southampton, but the great majority of the bombs fell in the sea or in open country. During the rest of the time the attack was aimed at the unique target of London, and about 92 per cent. of all the fatal casualties had occurred in the London region.

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Mr. Sandys pointed out that ever since Bomber Command made its great raid on Peenemunde in August, 1943, the British and American Air Forces had been conducting a continuous battle against Hitler's secret weapons. The targets attacked had included launching sites, storage depots and communications in France, as well as factories, special fuel plants, and experimental stations in Germany. Altogether over 100,000 tons of bombs had been dropped on these targets. On these operations the British and American Air Forces had together lost nearly 450 aircraft, including many heavy and medium bombers, involving a loss of approximately 2900 pilots and air crews.

Dealing with the defence arrangements to meet flying bomb attacks, Mr. Sandys revealed that a plan for the deployment of our defences was drawn up in January It provided for three defence belts, a balloon barrage just outside London, a gun belt beyond that, and beyond that again a fighter zone. At the same time, there was a competing operational claim for the available guns and ballons. Preparations for the invasion of France were going on and antiaircraft protection was needed for the embarkation ports and assembly areas. It was not known, of course, whether the flying bomb attack would start before, after, or during the invasion operations, and in consequence the deployment plans had to be very flexible. In point of fact, the attack started a few days after the landings in France, and the guns and balloons were thus already extensively sited around the Bitish ports of departure. In accordance with the plan the balloons and guns were immediately moved to prepared positions to the south-east of London. They began to come into action at once, and within twenty-four hours were beginning to take their toll of the bombs. During the first month fighters, guns, and balloons together had brought down some 40 per cent of the bombs launched.

As was to e expected, experience of the enemy's tactics and fuller knowledge of the technical characteristics of the bomb led to certain changes being made in the defence plans. From the point of view of defence there were several awkward features about the flying bomb attack. The bombs flew at a very high speed - between 350 and 400 MPH - and in an attempt to saturate our defences th were often launched in salvoes. As far as possible the weight of the attack wa concentrated in periods of cloudy weather, which restricted the operation of fighters. On certain dull days as many as 200 flying bombs were launched withi the twenty-four hours. The height at which the bombs flew also presented the guns with difficulty. The bombs came in at an average of 2600ft., which was rather too low to get the best results from heavy guns and rather on the high side for the 40 mm. and 20 mm. light guns.

Originally some 500 balloons were deployed, but when it was seen that the bombs were consistently flying low the barrage was rapidly thickened up to nearly 2000, the full operational height of which was not needed. By accepting a reduction in the height of the balloons it was possible to suspend additional light cables and practically all the balloons were fitted with one additional cable and many with two. Although the balloons were in the last line of defenc they made a substantial contribution, and of the bombs which entered the barrage area, nearly 15 per cent were brought down by them.

Regarding anti-aircraft guns, Mr. Sandys explained that during the period preceding the invasion a large proportion was sited around the embarkation port and assembly areas. When the flying bomb attack started these guns were immedi ately moved to prepared sites along the southern edge of the balloon barrage. The gun belt, stretching roughly from Maidstone to East Grinstead, had been sited as far inland as possible to reduce the minimum length of front needed to screen London. In order to ensure the quickest possible deployment the defence

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plan had provided largely for the use of mobile 3.7 guns, but experience proved at the low altitude of the bomb, combined with its very high speed, was too much for these manually operated mobile guns. About the middle of July it was decided to move the entire A.A. belt down to the coast, so that the guns could get an uninterrupted field of view. This re-deployment - a vast undertaking - entailed the moving and re-siting of some 800 heavy and 500 Bofors guns. At the same time arrangements were made to replace all the heavy mobile 3.7s by static guns, which normally are bolted on to a specially reinforced concrete platform. An extemporised platform of railway lines and sleepers was designed by Anti-Aircraft Command and proved a complete success. The new deployment, the substitution of static guns, and the introduction of certain other technical improvements, together with the increasing skill of the gunners, were reflected in the rapidly rising results. In the first week after the re-deployment the guns shot down 17 per cent of the bombs which entered the gun belt. In the second week the figure rose to 24 per cent, in the third week to 27 per cent, in the fourth week to 40 per cent, in the fifth week to 55 per cent, in the sixth week to 60 per cent, and in the last week to 74 per cent. After the guns were sited on the coast many of the bombs destroyed were brought down into the sea, and during the last fortnight of the attack only 46 per cent of them crossed the coast, as compared with 75 per cent in June.

Turning to the part played by fighter aircraft, Mr. Sandys said that during the first few weeks of the attacks the fighters operated in a single zone stretching over sea and land from off the French coast right up to the gun belt. In this period theyshot down over 1000 flying bombs, or nearly 30 per cent of the number launched. When the guns were re-deployed the fighter zone was divided. There was a sea belt extending from off the French shore as far as the forward boundary of the gun belt about 7 miles from the English coast and behind the gun belt there was a second fighter zone stretching up as far as the balloon barrage. The re-deployment gave the guns much greater scope and led to an improvement in the overall results of the combined defences, though it restricted the opportunities of the fighters. As so many bombs were shot down by the coastal guns the number of targets presented to the fighters inland was much reduced.

In the battle against the flying bomb fighters were faced with a number of difficulties. Only the fastest fighters possessed the high speed needed to overtake the bomb in level flight. Other types of fighter had to dive on to the bomb from several thousand feet above. The problem of exactly hitting off the correct angle of dive was a difficult one and could only be mastered with experience. Another problem was that pilots had difficulty in spotting the fast-moving bombs several thousand feet below. Over land help could be given by means of the radio-telephone telling pilots where the bombs were in relation to various landmarks. After the guns were re-deployed bursts of anti-aircraft fire also showed the pilots where the bombs were and enabled them to dive on to those not shot down. But over the sea there were no landmarks and no gun belt, and pilots were therefore given directions by a flotilla of motor launches stationed in the Channel.

In the hours of darkness it was, of course, easy to spot the flaming tail of the flying bomb many miles away. In order to bring down the bomb the pilot must fire his guns at a range of about 300 yards, and by night it was very difficult for the pilot to estimate how far away he was from the light of the jet. Scientists gave much attention to this problem and experiments were carried out with elaborate radio equipment. In the meantime, however, Professor Sir Thomas Merton produced a simple and ingenious range-finder which

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proved to be the complete answer. It was so simple that the whole device cost little more than a shilling. The last ten weeks were unusually wet and cloudy for the time of year, making the work of fighter aircraft more difficult, but since the beginning of the bombardment fighters had brought down over 1800 flying bombs. On account of the high speed of the flying bombs it was necessary to maintain constant standing patrols over land and sea throughout twenty-four hours in readiness for any that might come over.

During the attacks it was noticed that a small proportion of the bombs came in by night from a due easterly direction, and information was obtained that these projectiles were being launched from aircraft. Specially adapted Heinkel bombers were carrying them pick-a-back and launching them from the air over the North Sea. These bombs proved less accurate than those fired from the land and to meet this form of attack additional guns were deployed in the Thames estuary and Intruder squadrons were sent out to patrol over the Dutch and Belgian coasts. At the same time, attacks were made upon the aerodromes from which the launching aeroplanes were operating.

Summing up the work of the combined defences, Mr. Sandys stated that in the first week of the attack about 33 per cent of the flying bombs were brought down, whilst rather more than that reached London. By the end of the period some 70 per cent of the bombs launched were being destroyed by the defences and only 9 per cent were reaching London.

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103 [redacted]

OFFICE OF EMERGENCY MANAGEMENT
NATIONAL DEFENSE RESEARCH COMMITTEE
of the
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P STREET NW.
WASHINGTON, D. C.
Mass. Institute of Technology
Building 23
Cambridge 39, Mass.

September 18, 1944

Commanding General
Army Air Forces
Washington 25, D. C.

Attention: Lt. Colonel W. P. Allis
Room 4E-645, The Pentagon

Dear Sir:

As a result of your conversation with me September 15 in regard to setting up the Polaroid project of this Division as joint Army-Navy project, it seems to me that a certain amount of clarification is in order:

Early last spring the Polaroid Corporation approached us with a view to developing under our sponsorship a new guided missile controlled by infrared homing. At that stage of the game, it seemed unwise for the Division, in view of the difficulty of obtaining adequate testing facilities, the load on aerodynamic analytical groups and the like, to undertake this. However, we were impressed with this contractor's conception of infrared homing principles associated with a computer to establish such leads as to cause the vehicle to fly a collision course rather than a pursuit course.

Accordingly, under a broad request from the Air Forces and with strong Navy support, we entered into a contract with the Polaroid Corporation for the development of an infrared target-seeking device. It was our intention that this target seeker would be used with the ROC vehicle. This was in line with General McClelland's urgent request that every effort be made to adapt infrared target-seeking to ROC. The Navy Department, particularly the Bureau of Ordnance, was much impressed with the Polaroid's conception of a homing vehicle which could be hung on standard bomb racks and entered into a contract with them to produce such a vehicle which would utilize the target-seeking device being developed by Polaroid for Division 5, NDRC, under Contract OEMsr-1317 which, as I have mentioned, is responsive to Project AC-36. Further, to document their interest in the homing device, as well as in the vehicle for which their contract was undertaken the Bureau of Ordnance through the Coordinator's Office requested NDRC on May 11, 1944 to take notice of Project NO-257 which attested to their interest in the infrared control being developed by Polaroid. A copy of their letter requesting this project, which was subsequently accepted by Division 5 and NDRC, is attached hereto.

[redacted]

104 [redacted]

It would, therefore, seem to me that an attempt to make this contract a joint Navy-Army project at this time is redundant, in view of the documentation already established. The support given by the Navy to this project is extremely strong. Aircraft for target surveys have been made available. Critical electronic components have been expedited, and in many other ways the cooperation between the cognizant Navy Bureau and the Division's contractor have been outstanding. In giving this project its overall direction, this office has undertaken to assure that the output of the homing device developed thereunder should be suitable for Division 5's vehicle ROC quite as well as for the vehicle being developed by Polaroid for the Navy.

The whole situation seems to me to be a very happy one. The homing device involving a lead computer is being developed and two vehicles are being concurrently developed for its utilization. In these parallel programs, each of which embodies ideas of considerable novelty, an element of safety is obtained which might otherwise be lost.

The Division 5 effort in regard to this contract is being exerted by Dr. J. C. Boyce's office. He is travelling in the West at the moment but on his return, I suggest that you get in touch with him.

Very truly yours,

/s/ Hugh H. Spencer
Hugh H. Spencer
Deputy Chief
Division 5, NDRC

Enclosure

HHS:avf

cc: Dr. J. C. Boyce
Comdr. R. D. Conrad

[redacted]

AERONAUTICAL ENGINEERING

Retaliation Weapon—I

Much of the information contained in this and a succeeding article has been taken from "German Flying Bombs," a pamphlet produced by the National Association of Spotters' Clubs. It is reproduced here by kind permission of the N.A.S.C.

P[illegible]

Design and Development

[illegible]

[illegible] written off. Although German ingenuity has produced a weapon whose relative simplicity commands admiration, the journalist who said that the Luftwaffe had been "sacrificed on the altar of the Flying Bomb" was not overstating his case. In comparing Flying Bombs and conventional aircraft, one must bear in mind that the former can be used in daylight with some success. Assuming that destruction of London was considered by the enemy of first strategic importance and knowing that air superiority is a thing of the past for the Luftwaffe, one must confess that the Germans produced an ideal weapon. Whether this savage attempt at reprisals, launched at the expense of normal aircraft production at a critical moment, helped the German cause must be judged by the individual.

The construction and "flight" testing of Flying Bombs became of great urgency to the enemy after the defeat of the Luftwaffe in 1940. London, the most perfect target in the World for Flying Bombs, lay 120 miles from possible launching sites on the French coast. An aerial bombardment of Southern England by masses of these missiles would, the Germans justifiably hoped, bring Great Britain to her knees. While 100 launching sites capable of launching a total of about 1,000 missiles a day were built along the coast of the English Channel, the Luftwaffe experimental air station at Peenemünde, as well as several other Luftwaffe units, continued to develop the weapon.

During 1942, trouble was experienced with the wings, which were found to break loose after a short period of flight. To discover the cause of this weakness, a Flying Bomb was built, in which the warhead was replaced by a similarly shaped fuselage section designed to accommodate a person lying in the prone position. Hanna Reitsch was chosen for the experiments, according to German propaganda reports, because of her diminutive stature and ability to withstand abnormal strains caused by the gyrations of the missile. After four days of test flights during which observations were made through a periscope of the behaviour of the wings in flight, the weakness was discovered, but during the final landing the test pilot was severely injured.

On November 8, 1943, a British photographic reconnaissance aeroplane flying a sortie over Peenemünde photographed an experimental launching ramp with a Flying Bomb in place ready for take-off. This photograph roused the interest of officials in this country and the launching ramp was compared with various structures then being built in the Pas de Calais. Examination of the latter showed the new structures in France to be similar in form and layout to the launching ramps and assembly buildings at Peenemünde. Intelligence reports confirmed the knowledge that the Germans were preparing a new weapon for use against this country.

Every one of the original hundred launching sites was [illegible] tracked down and completely destroyed or rendered [illegible]

[illegible] By then, however, the Germans were committed to [illegible] weapon. Many factories had been turned over [illegible] of conventional aeroplanes and aero- [illegible] of the new missiles and their power [illegible] launching sites, of a simpler and more easily [illegible] were constructed despite constant attention [illegible] of the U.S.A.A.F. and R.A.F. Several Flying [illegible] over the Baltic Sea in the direction of [illegible] their exact range and deviations from [illegible] on Tuesday, June 13, 1944, the Germans [illegible] first Flying Bombs against Southern England. [illegible] several experimental types such as the variants [illegible] landed in Sweden, two types of Flying Bomb have [illegible] seen over Southern England. Distinguishing [illegible] of these versions are confined to the wing form. Most [illegible] used early in the offensive were of the type with [illegible] on their leading and trailing edges to "cut- [illegible]". After the first week or so of the attacks this type [illegible] replaced by a type with slightly longer [illegible] and square-cut tips.

[illegible] the V.1 Flying Bombs are small reaction- [illegible] mid-wing monoplanes with single tail units. Each [illegible] fuselage of streamline shape to which [illegible] wings and tail surfaces. The propulsion unit [illegible] the rear of the fuselage.

Construction

[illegible] of the entire structure of the Flying [illegible] complicated or precision-built parts being [illegible] the missile in flight. Except [illegible] and rudder, the structure is entirely [illegible] parts are made of light metal alloy.

[illegible] sections. These comprise a light- [illegible] a fuel tank, a compartment [illegible] bottles, and two sections containing [illegible] section consists of a pressed [illegible] joined together [illegible] The various sections are manu- [illegible] separately and brought together at assembly depots [illegible] launching ramps. The first [illegible] the warhead, which is attached [illegible] by four large bolts. The [illegible] forward and rear [illegible] thick and contains a charge of [illegible] 1,870 lb. of high explosive. Flanges in the [illegible] are used in con- [illegible] to the fuel-tank fuselage [illegible] of the nose cap.

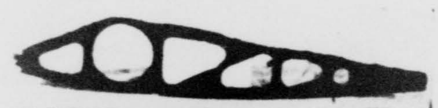
[illegible] the nose cap is a repeater compass used to [illegible] of the gyroscope located in the fuselage [illegible] the rear of that housing the compressed-air bottles. [illegible] mounted in the nose cap includes an air-log [illegible] detonators. Three detonators are [illegible] sensitive impact fuse, a clock [illegible] the warhead after two hours in the [illegible] detonator systems, and an all- [illegible] one right at [illegible] which operates at the [illegible] the ground.

[illegible] upon which the fuselage is built [illegible] and it is that used to [illegible] unit. Juncture of the wings [illegible] at this point, and although the construction of the section is principally the same as that of the other fuselage sections, additional stressing is provided to take the loads imposed by the attachment of the wings and the rest of the fuselage. Passing through this section is a hollow tube into which are inserted the spars by means of which the wings are attached to the fuselage. A fuel filling cap is fitted in the top of the tank and a fuel-delivery pipe is located in the bottom of the rear bulkhead. A lifting lug, by which the Flying Bomb is hoisted on to the launching ramp, is fitted on top of the fuel-tank section, to the rear of the fuel filler cap. Under this fuselage section is a cast-metal launching rail, which is fitted over a projection on the carrier of the launching ramp. This rail has thick vertical sides tapering in depth towards the rear. When the Flying Bomb launching carrier reaches the end of the ramp the Flying Bomb continues to move forward under its own power. The projection on the launching carrier slides out of the launching rail of the Flying Bomb.

Immediately to the rear of the fuel-tank fuselage section is a compartment containing the two spherical compressed-air bottles. Each of these bottles is a hollow iron sphere bound with wire over metal retaining strips. Air is stored, when the bottles are full, at a pressure of 100 lb. per sq. in. and is used to operate the directional control system and to force the fuel through the delivery pipes to the propulsion unit.

The two fuselage sections behind the compressed-air-bottle compartment contain the gyroscopes, the height and range-setting controls, and the pneumatic motors used to transmit the action of the gyroscopes into movement of the elevators and rudder.

Each of the wings is built up on a simple structure consisting of a detachable solid-drawn steel tubular main spar, a steel tubular rear spar of smaller diameter and a number of wing ribs. The ribs are fitted in pairs. This structure is covered



WING STRUCTURE.—The wing structure consists of a stressed skin of sheet steel attached to "Z"-section wing ribs, one of which is shown in the photograph above. Into this simple structure is inserted a detachable tubular main spar (see left) of 4½ ins. diameter.

by a stressed skin of sheet steel which is attached alternatively to the under surfaces and the upper surfaces of the ribs. Each pair of ribs, therefore, has one rib riveted to the stressed skin by its upper flange and one by its lower flange. Of "Z"-section with flanges top and bottom, the ribs serve as supports to hold the upper surface of the stressed skin away from the undersurface, while at the same time imparting to both surfaces camber resulting in an aerofoil section with high lift characteristics. The wings do not taper towards their tips, which are therefore of unusual thickness. Each tip is enclosed by a pressed sheet-steel fairing. Ailerons are not fitted. Manufactured as separate components, the wings are not attached to the Flying Bomb until shortly before launching. The two steel tubular spars with external diameters slightly smaller than the internal diameters of the holes in the wing ribs, are then fitted in the tubular sockets in the fuel-tank fuselage section and bolted in place. The two wings are pushed on to these spars and are locked in position.

Attached to the tail fuselage section, the fixed tail surfaces comprise a tailplane and a fin. Both are of steel construction, being built up in a similar manner to the wings. The elevators and rudder are made of a light metal alloy.

AIR BOTTLE.—Compressed air for operating the gyroscope and the pneumatic control system and for feeding fuel to the propulsion unit is stored in two spherical wire-bound air bottles. Air is stored at a pressure of 100 lb. per sq. in. when the bottles are full.

Propulsion Unit

Mounted above the rear of the fuselage, the reaction-propulsion unit is attached to the fuselage by a forked forward supporting strut located in the forward part of the fuselage section containing the gyroscopes and the height and range controls, and by the top of the fin, which serves as the rear

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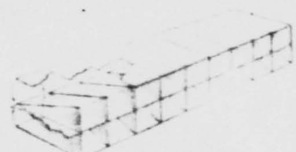
supporting strut. Shock absorbers are incorporated in the supporting struts. Of simple design and construction, the propulsion unit consists of three sections, a forward section containing the intake valves and the fuel atomizers, a combustion chamber, and a rear section. All the "working" parts of the propulsion unit are contained in the forward section, the diameter of which is 1 ft. 10½ ins. Immediately behind the circular air entry is a square grille which is composed of several rows of air intake valves. These consist of strips of steel lying on [illegible] supporting members of "V" section, the closed ends of the "V" pointing into the combustion chamber. The "V" section members have vertical [illegible] past which air can flow and upon which the steel strips lie. Attached to the grille at the forward, or open, ends of the "V" section members, the steel strips are arranged to exert, by virtue of their elastic properties, a force against the supporting members, so presenting, under conditions of equal pressure (see Fig. 1) on each side of the grille, a series of closed "V"s with the open ends of the "V"s towards the circular air entry in the front of the [illegible]. When the air pressure inside the combustion chamber drops, as it does after each discharge, the pressure of the air from the atmosphere on the outer faces of the "V"s [illegible] the air passing between the fins and the supporting members is sufficient to push the steel strips away from the supporting members at the previously closed ends of the "V"s and so force an entry past the steel strips into the combustion chamber.

Fuel is fed to the propulsion unit from the fuel tank by air [illegible] compressed-air bottles, and is delivered by way of a [illegible] and fuel-delivery pipes running up the forward supporting strut of the propulsion unit. Here it is fed into the combustion chamber through nine fuel atomizers interspersed among the intake valves and arranged in three rows of three, with the orifices facing into the combustion chamber. Fuel is drawn into the combustion chamber in a similar manner to the intake of air [illegible] the difference in pressure after each discharge between the inside of the combustion chamber and the fuel-delivery system.

The mixture of air and fuel is then ignited by means of the residual flame left in the combustion chamber [illegible] discharge, although ignition when the propulsion unit [illegible] started up is performed by means of a [illegible] sparking plug. After ignition, the pressure in the combustion chamber rises and exerts equal forces in all directions. The force exerted to the rear meets no resistance and is therefore expressed in a discharge of spent gases through the [illegible] of the combustion chamber and the rear discharge tube. The force exerted on the front of the propulsion unit acts upon the outer surfaces of the steel strips and presses them against the supporting "V" section members, closing the air intake valves and presenting a "solid" face upon which the [illegible] power resulting from the ignition of the [illegible] chamber acts, so driving the propulsion unit [illegible] Flying Bomb forward with a thrust [illegible] of the thrust is derived from the [illegible] but most is the result of the reaction [illegible] of the cycle of operation of the propulsion unit is [illegible] by its frequency, which is dependent upon its length [illegible] type at present used is 11 ft. [illegible] ins. long and [illegible] give approximately 40 cycles per second. In addition to the parts already mentioned, the unit consists of three [illegible] tubes, a large-diameter [illegible] chamber, and a smaller-diameter [illegible] discharge [illegible]. The weight of this unit, which develops about 600 [illegible] is approximately one quarter of that of an equivalent internal-combustion reciprocating engine, but its fuel consumption is about [illegible] times as great.

VALVE OPERATION.—These three diagrams show the operation of the intake valves of the propulsion unit. Fig. 1 shows the neutral position with equal air pressures on each side of the metal strips. In Fig. 2 the air pressure inside the propulsion unit is less than that outside and air forces the metal strips apart and flows past them into the combustion chamber. After ignition the pressure inside the combustion chamber rises and forces the metal strips together again (see Fig. 3).

FUEL ATOMIZERS.—Nine fuel atomizers are located in the air intake grid immediately behind the intake valves.

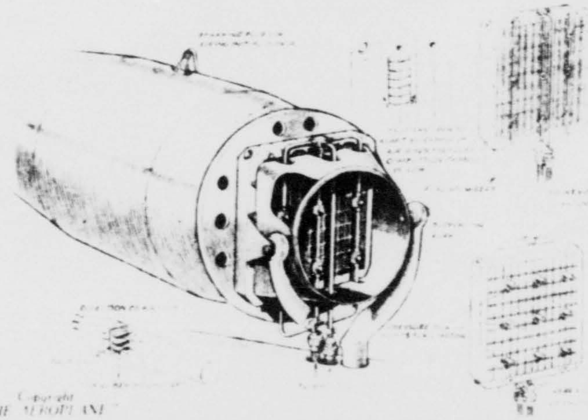


INTAKE VALVES.—This diagram shows the manner in which the metal strips of the intake valves lie on the "V" section fins of the supporting members.

Controls

Directional control of the Flying Bomb is governed by a battery of four gyroscopes, two controlling the compass course and the pitch movements, and two controlling the rates of any such movements. Bearings obtained from the [illegible] master compass in the nose cap are [illegible] used [illegible] the course

PROPULSION UNIT.—Consisting of nothing more than a hollow tube, in the forward end of which is mounted a square grille incorporating a series of air-intake valves and nine fuel atomizers, the propulsion unit of the Flying Bomb is capable of producing a forward thrust of 600 lb. The sketch below illustrates the bars, located immediately behind the combustion chamber, which form the only venturi in the unit. Two noteworthy features shown in the drawings, right, are the sparking plug and compressed air fuel injection system used to start the propulsion unit.



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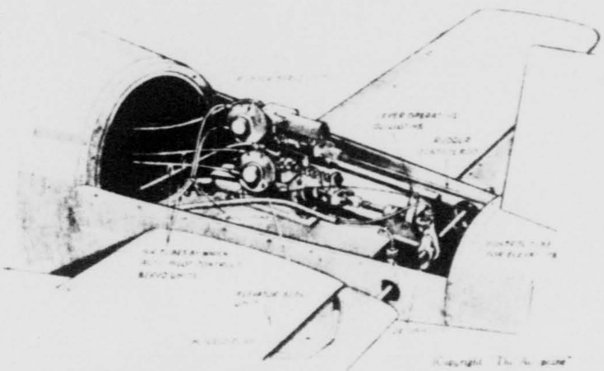
[illegible] from the compressed-air [illegible] the gyroscope and is directed [illegible] small [illegible] at the gyroscope rotor, [illegible] in its gimbals on two [illegible]. Movements of the [illegible] are transmitted to the elevators [illegible] pneumatic system based on [illegible] two small pneumatic motors [illegible] the tail fuselage section. These [illegible] consist of a cylinder and a [illegible] piston which is moved by [illegible]. An axle [illegible] is directly [illegible] the elevators, and [illegible] to the rudder. A movement [illegible] [illegible] [illegible] the axle [illegible]

[illegible]

[illegible] When these are exploded, two tail [illegible] as a result of which the [illegible] about [illegible] degrees. [illegible] the missile is at a sufficiently [illegible] of its dive.

(To be concluded.)



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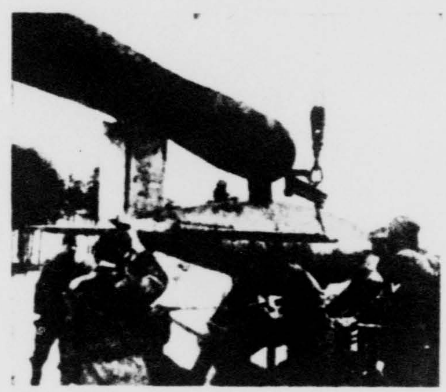
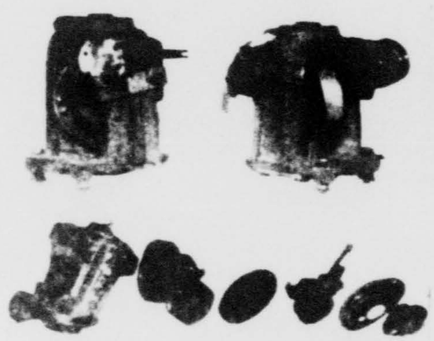
SERVO CONTROL UNIT.—Movements of the gyroscopes are transmitted to the elevators and rudder by two small pneumatic motors mounted in the tail fuselage section. Other parts shown in this drawing are the guillotine which immediately before the commencement of the final dive cuts the compressed air leeds to the pneumatic motor governing the rudder, and the detonators used to force the tail tabs down and so put the Flying Bomb into its dive.



TAIL SURFACES.—The fin of the Flying Bomb is used as the rear supporting strut for the propulsion unit. The other tail surfaces comprise a rudder, a tailplane, elevators and two tail tabs.



GYROSCOPES.—Four gyroscopes with rotors driven by compressed air govern the directional and yawing movements of the Flying Bomb.

PNEUMATIC MOTOR.—Two small pneumatic motors transmit movements of the gyroscopes into movements of the elevators and rudder. Each motor comprises a cylinder and a double-acting piston which is attached to a central axle, which in turn is connected to the movable tail surfaces.

[illegible] photographs

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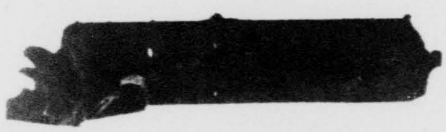
RETALIATION WEAPON II

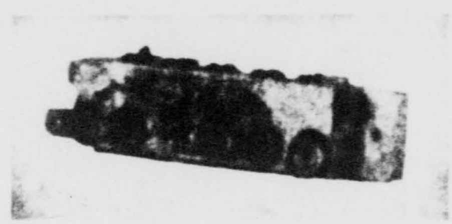
The first part of this article appeared in THE AEROPLANE of October 6, page 483

CABLE CUTTERS.—Strips of sharpened steel were fixed along the leading edges of Flying Bomb wings to act as balloon cable cutters.



PAMPHLET CARTON.—This is one of the cartons containing pamphlets which was dropped over Southern England from a Flying Bomb.

Refinements



COMPRESSED AIR DISTRIBUTOR.—This series of valves distributes the compressed air stores in the spherical air bottles to the gyroscopes and the pneumatic servo-control system.

LAUNCHING RAMP.—This photograph shows a Flying Bomb launching site captured in the Pas de Calais by Allied Forces. The actual launching ramp is shown between the two rails upon which was the derrick rod to lift the Flying Bombs on to the ramp. On the section of the ramp shown in rear can be seen the two rails which surmount it and upon which travels the "catapult" carrier, and the compressed air cylinders used to drive the carrier.

Data of the German V.1 Flying Bomb

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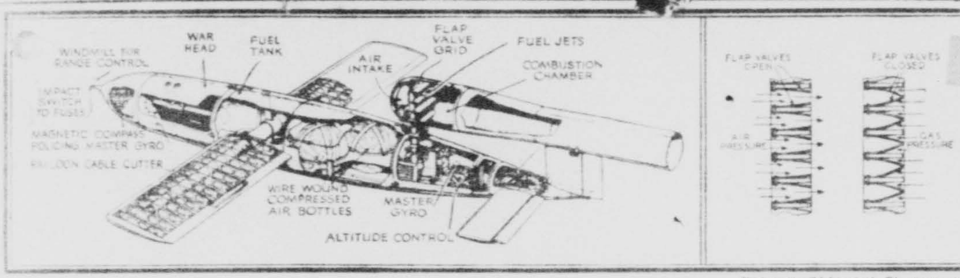


British Official Photograph

STRUCTURAL DRAWING OF GERMANY'S V-1 ROBOT BOMB
The Things are coming over again.

EXPERIMENTATION

Robot Bombs

Hard-working ATSC technicians last week announced they had constructed an exact replica of Germany's V (for vengeance) -1 robot bomb within two months after hundreds of parts scattered all over England (no bomb has been captured intact) had been shipped to the U. S.

Five of the command's 12 great laboratories—Power Plant, Aircraft, Equipment, Aircraft Radio, Materials—and the Engineering Shops collaborated on the V-1 project. They found the bomb is an exceptionally ingenious device (see drawing, left): it can be built for less than $1000, is much more accurate than often-bombed Britons care to admit. Its maximum error is no greater than a few thousand yards.*

The fuel is gasoline. The bomb carries 136 gallons, burns a little less than one gallon per mile, has a top range of 150 miles. It can be set to fly between 2000 and 5000 feet to take advantage of any cloud cover available. Three gyroscopes, driven by bottles of compressed air and assisted by a magnetic compass in the nose, keep V-1 on its course. A windmill in the nose regulates range. At the set time it jams the controls, forcing the bomb into a steep dive toward its target.

Simple Grill. Wright Field engineers were frank in their admiration of V-1's simple power system. Eliminating the usual jet propulsion compressor as too heavy, the Nazis hit on a way to use the force of inrushing air itself. A grill with nine small jets was mounted in the front (see drawing, right).

At the take-off the gas is ignited. In motion air rushing into the jets forces them open, passes into the combustion chamber. The explosions close the jets and expel the expanding vapors to the rear, giving the bomb its forward push. As the vapor escapes air again opens the jets and the process is repeated (45 times a second).

High air speed is needed to develop enough air pressure to open the jets. At less than 150 m.p.h. the bomb stalls. To build up enough pressure for a take-off, the bomb is driven along a launching platform or carried pickaback on an airplane until it is traveling 200 m.p.h. Then it takes off under its own power, gradually accelerates to 360 m.p.h.

Power Plant engineers doped out the engine in 17 days, analyzing the metals for alloys, reconstructing the design, machining and assembling parts in the Engineering Shops. Aircraft Laboratory tested a robot model in their 5-foot wind tunnel to determine aerodynamic reactions, tested the engine in their 20-foot tunnel to observe speed characteristics and fuel flow rates. Aircraft, Equipment and Materials contributed further resources and skills. AEL designed special electrical equipment to "track" the bombs from launching to final landing.

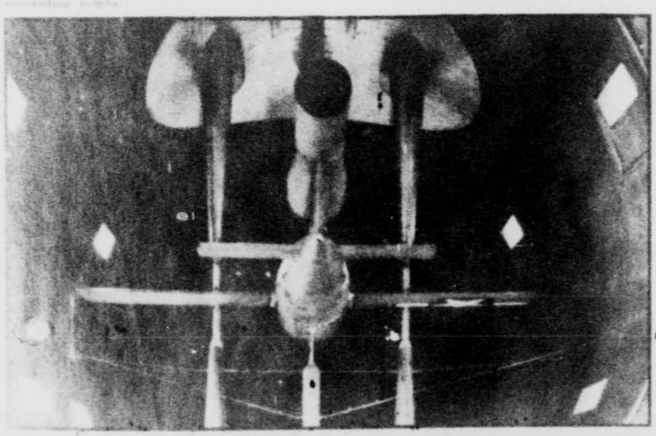
Vacation Cut Short. German robot assaults in force died out last September when the Canadian Army overran the launching coast across the channel. Evacuated Britons began streaming back into London, enjoyed a few bombless weeks before the Things unexpectedly started coming over again.

RAF night fighters guided from radar stations soon discovered the wily Nazis were mounting V-1s pickaback on old Heinkels and other obsolete bombers, launching them at night over the North Sea. The bombs arrive spasmodically, are but a feeble echo of the nightly terror when the platform-launched attacks were at a peak last summer. But not until war's end can citizens of London breathe as deeply and easily as they would like.

No plans have been revealed for the use of robot bombs against Japan. One thing is clear: ATSC officials emphatically stated last week that the U. S. is not interested in copying a weapon which destroys at random. They implied that considerable improvements in direction and range control will be made in V-1 before the Allies employ it in combat.

V-1 came too little and too late to bolster the Reich's sagging defenses. But it is a good guess that the war against Japan will last long enough to give the U. S.: (1) time to perfect robot bombs; (2) time to launch them (from aircraft carriers or platforms in China) against Japan. It is also a good guess that robot bombs may cast a far blacker shadow over the postwar world than any other weapon developed in World War II. It is only a matter of technical improvements to extend their effective range from Berlin to Paris, Berlin to London, Berlin to New York.

* The Germans equipped every tenth V-1 launched from ramps with a radio transmitter so the bomb's course could be followed. Corrections in range and direction were then made, giving the Nazis disconcerting accuracy with succeeding bombs.



ROBOT BOMB IN 20-FOOT WIND TUNNEL
Engineers were frank in their admiration.

Understatement Dept.

15

Wrote Seabee Lloyd Herman of his experiences overseas: "Jap shell fire demolished two tents while I was in them. This I found a bit exciting . . ."

WRIGHT TAKE-OFF

Policy, Loose File
9.711-Brd
ac/a 8702
31-1/11 Maj Vogel

[redacted]

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CL[ASS]IFICATION AUTHORIZED BY
Director, NDD

Date Initials 1840

30 November 1944

K-91975

MEMORANDUM FOR THE COMMANDING GENERALS, ARMY AIR FORCES, ARMY GROUND FORCES AND ARMY SERVICE FORCES

THROUGH THE DEPUTY CHIEF OF STAFF

Subject: Army Guided Missiles Program.

1. Reference is made to Memorandum this Office, 4 November 1944, subject above, in which an Army conference was proposed for the purposes of reviewing the existing development programs in guided missiles and of discussing their future trends. The conference was held on 15 November 1944. The programs presented by Army Air Forces and Army Ground Forces are outlined in the attached summaries.

2. It is believed that the research and developmental projects underway in the Army adequately and effectively cover our future tactical and strategical needs that can be forseen at this time, and are commensurate with our scientific and productive resources.

3. There is a need for closer liaison among related projects, and for a more fluid exchange of information between the agencies which have command interests in these projects. It was determined that there already exist adequate status reports and records within each Force, and it was felt unnecessary and unwise to set up any additional administrative machinery for compiling information. The conferees were made aware of the records already existing, and agreement was reached on providing a suitable exchange of these, and also for assigning liaison officers between Services as necessary. The impetus for the exchange of data among agencies must derive from the Services themselves, as only in this way can the coordination be effectively maintained.

4. Certain types of projects can be simplified by direct action of the sponsoring Service. For instance, there are five possible types of control available for a certain missile. The sponsoring Service must at the appropriate time eliminate those showing least promise. This can be done by the working arrangements already established with outside agencies such as the Navy Department, OSRD, NACA, etc. These arrangements should not be disturbed but strengthened by the Services as necessary.

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5. A Joint Air Force - Ground Force range is necessary for obtaining flight data on missiles of ranges up to 125 miles. An informal agreement, based on a preliminary survey, was reached on such a range which would lie in the area north of El Paso, Texas. Further investigation is underway prior to formal submission of this matter. It is understood that eventually, as further development progresses, water ranges must be resorted to.

6. The "Jet Missiles Board" of the Navy Department is currently reviewing similar projects sponsored by the Navy. Coordination of the overall programs of the War and Navy Departments, supplementing the working coordination already effected between individual agencies, will insure that the U.S. effort is given direction and that new requirements can be quickly and effectively met in this field of research and development.

Wm. A. BORDEN,
Brigadier General, G. S. C.,
Director, New Developments Division

3 Incls:
#1 - Personnel attending conference
#2 - Summary of AAF Guided Missiles, 15 Nov 44
#3 - Ordnance Program, Guided Missiles, Nov 44

cys:
President, Navy Jet Missile Board
Dr. Bush, OSRD
Dr. Bowles, OSW

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HEADQUARTERS, ARMY AIR FORCES
Washington 25

AC-75.

AAF 471.6 4 December 1944

SUBJECT: Policy on Development and Procurement of Propellant Powder

TO : Director, Air Technical Service Command
Attn: Chief, Engineering Division, TSCEP
Wright Field, Dayton, Ohio.

1. Your attention is invited to the inclosed copy of a letter from the Hq. Army Air Forces to the Chief of Ordnance, dated 13 September 44 and 10 indorsements thereto.

2. In the 10th Indorsement the Army Service Forces are advised by this Headquarters that the Army Air Forces do not desire to continue in the development of propellant powders for such projects as are now being carried out under NDRC, Project AC-75. This includes assisted takeoff units, launching rockets for JB-2's, hydro-bombs and allied developments. The indorsement further stated that the Army Air Forces desire the Chief of Ordnance to have complete responsibility for the development, procurement and loading of all types of propellant powders. It is obvious that this decision will affect the plans of the Air Technical Service Command with regard to developmental propellant powders. It is intended that eventually the Monsanto Pilot Plant at Dayton, Ohio, which is now operated under the supervision of NDRC, will be transferred to the Ordnance Department. In the case of assisted takeoff units, the design of the entire unit must be matched to the characteristics of the aircraft with which it is used. This will require extremely close cooperation between the Air Technical Service Command and the Ordnance Department.

3. This decision was motivated by the fact that in post war years, organizations which are now available to the Army Air Forces for developing propellant powders, will probably be disbanded or at least inactivated. Industrial facilities will not be organized for carrying on constant development. In contrast with this, the Ordnance Department will have a peace-time organization with the necessary personnel and facilities for carrying on the development of all types of powders. It is believed that the best interests of the Army Air Forces will be served if only one organization is charged with the development, and this organization will necessarily be the Ordnance Department.

[redacted]

9th Ind — 6 Nov
10th Ind — 6 Nov

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Subj: Policy of Development and Procurement of Propellent Powder
AAF 471.6

4. The Army Air Forces will continue to have prime responsibility for the preparation of military requirements and characteristics for such propellants as are used by the Army Air Forces. As with all other Ordnance items used by the Army Air Forces, these requirements and specifications will be forwarded to the Ordnance Department through the Army Service Forces and this Headquarters will take necessary measures to insure that proper cooperation is obtained. If, in the future, the Air Technical Service Command believes that the Ordnance Department is not supplying adequate service with regard to speed, quantity and quality, it is desired that this Headquarters be advised immediately so that necessary steps can be taken to obtain satisfactory results.

O. P. ECHOLS
Major General, U.S.A.,
Asst. Chief of Air Staff,
Materiel and Services

Ref Ltr dtd Sept 13 w/10 Inds
1st Ind - 14 Sept
2nd Ind - 20 Sept
3rd Ind - 2 Oct
4th Ind - 4 Oct
5th Ind - 16 Oct
6th Ind - 21 Oct
7th Ind - 27 Oct
8th Ind - 1 Nov
9th Ind - 6 Nov
10th Ind - 6 Nov

Ref A & R dtd 7 Dec 44, & 24 Jan 45
Ltr 9 Oct 44 Inds
1st Ind - 19 Oct
2nd Ind - 27 Oct
3rd Ind - 7 Nov
4th Ind - 16 Nov
Ltr 5 Feb
Ltr 10 Nov.

[redacted]

AFTC Form No. 19-8 (17 Oct 44) 416 [illegible] 25-4PP

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ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

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Number all comments consecutively.
Place initials of dictator and typist, telephone number and location to right of signature.
Separate comments by horizontal lines across page.

SUBJECT Guided Missiles.

TO TSBPR FROM TSBPR4 DATE 7 Dec. 1944 COMMENT NO. 1

1. It is recommended that:

a. The handling of all prime Guided Missiles items within the Production Section be concentrated in one organization.

b. That a. be effected by placing all prime Guided Missile project engineering and coordinating responsibilities in Aircraft Sub-Section, either in Glider & Miscellaneous Branch which now has most of the Guided Missile items or in a Guided Missiles Branch.

c. That effective with the accomplishment of b. the Division Coordinator established by Production Division Notice of 4 March 1944 be discontinued.

2. Factual Data:

a. While no Guided Missile has as yet achieved any outstanding tactical success, more and more attention is being focused on Guided Missiles. Development programs are growing and the quantities of "left-overs" from past procurement are increasing.

b. In AC/AS M & S there is now a Guided Missiles Unit, Equipment Section, Engineering Branch, Materiel Division, in place of what was formally a Radio and Radar Section activity. The Chief of this Unit is M & S Project Officer for all Guided Missiles.

c. An Officer is assigned exclusively to Guided Missiles in the Communications Equipment Section, Supply and Maintenance Branch, AC/AS M & S to follow the radio, radar and electronic equipment for Guided Missiles.

d. Guided Missiles requirements are now a function of Bombardment Branch, in Requirements Division, AC/AS OC & R.

e. In Engineering Division, ATSC, all Guided Missiles responsibilities are concentrated in Special Weapons Branch, Equipment Laboratory.

f. In the Production and Procurement Divisions, up to the present time, there has been no centralized responsibility for Guided Missiles. The GB series Glide Bombs and the JB-2 Buzz Bomb are assigned to Glider & Miscellaneous Branch, Aircraft Sub-Section.

g. "Castor" was initially assigned to a Project Officer in Bombardment Branch, Aircraft Sub-Section.

h. Azon was initially assigned to Radio-Electrical Unit in Aero-Equipment Branch and Armament Unit in Components Branch. Azon has since been cancelled and there remains only the reuse of surplus components in future programs.

416 - Guided Missiles

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TO TSBPR FROM TSBPR4 830 DATE 7 Dec. 1944 COMMENT NO. 1

i. Various components require reassignment as a result of the reorganization. Azon servo-motors and "Castor" trim board, both electrical devices, are currently being handled by Instrument Branch. Gyro Antenna Mount, a radio accessory, is currently handled by Electrical Branch.

j. On 4 March 1944 Lt. Col. K. P. Royce was appointed Production Division Coordinator to bring the loose ends together and expedite the matters which were dragging. Despite the fact that the Notice appointing him was restrictive and because Guided Missile activities were spread so widely, Lt. Colonel Royces' activities were rapidly becoming those of a Project Officer or Command Coordinator.

k. Major Marshall replaced Lt. Colonel Royce on 28 August 1944 and by working with Major Mullen and Major Barstow, Office of Administration, and with personnel of Engineering, Supply and Maintenance Division has checked that trend. In the "willie" and subsequent CTI's, clear and appropriate assignment of duties have been made to the various Divisions concerned.

l. CTI's now in the Production Section require procurement action for Razon and Felix. Razon will involve components similar to Azon including:

(1) A special tail assembly for a standard 1000 lb. bomb with rudder and aileron control surfaces.

(2) Special kits of brackets, wire, plugs, etc., for modification of aircraft for use with these devices.

(3) An attachment ring and flare assembly, ordnance supplied.

(4) A G.F.E. radio.

(5) A C.F.E. Gyro Unit obtained as a surplus from Azon.

(6) C.F.E. servo-motors.

(7) C.F.E. batteries.

m. Felix will require (1), (2), (3) (attachment ring only), (5), (6), (7), and a precision electrical device known as a bolometer.

n. Except for the fact that these devices, like Azon, do not have wings they involve problems common to the Glide Bombs and other Guided Missiles.

3. Summary:

The reasons for the recommendations of Par. 1 will be evident from the Factual Data detailed above. Action on recommendations will:

a. Eliminate necessity for a separate coordinator.

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ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

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SUBJECT Guided Missiles.

TO TSBPR FROM TSBPR4 DATE 7 Dec. 1944 COMMENT NO. 1

Page 3

b. Provide for immediate appropriate assignment of Razon and Felix prime project responsibility.

c. Provide a single point of contact within the Division on all Guided Missile matters.

d. Eliminate delays, duplication of effort and improper assignments such as have occurred in the past.

Orville E. Mohler
ORVILLE E. MOHLER,
Lt. Colonel, Air Corps,
Chief, Aero-Equipment
Sub-Section

H. F. Marshall
Major H.F.Marshall:
gk-TSBPR4Q
Ext. 2-5233

TO: TSBPR FROM: TSBPR3A DATE: 12-16-44 COMMENT NO. 2

1. Recommendation of Aeronautical Equipment Sub-Section is supported by Aircraft Sub-Section.

2. If this transition of authority is approved by Chief, Production Section, it is our intention to assign the responsibility for all Guided Missiles to Glider and Miscellaneous Branch of Aircraft Sub-Section. The alternate solution of the creation of a Guided Missiles Branch of Aircraft Sub-Section is recommended against for the following reasons:-

a. Glider and Miscellaneous Branch is already handling a considerable portion of the task, i.e., glider bombs, buzz bombs, aerial targets etc.

b. To create another Branch would be to weaken the existing branch structure by necessary personnel readjustment. Any further disruption of the organization and space arrangements at the present time is looked upon with disfavor for obvious reasons.

3. At least for the time being, no additional personnel will be required by Aircraft Sub-Section to accomplish this work in the event the task is assigned to Aircraft Sub-Section.

4. It is assumed that the procurement of equipment complements will be made in the customary manner by Aeronautical Equipment if the complete responsibility for Guided Missiles is assigned to Aircraft Sub-Section.

WF, Area B-10-20-44-1 MH.

continued on Page 4.

ATSC Form No. 10-3 (11 Oct 44)

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ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

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SUBJECT Guided Missiles DATE 12-16-44 COMMENT NO. 2

TO TSBPR FROM TSBPR3A

PAGE 4

5. It is obvious that Aircraft Sub-Section action upon some projects, i.e., Azon, Razon, Felix, etc., would be confined principally to monitoring the project to insure complete, adequate and prompt handling upon the part of all Procurement Division agencies involved.

6. It is requested that a decision with regard to the above subject be provided this Sub-Section.

C. H. Mitchell
C. H. MITCHELL,
Colonel, Air Corps,
Chief, Aircraft Sub-Section.

Lt.Col. E.J. Gujer
GA/TSBPR3A.
Ext. 2-4154

cc:
Lt. Col. Mohler (TSBPR4)
Lt. Col. Dichman TSBPR3H
TSBPR3I - Bomb. Br.
TSBPR3G - Training & Transport
TSBPR3F - Fighter Branch

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WF, Area B-10-20-44-1 MR.

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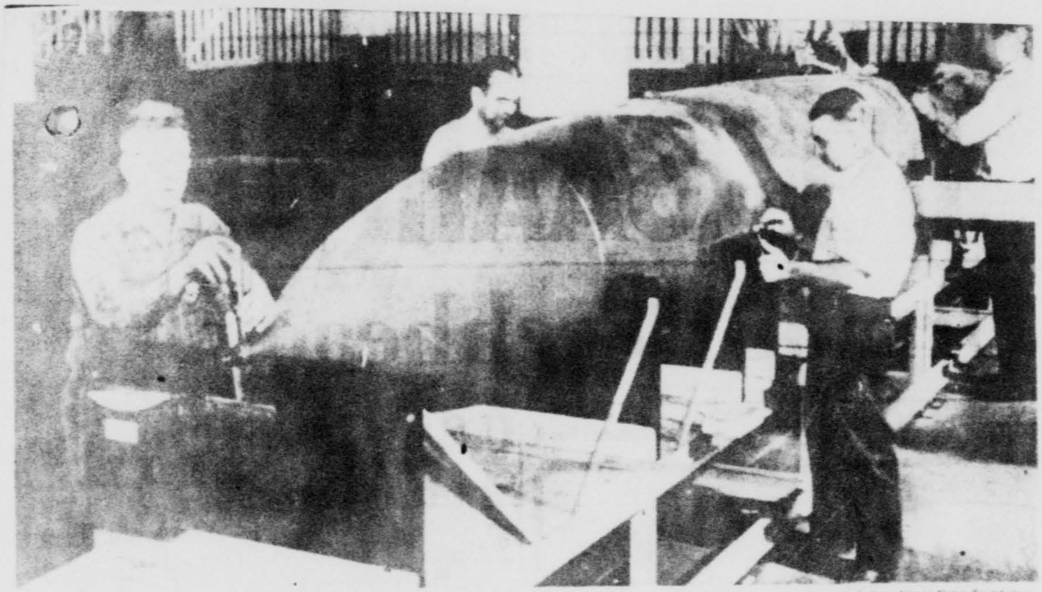

—International News Soundphoto

WORKERS AT THE aircraft division of Willys-Overland Motors, Incorporated, at Toledo, O., are turning out jet-propelled robot bombs as American counterparts of the Nazi V-1. These are for the air forces. This bomb was one of the first shipped from the plant.

PITTSBURGH POST-GAZETTE
9 December 1944

U. S.-Type Buzz Bomb In Mass Production

Junk Parts of German Missile Enable Yank Experts to Build Superior Weapon

Toledo, O., Dec. 8—(AP)—An American version of the Nazi V-1 "buzz bomb" is in production at the Willys-Overland motors plant here, President Charles E. Sorenson disclosed today.

An experimental model of the weapon was jet propelled through the air October 11, just 60 days after junk parts of a Nazi bomb were flown here from England, the air service technical command said in an earlier announcement, which did not disclose the location of its proving grounds.

Yankee tinkering genius improved on the German version which terrorized London last summer, the ATSC stated. "Its launching ramp is better because it can be built in four days whereas the Nazis require two weeks."

Mass production was started 60 days after receipt of the contract, Sorenson reported. "The aerial bomb, shipped complete except for the engine and controls, has a 27-foot fuselage and a wing span of 17 feet.

"Fuel tanks containing ordinary low-test gasoline which give the bomb a range of about 150 miles are amidships."

V-2 Rocket Attains Speed Of 3,000 Miles Per Hour

London, Dec. 8—(UP)—The German V-2 rocket bomb travels at 3,000 miles an hour in some phases of its 200-mile, five-minute journey from launching sites in the enemy-occupied Netherlands into England, the air ministry news service disclosed today in revealing hitherto concealed information about the enemy weapon.

The news service said it was believed that rockets launched against the south of England required operation of their motors for only about a minute as after they reach the top of their trajectory—60 miles up—they follow the ordinary principle of falling artillery fire.

At times the rocket's body, weighing 12 tons, glows red from the friction of its passage through the air.

The news service said that there are six main assemblies in the shell-like hull of each rocket. The nose packs a ton of explosive; fuel consists of 7,500 pounds of alcohol and 11,000 pounds of liquid oxygen.

The rocket bomb is launched by an electrical charge. It is controlled by a gyroscope mechanism during its flight. The amount of fuel it uses can be controlled by a mechanism set beforehand, or by remote control ra[illegible]

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Key committee 1144

CONFIDENTIAL

December 15, 1944

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

MEMORANDUM

GUIDED MISSILES, NACA PROGRAM AND FACILITIES

While an effort is now being made to centralize and coordinate work on guided missiles in various branches of the Armed services and in N.D.R.C., it appears to me desirable to outline the part which the NACA is prepared to undertake in any general program dealing with guided missiles.

The NACA is authorized by statute to undertake on its own initiative "the scientific study of the problems of flight with a view to their practical solution". The policy of the Committee is to undertake scientific and engineering studies of such guided missiles as come within the cognizance of the Army Air Forces and the Naval Bureau of Aeronautics. It further restricts its own activities to those fields in which it has staff and facilities, developed primarily for aircraft needs. Consequently, the Committee prefers to leave to others, presumably better equipped, research in radio, radar, television, photoelectric, infra red, and special applications of physics to [illegible] and guiding devices. The Committee is not prepared to undertake research and development of fuses, explosives, [illegible] and [illegible] devices.

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A very substantial portion of the Committee's staff and funds is now devoted to research in the following fields:

1. Subsonic aerodynamics
2. Supersonic aerodynamics
3. Internal aerodynamics
4. Stability and control of missiles in flight
5. Instrumentation for control
6. Combustion
7. Compressors
8. Turbines
9. Jets
10. Apparatus for self-propulsion
11. High-temperature metals

Research results are distributed in the form of reports to an authorized mailing list. The Committee's research program includes matters of immediate concern to the current development projects of the Army and Navy, and also long-range problems expected to have a bearing on the future security of the United States in the light of possible technical advances.

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EQUIPMENT AVAILABLE

1. Subsonic Aerodynamics. During the current year, wind tunnels and staff have been used for aerodynamic analyses of a large number of missiles for the Army, Navy and A.A.F. at subsonic speeds. For one glide bomb, eleven separate reports have been made. The equipment used includes the following wind tunnels:

Langley Laboratory	20 ft (F.R.T.)	100 mph
Langley Laboratory	8 ft (H.S.T.)	600 mph
Ames Laboratory	7 x 10 ft	300 mph
Ames Laboratory	12 ft (V.D.T.)	750 mph (building)
Ames Laboratory	15 ft	600 mph
Cleveland Laboratory	20 ft (altitude)	500 mph

2. Supersonic Aerodynamics. The Committee's general research program has been under way for the past ten years, and a substantial body of knowledge has been acquired for the guidance of designers whose projects bring local velocities through the speed of sound. Application of these facilities to problems of high-speed self-propelled missiles is a natural extension of the fundamental program. In particular, control effects at critical and supersonic speeds must be explored. The Committee's confidence in wind tunnel methods has recently been confirmed by excellent correlation of drag results at critical speed for a

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Mustang fighter (dived) with wind tunnel tests of a third size model tested at the same speed in the 16-ft tunnel at Ames Laboratory.

The supersonic program includes work with the following wind tunnels:

Langley	7.5" x 10" (induction)	Mach No.	2
Langley	4" x 18" "	" "	1
Langley	24" "	" "	1
Ames	1' x 3' (continuous)	" "	2 (building)
Ames	1' x 3' (induction)	" "	2.8 "

In addition, Langley is conducting dropping tests of missiles, released at 35,000 ft, with altitude, acceleration and drag radio telemeter instrumentation, and with radar and photo recording of the flight path. Mach numbers up to 1.1 are attained. The British at Farnboro are participating with NACA in a joint research program along this line.

The shooting of objects through a long 8-ft diameter evacuated tube has been proposed for the study of supersonic flow phenomena, and funds have been appropriated to construct the necessary apparatus at Langley. Very high Mach numbers can be obtained in this way. It is expected to have unique instrumentation available next year.

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In this connection, it should be mentioned that the facilities of Army ordnance at Aberdeen include:

Indoor firing range for 50-cal and 20-mm

2-ft wind tunnel, Mach No. 1.2, (building)

1-ft wind tunnel, Mach No. 3, (building)

There are no important facilities for supersonic aerodynamic research elsewhere in this country.

3. Internal Aerodynamics. Any jet-propelled missile (not a rocket) requires the intake of a relatively enormous quantity of air, its passage through ducts, with subsequent compression, expansion and ejection. The internal aerodynamic losses at high speed may easily defeat the purpose of the design. Research on flow phenomena through such intakes and passages has been highly developed in connection with engine cooling and supercharging. The Cleveland Laboratory is provided with powerful sources of supply of compressed air for jet propulsion studies and the research groups have developed useful methods of analysis of internal flow phenomena at critical and supersonic speeds.

An appropriation of some $3,000,000 has just been passed to enable the Committee to enlarge facilities at Cleveland for the experimental study of such flow problems. This equipment has no parallel elsewhere in the world.

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4. Stability and Control. At Langley, a group of some thirty engineers, physicists and applied mathematicians has been assembled over the past few years to handle problems of airplane stability and control. They translate aerodynamic results of wind tunnel tests into predicted flying characteristics of new airplanes, analyze flight trials of existing airplanes and propose alterations to improve flying characteristics.

During the past year, this group has been almost exclusively devoted to flying missiles, and it is expected that this condition will continue as long as priority is demanded for such work.

The services of the group also have included attendance for consultation at contractors' works, and at Eglin, Wright, Tonopah, etc., for flight trials.

In general, this group has been unable to conduct a consistent research program, as its services were required to overcome troubles with many specific missiles designed by others, often without adequate aerodynamic background. It is hoped that this condition can be remedied as designers become familiar with the results of reported research, and as the Army and Navy come to disclose their problems earlier and more fully, rather than late and partially.

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[illegible]. <u>Instrumentation</u>. Langley, Cleveland and Ames Laboratories have each a strong instrumentation group, serving their special requirements. At Langley a specialty is made of flight instrumentation and this research group has had a great deal to do with guided missiles. The instrumentation skill and experience of Langley could be better utilized by setting up a temporary firing point on Cherry Point, N. C., where new missiles could be properly adjusted and equipped for flight, rather than as at present to send individuals to distant points to advise others with their flight trials.

[illegible]. <u>Combustion</u>. The Cleveland Laboratory is deeply concerned with fuels and combustion research, as the basis of the internal combustion engine, the gas turbine and the jet propulsion power plant. At present a substantial portion of the staff is engaged on problems of self-propulsion of missiles. Projects include:

Exploratory work on rocket fuels (Army)
Intermittent jet engine (Army and Navy)
Optimum design of long-range missile (Army)
Ram jet theory and experiment (Army and Navy)
Burner experiments (Navy)
Combustion chambers (Navy)

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facilities include a copious supply of combustion air and combustion gases, physical-chemical apparatus for study of the combustion process, burner development, metallurgical development, fuel evaluation, and thermodynamic studies in general.

Combustion at high flow rates under altitude conditions is checked in the altitude wind tunnel ([illegible] ft, [illegible]00 mph, $-40^{\circ}F$).

[illegible]. Compressors. Results of research on engine superchargers and on compressors for gas turbines is applicable for certain long-range missiles where combustion air must be compressed to enhance efficiency. Cleveland has an experienced group specializing in this subject and provided with extensive equipment, including instrumentation.

[illegible]. Turbines. Experience in turbine research at Cleveland may be applicable to missiles of long range. The gas turbine work has grown out of the exhaust turbo drive for airplane engine superchargers and has developed further with modern jet propulsion power plants. Extensive facilities and expert staff are available.

[illegible]. Jets. The early work of the NACA at Langley evolved an effective ram jet with suitable burner. This had no application to current airplanes as a thrust augmenter because

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of the high speed required for efficiency. More recently, research on ram jets has been resumed at Cleveland where the altitude wind tunnel permits evaluation under flight conditions.

Cleveland is active in the study of various aspects of jet propulsion for both airplanes and missiles, including a comprehensive search for the optimum conditions for an interrupted jet of the German type. Very great improvements appear to be possible.

A research team at Cleveland has evaluated the augmented thrust given by a jet when water is injected before combustion and when additional fuel is injected after combustion. The research results may be significant for missiles.

<u>10. Apparatus for Self-Propulsion</u>. The evaluation of whatever apparatus a missile is given for its propulsion is a matter for which Cleveland is well equipped to handle. The current program of research projects for jet-propelled airplanes includes the analysis of details of performance of four different turbo-jet power plants. The smallest of these has very interesting possibilities for a long-range missile.

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11. High-Temperature Metals. The effective use of jet propulsion, including associated combustion chambers, turbines, nozzles, etc., has a limitation in the metals available to withstand high temperatures. The Committee has had extensive experience in this field of research, and its experience is available for similar problems which arise in the case of missiles.

J. C. Hunsaker
Chairman

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HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

28 December 194[illegible]

MEMORANDUM FOR AC/AS, Operations, Commitments and Requirements:

Subject: Controlled Missiles

1. Recent changes in emphasis in the guided missiles program make it advisable to consider controlled missiles as another class of airplane, insofar as assignments of responsibilities to offices of this Headquarters are concerned.

2. Effective immediately, your office is charged with responsibilities for controlled missiles in accordance with the basic definition of responsibilities as outlined in AAF Regulations 20-[illegible] and 20-46, and amendments thereto, with the following exceptions:

a. The Air Communications Officer is charged with completing the Campbell Project and the work through the stage of test introduction into theaters of other guided missiles projects now under way which fall into the following category:

(1) Guided missiles which do not require any propulsion units, whether ram-jet, rocket, or more conventional means, and which have an electronics system of flight control.

3. Effective simultaneously, the special directives to the Air Communications Officer, under date of 29 September 194[illegible] and 1[illegible] October 194[illegible] on the subject of guided missiles, are rescinded.

4. As the Air Communications Officer completes test introduction into theaters of those missiles included in 2a, further responsibilities for them will be handled through normal staff channels. All new projects, including those which fall into the category of 2a (1), will be handled through normal staff channels.

5. Under this reassignment of responsibilities, and subject to the exception outlined in paragraph 2:

a. AC/AS, Operations, Commitments and Requirements is specifically charged with primary responsibility for developing as necessary, and establishing military characteristics, statements of military necessity, and basis for computation of quantitative requirements for controlled missiles and countermeasures therefor. The AC/AS, [illegible] will establish military characteristics for component parts of guided missiles to the extent that military characteristics for such parts are not implicit in the over-all characteristics approved and forwarded to the AC/AS, Materiel and Services for research and development purposes.

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3. AC/AS, Materiel and Services is especially charged with primary responsibility for exercising staff supervision over the research, development, procurement, installation, maintenance, storage and issue of guided missiles. In carrying out this responsibility, the AC/AS, M&S will insure an integrated development and procurement program for guided missiles, including component parts thereof, and will be held responsible for reporting to the Commanding General, AAF or Chief of Air Staff with respect thereto.

4. The Air Communications Officer is especially charged with advising and recommending to the AC/AS, OC&R possible new developments or uses of existing radar and radiation control mechanisms and other communications equipments for guided missiles. He will exercise his normal over-all monitoring responsibility for communications aspects of controlled missiles.

5. The AC/AS, OC&R is designated as the office of primary interest in this Headquarters in the guided missiles program. That office will maintain current information with respect to the status of the program, and will insure coordination on the part of all offices of this Headquarters concerned therein.

6. The responsibilities established by this directive are limited to the responsibilities assigned to the Commanding General, AAF for research and development of guided missiles as outlined in memorandum for the Commanding General, AAF from the Deputy Chief of Staff, 2 October 1944, subject: "Guided [illegible] Missiles."

7. At present there are five officer positions authorized in the Office of the Air Communications Officer for working on guided missiles. Effective immediately, action will be taken to transfer from the Office of the Air Communications Officer to the AC/AS, OC&R:

a. The officer, together with the position which he fills, who is working on the "Mary Willie" project.

b. One officer position authorization, presently not filled.

8. As the special exception projects outlined in paragraph 2 are completed insofar as the Air Communications Officer is concerned, the three officers engaged in these projects, together with their positions authorizations, will be transferred to the appropriate Headquarters office normally responsible for the activities in which these officers have been engaged.

9. Attached is a copy of a HQ Office Instruction which is being issued to inform all Headquarters staff agencies of this matter.

1 Incl
HQ OI [illegible] Assignment of
Guided Missiles [illegible]
[illegible]
[illegible]

FREDERIC H. SMITH, JR.
Brigadier General, U. S. Army,
Deputy Chief of Air Staff.

Identical memorandum forwarded to:
Air Communications Officer
AC/AS, M&S
Component Control

[redacted]

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COPY

21 January 1945

SUBJECT: Prepayment to OSRD on Crash Procurements.

TO: Director
AAF, Air Technical Service Command
Wright Field, Dayton, Ohio
Att: Brig. Gen. F. O. Carroll
Chief, Engineering Division (TSENS)

1. Reference is made to the need for accomplishing the expeditious transfer of AAF funds to the OSRD in prepayment for the crash procurements made by that organization of development models of equipment for operational use of AAF installations.

2. Cognizant that present methods are not fulfilling the above requirements, informal inquiries have been made of the offices of the Budget and Fiscal Officer, at your Command, and also within this Headquarters, relative to the establishment of a simplified method of making such payments to the OSRD.

3. Experience has indicated that most, if not all, of such crash procurements have been made in connection with radio and radar activities. The suggested plan has therefore been advanced that the Director of the Radio and Radar Section, Engineering Division, within your Command, could initiate one (1) purchase order against funds allocated to that Section, to cover the anticipated expenditures for applicable crash procurements of radio and radar development models that will be made by OSRD during the balance of the fiscal year. Such a purchase order would be so worded as to describe in general terms the radio and radar procurements to be made by the OSRD for the Army Air Forces within a stated period of time, and would stipulate that any unused or unallocated portion of the funds, transferred as a result of this purchase order, would be subject to return to the Army Air Forces upon proper notice to the OSRD by the Director of the Air Technical Service Command.

4. Acceptance of the purchase order would be signified by OSRD, with confirmation of understanding that such funds received will be used to finance individual crash procurement requests made by proper AAF agencies to the OSRD that are within the scope of the initial purchase order. Upon completion of these preliminary steps, OSRD would prepare Form 1080 voucher in the amount of the aforesaid purchase order and submit the same to the Director of Air Technical Service Command, attention Budget and Fiscal Officer, who would indicate the approval of the transaction, designate funds chargeable, and transmit the voucher with three (3) copies of the purchase order to the Budget and Fiscal Officer, Headquarters, Army Air Forces. This Headquarters would then process the voucher so as to result in the transmittal of an advance payment check for the full amount of the voucher to OSRD. Upon receipt of these funds, the OSRD would then take necessary action to establish the proceeds of the check in an applicable work fund.

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5. It is directed that an immediate review of the plan set forth above be made, and if no alternate proposal is submitted to this Headquarters from your Command, necessary action be taken to implement the accomplishment of this method of payment to the CERD.

By command of General ARNOLD:

J. P. PHILLIPS
Colonel, Air Corps
Chief, Materiel Division
Office, Asst. Chief of Air Staff
Materiel and Services

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ATSC 121.7 (31 Jan 48) 1st Ind. TSERD (TSERE)

HQ AAF ATSC Wright Field, Dayton, Ohio, 14 February 1948

TO: Commanding General, Army Air Forces, Washington 25, D. C.
Attention: Asst. Chief of Air Staff, Materiel & Services

1. At the present time funds for the research and development program of the Radio and Radar Section are exhausted. A recent request for an additional allocation of $4,000,000, of which $1,000,000 was 510 money and $3,000,000 was 130 money. This additional authorization as of this date has not been received but will be insufficient to carry out the approved program of the Radio and Radar Section.

2. It is impossible to foresee the amounts of money which may be necessary on approved crash programs. Since the OSRD is not supposed to engage in quantity procurements, it is not believed advisable to turn over funds for quantity procurement, particularly in those cases where the NDRC enters into a contract with a commercial manufacturing concern. Such contract would be more satisfactorily processed by the procuring agency of the Army Air Forces with the NDRC on an advisory or consultative status. An exception would be the case where the NDRC would have the equipments manufactured by the Radio Construction Corporation. This latter organization is an agency of the NDRC.

3. The Procurement Division of the Air Technical Service Command has instituted an emergency procedure for expediting emergency procurements. Under this procedure a go-ahead can be given to a commercial manufacturer in from one to three days.

For the Director:

/s/ F. O. CARROLL
Brigadier General, U.S.A.
Chief, Engineering Division

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5 - 8/13/94 COPY W-793 Filed 5 Feb 45

[redacted]

MAJOR COMMAND RESPONSIBILITY FOR EMPLOYMENT OF GUIDED MISSILES [redacted]

A paper, designed for submission to the Chief of Staff and now in the hands of the Chief of Air Staff, has been prepared which will, if approved, establish long term responsibilities of major commands for the operational employment of guided and controlled missiles.

The present War Department policy respecting guided and controlled missiles establishes responsibilities for the development of these new weapons, but fails to indicate responsibilities for operational employment. In view of General Arnold's stated belief that the future of the AAF lies to a great extent with pilotless aircraft and guided or controlled missiles, and in view of the confusion which has arisen concerning operational employment of the JB-2 buzz bomb as between the AAF and the AGF (decision on which assigns responsibility to the AAF), it is apparent that a firmer policy is required.

The proposed policy, establishing responsibilities for both development and employment, is based upon the fundamental missions of the major commands as well as upon the technical characteristics of the missiles, and would provide:

a. That the Air Force have responsibility for operational employment for all guided or controlled missiles, regardless of their technical characteristics, capable of complementing or supplementing the strategic or tactical air effort, with the exception of those new weapons capable only of complementing, supplementing, or supplanting close cooperation of air elements with ground elements.

b. That the Ground Forces have responsibility for operational employment of all guided or controlled missiles, regardless of their technical character, capable of complementing, supplementing or supplanting artillery fire or close coordinating air effort, but without the capability of further application.

c. That the Air Forces have the responsibility for operational employment of guided or controlled missiles capable of complementing or supplementing interceptor fighters, and which are sustained by means other than the momentum of the missile.

d. That the Ground Forces have responsibility for operational employment of guided or controlled missiles complementing, supplementing or supplanting anti-aircraft fire, and which depend for sustenance on the momentum of the missile.

(Col Giffin-3020)

[redacted]

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Signal Corps
G M Br., AC/a1-4
5. -1/2

2W611

[redacted]

HEADQUARTERS, ARMY SERVICE FORCES
WASHINGTON 25, D. C.

SPROP

5 Feb. 1945

MEMORANDUM FOR THE CHIEF SIGNAL OFFICER.

Subject: Countermeasures for Enemy Guided Missiles.

1. Reference: Attached letter from Headquarters, Army Ground Forces to this Headquarters, file 471.94 (S) (27 Jan 1945) GNRQT-5/13309, dated 27 January 1945, subject as above.

2. Within Army Service Forces, the Chief Signal Officer hereby is assigned the following responsibilities with respect to guided missiles:

a. Development of equipment and methods for tracking hostile missiles in flight from point of launching to point of impact.

b. Development of equipment and methods for electronically detecting and locating enemy launching sites.

c. Development of equipment and methods for neutralizing or taking over electronic control of hostile missiles.

3. The enemy currently is directing against our forces their own version of guided missiles against which countermeasures are needed immediately. The Ordnance Department of Army Service Forces, Army Air Forces and the Navy all have extensive programs for the development of such missiles. Countermeasures are first put into combat.

4. The Chief Signal Officer is directed to initiate and prosecute under high priority the thorough studies of our own and enemy designs which are necessary to enable him to discharge the responsibilities assigned in Paragraph 2.

5. As soon as the design and development of countermeasures equipment can be formalized, it is desired that appropriate projects be established and coordinated among interested agencies by the Signal Corps Technical Committee.

6. In order to obtain most expeditiously all pertinent information available in this country, the Chief Signal Officer will require the utmost cooperation of the agencies which are engaged in the development

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SPRD
Subject: Countermeasures for Enemy Guided Missiles.

of guided missiles. For the purpose of obtaining this information direct correspondence with the appropriate agencies is authorized. If formal clearance is necessary, this Headquarters should be furnished the names of the Officer or officers for whom that clearance is desired.

FOR THE COMMANDING GENERAL:

PHILIP R. FAYMONVILLE
Colonel, General Staff Corps
Director, Research and Development Division

1 Incl:
Ltr fm AGF to
ASF, dtd 27 Jan 45

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TAB B

COPY W-798
[redacted]

6 Feb 45

Guided Missiles

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1. Reference is made to Top Secret Disposition Form, subject "Guided Missiles" to the CG, AAF from OpD WDGS, dated 30 January 1945, in which a decision is reiterated as to the responsibility of major commands in the employment of a guided missile.

2. It is apparent that, under existing directives, the question of major command responsibility for the operational employment of each newly developed guided or controlled missile must continue to arise. This time consuming process, especially unfortunate in that it leads to either a duplication or a lack of preliminary planning for the use of such new weapons, would be unnecessary provided an adequate policy governing the assignment of major command responsibility for operational employment of guided or controlled missiles could be formulated. It is considered that such a policy can now be formulated.

3. The AAF believe that responsibility for operational employment of guided missiles can be assigned realistically only in terms of the missions of the major commands as well as the technical character of the missiles. The missions of the AAF are:

a. To gain air superiority by attacks against aircraft in the air and on the ground and against those installations which the enemy requires for the application of air power.

b. To destroy the enemy's industrial capability of waging war and the enemy's will to resist.

c. To disrupt hostile lines of communication, destroy supply dumps and installations, and attack hostile troop concentrations in rear areas.

d. To destroy selected objectives in the battle area in furtherance of the combined air-ground effort.

4. The JB-2 and any weapon with similar capabilities can conceivably be employed in accomplishing any or all of the above missions. In accomplishing the mission of 3d above, such weapons could be operationally employed by units of either Air or Ground Forces. However, only the air commander can employ such weapons fully against both strategic and tactical targets, and, in terms of economy of means, it would appear advisable to charge the Air Forces with responsibility for operational use of all weapons whose capabilities resemble those of the JB-2.

5. In order to clarify policy as it pertains to operations as well as development, the attached proposed revision of memorandum from the Deputy Chief of Staff, subject: "Guided Missiles" dated 2 October 1944, is recommended for signature.

Incl
Memo to CGAAF
AGF
ASF

BARNEY M. GILES
Lt General USA
Chief of Air Staff

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223 Refer:F:TMR

OFFICE FOR EMERGENCY MANAGEMENT

OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

VANNEVAR BUSH
Director

1530 P STREET NW.
WASHINGTON, D. C.

February 1[illegible], 1945

SECRET

Commanding Officer
Air Technical Service Command,
Wright Field,
Dayton, Ohio

Subject: Project AC-36

Dear Sir:

This is with reference to the transfer of funds to OSRD to cover the cost of equipment being produced under the subject project.

As you know, this office, at the specific request of the Army Air Forces, entered into commitments with various industrial firms for the production of 'Felix' equipment. In my letter of November 25, 1944, I advised you that OSRD had issued a letter of intent in an amount up to $4,000,000 to Remington Rand, and that this letter would be withdrawn when and if the Army Air Forces entered into a contract with Remington Rand for the same work. It later became apparent that the Air Forces contract with Remington Rand would require considerable time to execute, and OSRD proceeded to write a contract for the $4,000,000 work covered by the letter of intent. I advised you of this fact in my letter of January 1, 1945 with which I enclosed a Standard Form 1080 voucher in the amount of $4,000,000 to effect a transfer of funds to OSRD for the cost of this contract.

In addition to the $4,000,000 voucher I had previously transmitted in my letter of November 25, 1944 a voucher for $[illegible]00,000 to cover additional expenses which OSRD was incurring under other contracts in connection with the 'Felix' equipment.

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SECRET

Despite the length of time that these vouchers have been pending, neither transfer of funds has been completed. This situation places OSRD in a very embarassing position, in that funds appropriated to it for research and development are tied up in production work for the Army Air Forces. In view of this condition, I must request that you take immediate steps towards bringing these transfers to completion. It is my understanding that the voucher for $4,000,000. has now reached the Budget and Fiscal Office of the AAF in Washington. However, will you please take every effort to follow-up on this voucher and prevent any further delay in its settlement?

The settlement of these vouchers is not the only instance in which OSRD has encountered a delay in receiving a transfer of funds from the Air Technical Service Command. Under date of November 9, 1944, there was forwarded to you a voucher in the amount of $825,000. covering the cost of equipment produced under Project AC-105, and under date of November 17, 1944, a voucher in the amount of $25,000. covering the cost of equipment produced under Project SC-38. Despite assurances that these transfers would be completed within a week, these funds were not received until December 11, 1944, and December 16, 1944, respectively. Unless some procedures can be effected within the AAF to assure less delay in the settlement of similar transfers of funds, it will be difficult for this Office to accept further project extensions involving transfers of funds from the AAF, particularly in the latter part of the fiscal year.

Very truly yours,

Irvin Stewart
Irvin Stewart
Executive Secretary

13:08

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SECRET

COPY 1103 [redacted] COPY AC-75

Written 2/17/45
Major A W Logan/ers/3350

AFDMA-RE
20 February 1945

Development of Rocket Propulsion Devices.

Director, AAF Air Technical Service Command
Wright Field, Dayton, Ohio

1. The development program of the Army Air Forces in the field of thermal engines and rocket propulsion has progressed to a point where it is necessary to establish a suitable research and development activity for rocket power plants as the sole means, as well as auxiliary propulsion of aircraft.

2. Basic policy with respect to the responsibility of development of rocket devices, insofar as they relate to guided missiles, is provided in Memorandum for Commanding General, Army Air Forces, dated 2 October 1944, from Deputy Chief of Staff. Paragraphs applicable to Army Air Forces are quoted below:

> "2a. That the Commanding General, Army Air Forces, have research and development responsibility, including designation of military characteristics, for all guided or homing missiles dropped or launched from aircraft.
>
> "2b. That the Commanding General, Army Air Forces, have research and development responsibility for all guided or homing missiles launched from the ground which depend for sustenance primarily on the lift of aerodynamic forces. For the present the designation of desired military characteristics for the equipment is charged to the Army Air Forces, and to Army Ground Forces as their interests appear.
>
> "3. Propulsion units, whether ram-jet, rocket, or more conventional means, and control systems, whether mechanical, radio, radar, television, or infra-red, are considered as integral components of specific weapons. The research and development of these two aspects of guided missiles therefore fall within the purview of the arm or service having responsibility for development of the weapon in which they

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be used. In contradistinction are the developments in warheads, non-integral launching devices, ground components of control systems supplementary to the primary control [illegible], etc., for which any service having a basic technical ability in research should be called upon for assistance."

2. Division of responsibility for development of rocket motors and fuels for Army Air Forces application is presently as follows:

a. The development of rocket assisted take-off devices, formerly the responsibility of the Jet Propulsion Branch, Air Technical Service Command, is being transferred to the Chief of Ordnance.

b. Chief of Ordnance is responsible for the development and procurement of solid propellants of all types.

c. Chief of Chemical Warfare is responsible for development and procurement of propulsive liquids of all types.

3. The emphasis at present is on development of rocket propulsive devices for guided missiles and very little research or development provides for the possibility of rockets as the sole means for aircraft propulsion. Studies are under way at Air Technical Service Command for development of a transonic or supersonic airplane powered by turbine jet propulsion and rockets. Development of power plants, including conventional reciprocating, gas turbines for both propeller drive and jet propulsion, [illegible], and impulse engines (such as German robot motor) whether for aircraft or missile application is the responsibility of the Power Plant Laboratory, Air Technical Service Command. Thus, the development of rocket motors is the only power plant not at present under the supervision of this laboratory.

4. It is probably premature at this time to consider the actual application of rocket devices for aircraft propulsion other than those types that have already been considered for booster or auxiliary power purposes because of limitations of fuel characteristics, handling and storage, and metallurgy of motors. However, if progress in the development of jet propulsion devices in all their various forms over the past few years can be used as a yardstick, it is evident that it will only be a matter of time until rocket devices must be considered as a means of aircraft propulsion. If research into means of propulsion for future aircraft is to be fully implemented, it is believed essential that research on rockets be included in the present power plant development program.

5. The matter of rocket propulsion for various devices, particularly aircraft, has been given considerable study by activities of this

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Headquarters in an attempt to determine whether such development should be aligned with present as well as projected Air Technical Service Command Power Plant Laboratory efforts in developing conventional and unconventional engines. As a result, it has been concluded that in projecting an overall power plant program, consideration should be given to all possible means of propulsion for aircraft, including rocket propulsion. It is believed that this program can best be implemented by including under the Propulsion and Accessories Section, Air Technical Service Command (preferably in the Power Plant Laboratory), a suitably staffed activity, together with adequate facilities, charged with research and development of rockets as the sole source of propulsion of aircraft, as well as studies of rockets as a means of booster or auxiliary power. Such an activity should be initially engaged in reviewing progress of rocket developments already accomplished by other activities, including the Bureau of Ordnance, Navy Department, Ordnance Department, U.S.A., Office of Scientific Research and Development, National Advisory Committee for Aeronautics, etc. Following the above survey, theoretical studies should be undertaken of rocket motor designs for purposes previously outlined supplemented by such development and tests (laboratory and flight tests) as may be deemed necessary. Since the Power Plant Laboratory is already engaged in a research prgram on high heating value fuels, such protions of this fuel program as are applicable may be readily combined and expanded with above mentioned rocket research and development. It is desired to point out that this proposal is not meant to replace in part or supersede present research and development work which other activities of the Army Air Forces or the Army Ground Forces have under way of rockets for propelling bombs or missiles. This new activity should, however, coordinate its research with that of respective services in order that advantage may be taken of new developments and techniques concurrently being investigated by those services.

7. It is therefore directed that the necessary steps be taken to establish a suitably staffed activity in the Power Plant Laboratory, together with adequate facilities, for research and development of rockets as the sole means of aircraft propulsion, as well as studies of rockets for auxiliary power.

10:03

/s/ O. P. ECHOLS
Major General, U.S.A.
Assistant Chief of Air Staff
Materiel and Services

AFDMA-2 AFDMA-1 AFAAS-1

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AFDMA-1 Lt.Col. Stace/Brig.Gen.Phillips/ss
AFDMA-20 4908-71500
Written 28 Feb 45

28 February 1945

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2/28/45 JFP

MEMORANDUM FOR NEW DEVELOPMENTS DIVISION, WDSS
ATTENTION: Brig. Gen. W. A. Borden

SUBJECT: Army Air Forces Guided Missiles Program

1. Reference is made to conference in your office 27 February attended by Generals Echols, Crichlow, the undersigned and Colonel Trichel during which mention was made of a request which this office had received from the Guided Missiles Committee for detailed information on the Army Air Forces program.

2. It was the understanding of General Echols and the undersigned in the above conference that you were not in entire agreement with the necessity for our furnishing detailed data to the Guided Missiles Committee. However, in accordance with the specific request of Colonel Shinkle and follow-ups by Colonel Fishel to Lt. Col. Stace, of this office, there is forwarded the following for transmittal to the Guided Missiles Committee:

a. Tab A - Copy No. 104 of the Army Air Forces summary "Guided Missiles Development Status and Availability.

b. Tab B (B-1, B-2, B-3, B-4). Army Air Forces Headquarters Organization Chart. The functions of the various offices are in accordance with AAF Regulations 20-1 of 1 September 1944 (Tab B-2) as amended by 20-1A, B, C and D (Tab B-3), and with Headquarters Office Instruction 20-79 of 1 January 1945, "Assignment of Guided Missiles Responsibilities within the AAF," (Tab B-4. Note: Under the present interpretation of this Instruction the Air Communications Officer retains responsibility for sponsoring, until test introduction into the theatre, the VB-3, VB-4 and VB-6).

c. The offices primarily concerned with guided missiles in the various Headquarters offices follow:

(1) AC/AS, OC&R - Munitions and Missiles Section, Bombardment Branch, Requirements Division.

(2) AC/AS, M&S - Special Weapons Section, Engineering Branch, Materiel Division.

(3) Air Communications Officer - Special Projects Section, Equipment Division.

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Memorandum for New Developments Division, WDGS, Attn: Gen. Borden

c.c. DM-1 file

d. Tab C. Organization Chart of the Engineering Division, Air Technical Service Command. This Division carries on all Army Air Forces development work. The Pilotless Aircraft Branch of the ATSC Engineering Division Liaison offices uses all the necessary Laboratories for any guided missiles developments. These Laboratories also supervise and carry on the basic research that leads to airplane and guided missiles improvements and developments.

3. The Army Air Forces through the Air Technical Service Command also uses many other agencies for assistance and guidance. These include OSRD (including NDRC), National Advisory Committee for Aeronautics, California Institute of Technology, various units of the Army Service Forces and the Navy, the British, and both commercial and scholastic laboratories and research organizations. Included among the civilian advisory groups concerned with AAF guided missiles are the following:

a. Office of Dr. E. L. Bowles, Expert Consultant to the Secretary of War and Special Consultant to Commanding General, Army Air Forces.

b. Scientific Advisory Group (Office of Dr. Von Karman), Chief of Air Staff.

c. NACA Special Committee on Self-Propelled Guided Missiles. Details of this Committee were forwarded to New Developments Division on 9 February 1945.

J. F. PHILLIPS,
Brig. Gen., U.S.A.,
Chief, Materiel Division,
Office, Asst. Chief of Air Staff,
Materiel and Services.

[redacted]

[redacted]

MEMORANDUM TO ASSISTANT CHIEF OF AIR STAFF, [illegible]

Subject: Field Trip

1. A recent trip took this office [illegible] new developments in the guided missile [illegible]

a. [illegible] at [illegible] the glide bomb with [illegible] at night [illegible] dropped from an altitude of [illegible] The target itself [illegible] ft of the flare. Very definite control [illegible] as it descended on its [illegible] been the most vitally interested [illegible] in this [illegible] as military requirements have been [illegible] for the [illegible] missile for two reasons:

(1) That the bomb must be carried [illegible] acceptable to our theater commanders [illegible]

(2) Because of the tactical difficulty of [illegible] at the target.

b. Snazon (Azon-Azimuth). The following [illegible] an airplane which was to drop the Snazon [illegible] 20,000 ft. Fire broke out in the electrical [illegible] at about 17,000 ft. The set-in [illegible] the bomb pattern to stay small and compact. No control [illegible] was tried. The drop was considered successful because of the [illegible] pattern on the ground; a great improvement over other [illegible] bombs.

c. Tiny Tim. The firing of the Tiny Tim [illegible] at Muroc, California. The 1200 lb Tiny Tim is allowed to fall out of the bomb bay, and drops the length of the lanyard which is [illegible] ft long. Here the rockets are ignited and the bomb speeds [illegible] from 4500 ft from the target at an altitude of [illegible] results. This is too close, however, for an aircraft [illegible] before [illegible] over the target. The Navy Air Arm is doing their experiments with Tiny Tim [illegible]

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... interesting afternoon ... School of ... their program ... take the lead in the jet ... the following ...

... The ... has moved ... having the main field at ... which was formerly a CAA field ... gradually expanding from ... buildings and is devoted to ... the ... between ATSC's

JAMES L. TRAVIS
..., Air Corps
..., Munitions and Missiles Section
... Branch, Requirements Division
Office of Asst Chief of Air Staff
Operations, Commitments and Requirements

[redacted]

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ATSC Form No. 10-888 (3 Jan 45)
(Old ATSC Form No. 43)

30 March 1945
JRD:ajt:TSBPR3H1 2-3223

Procurement Division (TSBPR3H1)

Hq, AAF, ATSC, Wright Field, Dayton, Ohio

COORDINATION DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
OTHER

Commanding General
Army Air Forces
Washington 25, D. C.

30

Attention: AC/AS, M&S

Wash.spec. mail pouch

MX-544

ORVAL R. COOK
Brig. General, U. S. A.
Chief, Procurement Division

TSBPR3H1-3-267 . . . . . . 1. JB-2 JET BOMB IS THE SUBJECT OF THIS MESSAGE, IN COMPLIANCE WITH DIRECTIONS CONTAINED IN TELETYPE WAR 58104, DATED 24 MARCH 1945, THE AIR TECHNICAL SERVICE COMMAND HAS INITIATED ACTION TO SELECT CONTRACTORS FOR PARTICIPATION IN THIS PROGRAM. AS NOTED IN TSBPR3H1-3-129, DATED 16 MARCH 1945, CONTRACTORS PREVIOUSLY SELECTED ARE NO LONGER AVAILABLE, AND IT IS NECESSARY TO FORMULATE ENTIRELY NEW PLANS. THERE IS NOW A NOTICEABLE RELUCTANCE ON THE PART OF CONTRACTORS PREVIOUSLY CONSIDERED TO ENGAGE IN THIS WORK. THIS ATTITUDE IS IN MARKED CONTRAST TO ENTHUSIASM OF A FEW WEEKS AGO AND MAY BE ATTRIBUTED TO FOLLOWING CAUSES:

a. STOPS AND STARTS IN THE PROGRAM CAST DOUBT ON STABILITY OF JB-2 REQUIREMENTS AND ORDERS.

b. LOW PRIORITY RATING OF GROUP 5 WITH ATTENDANT DIFFICULTIES IN SECURING [illegible]. CONTRACTORS CAN SEE THEIR EMPLOYEES IDLE FOR LACK OF MATERIAL AND PARTS AND CAN DO NOTHING ABOUT IT.

[illegible] THE HOPE THAT AFTER V E DAY MANUFACTURERS MAY BE PERMITTED TO RESUME [illegible] PURSUITS EVEN ON A LIMITED SCALE.

2. ATTENTION IS INVITED TO THE FACT THAT IMPROVEMENTS IN THE AIRFRAMES AND IN [illegible] OF LAUNCHING HAVE RESULTED IN CHANGES TO THE JB-2 BOMB WHICH MAKE THE 75TH ARTICLE, PREVIOUSLY DESIGNATED "THE MODEL" OBSOLETE. THE MODEL FOR THIS FUTURE

Boomer
Orval R. Cook
[illegible]
J.R. Dugan
Schoellkopf
[illegible]

(see Page 2) X-88340

Classification cancelled
or ~~changed to~~ __________
AUTH:
By CD35[redacted]
Signature and Grade
Date 11-1-45

CENTRAL FILE COPY

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WD. Area 2-1-1-45-600M

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Messageform TSEPR3d1-3-267, dated 30 March 1945 (Continued)

PROCUREMENT WILL PROBABLY BE THE 250TH ARTICLE AFTER WHICH ADDITIONAL CHANGES WILL BE HANDLED BY A BLOCK SYSTEM.

3. IT SHOULD ALSO BE NOTED THAT THE INSTALLATION REQUIREMENT FOR AN/APA-1 RADAR EQUIPMENT FOR CONTROLLING THE FLIGHT OF THE JB-2 AFTER LAUNCHING WILL NOT BE INCLUDED IN THE INITIAL PHASE OF THIS ADDITIONAL PROCUREMENT SINCE THE INSTALLATION HAS NOT AS YET BEEN MADE, TESTED, NOR APPROVED FOR PRODUCTION. AS SOON AS THIS EQUIPMENT IS AVAILABLE AND OPERATING SATISFACTORILY, PROVISION WILL BE MADE TO INCORPORATE THIS ADDITIONAL EQUIPMENT OR PROVISION FOR SAME IN THE AIRFRAMES BEFORE DELIVERY TO THE THEATER OF OPERATIONS.

4. IT IS UNDERSTOOD THAT THE JAC PREFERENCE RATING FOR THIS PROJECT WILL PROBABLY BE GROUP 3. IT IS DESIRED TO POINT OUT THAT WITH THIS LOW RATING IT WILL BE DIFFICULT, IF NOT IMPOSSIBLE, TO MEET THE DESIRED PRODUCTION SCHEDULE UNLESS THE SITUATION REGARDING MATERIAL, PARTICULARLY STEEL AND ALUMINUM, IMPROVES CONSIDERABLY IN THE NEXT FEW MONTHS.

5. CONTACT HAS BEEN MADE WITH THE OFFICE, CHIEF OF ORDNANCE, RELATIVE TO THE PRODUCTION OF PROPELLANT FUEL, ROCKET MOTORS AND LOADED WARHEADS. IT IS UNDERSTOOD THAT THIS MATERIAL WILL BE PROCURED FROM ORDNANCE FUNDS AND IT IS REQUESTED THAT THIS POINT BE CONFIRMED. THE OFFICE, CHIEF OF ORDNANCE EXPRESSES SOME CONCERN REGARDING THE POSSIBLE INTERFERENCE OF ORDNANCE ITEMS FOR THIS PROJECT WITH OTHER ITEMS OF THE WAR PROGRAM. AS SOON AS THE AIR TECHNICAL SERVICE COMMAND IS IN A POSITION TO ESTABLISH A REALISTIC SCHEDULE FOR JB-2 AIRFRAMES AND GOVERNMENT FURNISHED EQUIPMENT, THE AC/AS, M&S WILL BE ADVISED IN ORDER THAT IN TURN THE OFFICE, CHIEF OF ORDNANCE MAY BE ADVISED AND THE REQUIREMENTS FOR ORDNANCE ITEMS ESTABLISHED.

CC:
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TSTEX
TSCEP

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or changed to
AUTH: C1935
By [redacted]
Signature and Grade

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Lt Col Stace/mjr/2100
Written 27 April 1945

MEMORANDUM FOR THE ASSISTANT CHIEF OF AIR STAFF, OPERATIONS, COMMITMENTS AND REQUIREMENTS AFDMA-2G

SUBJECT: Japanese Piloted Suicide Bomb

1. Reference is made to your Memorandum of 15 April 1945, subject as above. A copy of this Memorandum is attached.

2. Representatives of this office and of the Air Technical Service Command have examined the subject device, now called Project "BAKA", at Anacostia.

3. The missile air-frame presented no innovations in design. A further examination will be made of the propulsion rockets and the warhead as soon as they are available.

4. Since this missile is basically a glide-bomb type with short endurance propulsion to increase the speed, it is recommended that consideration be given to glide-bombs specifically designed for remote control, before any extensive program is undertaken to investigate the difficult program of adapting remote control or seeker devices to an airframe not specifically designed for this type of control.

5. Attached for your information is a "Short Description of AAF, Navy, German and Japanese Glide Bomb Types."

6. The very extensive AAF glide-bomb development program has been curtailed, in view of the lack of apparent operational interest expressed by AC/AS, OC&R representatives in the Guided Missiles reviews of 2 November 1944 and 22 February 1945, and the Memorandum from the AC/AS, OC&R, of 2 March 1945, subject "Controlled Missile Program."

7. It is believed that a clarification of the operational possibilities forusing the glide bomb-types would be of great value. It is requested therefore that a statement be forwarded of the desired military characteristics and types of missions for missiles of the glide-bomb type.

8. These characteristics will be studied by this office and by the ATSC and recommendations will be forwarded on the missile or missiles that can be made available most readily to meet the operational requirements.

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Propulsion
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AFDMA-3B
5 May 1945

MEMORANDUM FOR: Brigadier General J. F. Phillips.

SUBJECT: Rocket Propulsion Program.

1. Responsibility in the rocket propulsion program as now established is divided between the Army Air Forces and Army Service Forces. This division is predicated on the basis of allocation of research and development and, in most cases, procurement to that activity having basic technical ability in various aspects of same. Briefly, this division has resulted in the following:

a. The Army Service Forces having responsibility over research, development, and procurement for the Army Air Forces of all droppable assisted take-off and launching devices of rocket nature, using chemical fuels for launching of personnel and pilotless aircraft from the ground.

b. The Army Air Forces has responsibility over research, development, and procurement of all rocket devices, using chemical fuels that are integrally installed in personnel carrying and pilotless aircraft that are used for booster, auxiliary or sole means of propulsion. Procurement of large scale quantities of rocket devices and their fuels for this program is not as yet settled; however, it is probable that any such procurement would be made through the Army Service Forces, since that agency has cognizance over the majority of applicable manufacturing facilities.

c. The Army Air Forces is also charged with the responsibility of research and development for rocket propulsion devices for use in guided missiles that are launched from aircraft.

d. The Army Air Forces is authorized to undertake development of rocket launching devices when such procedure is considered desirable or necessary to insure satisfactory or expedited completion of a missile development program. In the event launching developments involve the use of solid or liquid chemical propellants, ~~they~~ Such developments will be limited to the application of existing propellants. ?

2. Above division of responsibility is generally conceded by competent authority to be the most advantageous possible at this time in view of the disposition of technical ability in chemical fuel matters, the peculiar and unconventional nature of these devices, and the general status of

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development. It is recognized that research and development of rocket motors and their fuels cannot practicably be separated due to closely allied characteristics such as metallurgy, thrust required, duration of thrust, etc. This, in turn, has been one of the basic factors that resulted in establishing the policy governing present division of responsibility. It is, however, pointed out that until the foregoing allocation of responsibility was made, the Army Air Forces at Wright Field carried on an extensive research and development program in the field of assisted take-off directly with various commercial activities. Several different assisted take-off devices were tested during the above period of fighter, medium bombardment, and heavy bombardment type aircraft. Considerable work has also been accomplished to date by the Army Air Forces in development of launching devices of rocket nature for JB-2 (V-1) type winged missiles. It therefore follows that the fact that basic technical ability in the field of rocket motors and fuels for assisted take-off and launching purposes is presently generally confined to the Army Service Forces should not necessarily be considered a situation that will continue indefinitely. This is exemplified by the fact that approval has recently been granted by the AC/AS, M&S, to undertake a rocket propulsion program for personnel and pilotless aircraft at A.T.S.C. This program includes research and development of both rocket motors and their fuels and, in this connection, it is presently planned to utilize Ordnance Department and Chemical Warfare Service personnel in conjunction with A.A.F. personnel.

3. With the advent of jet propulsion aircraft, an accelerated need for new and improved assisted take-off and launching devices has concurrently become apparent. Jet-propelled aircraft, particularly those using turbo jet engines, raise several highly specialized problems, one of which is means for improving take-off characteristics. Review of the current status of development of assisted take-off devices indicates that both integral and droppable types have been developed and tested on conventional aircraft under the cognizance of the A.T.S.C. Integral units used thus far have been confined to the liquid fuel type while the external or droppable units have utilized either liquid or solid fuels. As presently known, assisted take-off devices using solid fuels are generally considered to be most satisfactory due to their simplicity and less hazardous features. The manufacture, storage, and handling of liquid fuels for rocket devices have been and still are dangerous; however, it is highly probable that, as development progresses, these factors can be overcome to some extent. Any urgent requirement for assisted take-off devices, particularly as may exist for jet-propelled bombardment type aircraft, may also be influential in outweighing within reason, such dangerous aspects as may be prevalent.

4. It is difficult to predict the trend of development in the field of droppable assisted take-off and launching devices; however, it is evident that such devices employing liquid and solid fuels or possibly both, of droppable, integral and combination droppable-integral (employing integral motors and droppable fuel tanks) nature, will probably be used extensively.

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Problems allied with employment of assisted take-off and launching devices utilizing chemical fuels are intimately associated with the structure of the vehicle involved and, therefore, become an A.A.F. responsibility. As the need for such devices becomes more apparent, particularly when employing jet propulsion aircraft, the necessity for complete integration of all phases of this equipment into applicable A.A.F. activities will be highly essential. In the case of development, installation and utilization of integral or combination integral-droppable units, A.A.F. responsibility will become an absolute necessity. Based on the foregoing, it can therefore be concluded that research, development, and employment of assisted take-off devices should be re-assigned as an A.A.F. responsibility, at an early date.

5. It further appears that the entire field of rocket propelled aerial weapons should be examined for the purpose of determining the extent which the A.A.F. should become engaged, insofar as responsibility for development is concerned. The present division of responsibility where the Army Service Forces is charged with the development of ground launched missiles which depend on momentum for sustenance, and the A.A.F. is charged with development of ground launched missiles depending on aerodynamic forces for sustenance, will lead to duplication of effort of long range super-sonic rocket propelled missiles, as this field is expanded. It is highly probable that rocket propulsion devices used in either type of unit (i.e. - depending on momentum or aerodynamic forces for sustenance) will be directly applicable to the other and, in fact, may be the only type of propulsion device capable of developing sufficient thrust to enable velocities presently envisioned. It may be necessary to compromise the above assumption, in view of the indicated application of ram jets; however, the opinion held by various scientists in this country indicates that rocket propulsion devices will have to be used for velocities beyond Mach numbers 2.5 - 3.0, which is presently the estimated maximum performance believed possible with ram jets. It is probably premature at this time to predict the scope of future employment of ground launched or air launched missiles; however, if V-1 and V-2 type missiles employed thus far in this war, plus present research and development programs underway by various U.S. governmental agencies, can be used as a forecast, it is evident that such weapons will occupy a ~~permanent~~ prominent place in the future.

With a view toward allocating responsibility, the identity of V-2 type missiles is presently under study by several War Department activities. It appears that the A.S.F. has taken this responsibility on the basis that they are responsible for development of ground launched missiles that depend on momentum for sustenance. Above assumption on the part of the A.S.F., while within existing regulations, is not believed desirable when considering long range aspects of research and development of such weapons. The V-2 can hardly be identified as artillery, nor can it be identified as an airplane; however, it does have a relatively close relationship to certain developments currently under consideration by the A.A.F. These developments

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LIST OF GUIDED MISSILES 1673

PROJECT NAME	CODE	MX NO	SPONSOR	CONTRACTOR	LAUNCHED FROM	TARGET	POWER	CONFIGURATION Head	Wing	Tail	ATTACK ANGLE	BANK	SPEED MPH
AZON	VB-1		NDRC & AAF	GULF	AIR	Ground	Gravity				Large	No	[illegible]
AZON	VB-2		NDRC & AAF	Gulf	Air	Ground	Gravity				Large	No	600
RAZON	VB-3		NDRC & AAF	Gulf	Air	Ground	Gravity				Large	No	[illegible]
FELIX	VB-6		NDRC & AAF	MIT	Air	Ground	Gravity				Large	No	600
DOVE			NDRC & Navy	Polaroid	Air	Ground (Naval)	Gravity				Large	No	600
ROC-X	VB-12 VB-9	603 602	NDRC	Douglas	Air	Ground	Gravity				Zero	No	450
ROC-00-1000V	VB-10	601	NDRC	Douglas	Air	Ground	Gravity				Zero	No	500
ROC-00-1000T	VB-10	601	NDRC	Douglas	Air	Ground	Gravity				Zero	No	450
GLOMB			Navy Aer.	Navy	Air	Ground	Gravity				Moderate	Yes	
PELICAN			Navy Aer., NDRC	Bu. Stds.	Air	Ground	Gravity				Moderate	Yes	200
BAT			Navy Aer., NDRC	Bu. Stds.	Air	Ground (Naval)	Gravity				Moderate	Yes	200
	GB-1		AAF	Aeronca	Air	Ground	Gravity				Moderate	Yes	
	GB-2		AAF		Air	Ground	Gravity				Moderate	Yes	
	GB-3		AAF		Air	Ground	Gravity				Moderate	Yes	
	GB-4		AAF		Air	Ground	Gravity				Moderate	Yes	
	GB-5		AAF		Air	Ground	Gravity				Moderate	Yes	
	GB-6		AAF		Air	Ground	Gravity				Moderate	Yes	
	GB-7		AAF		Air	Ground	Gravity				Moderate	Yes	
	GB-8		AAF		Air	Ground	Gravity				Moderate	Yes	
	GB-9		AAF		Air	Ground	Gravity				Moderate	Yes	
ROC [illegible]-1000H	VB-11	604	NDRC	Douglas	Air	Ground	Gravity				Zero	No	45
RAZON	VB-4		NDRC & AAF	Gulf	Air	Ground	Gravity						
DERVISH			AAF		Air	Ground	Gravity				Large	No	10

11 MAY 1945

LIST OF GUIDED MISSILES 1673

POWER	CONFIGURATION Head	Wing	Tail	ATTACK ANGLE	BANK	SPEED MPH	INTELLIGENCE	CONTROL	WEIGHT (Pounds) Gross	Warhead	STATUS OF DEVELOPMENT
Gravity				Large	No	6[illegible]		Radio		1000	In theaters
Gravity				Large	No	600		Radio		2000	Tests
Gravity				Large	No	600		CRAB, Radio		1000	Tests
Gravity				Large	No	600	Infrared				Tests
Gravity				Large	No	60[illegible]	Infrared				Tests
Gravity				Zero	No	45[illegible]	Photoel, RHB				Tests, discontinued
Gravity				Zero	No	50[illegible]		CARP			Tests
Gravity				Zero	No	450		TV			Tests
Gravity				Moderate	Yes			TV			Tests, discontinued
Gravity				Moderate	Yes	200	RHB				Tested successfully, Application in theater not [illegible]
Gravity				Moderate	Yes	200	SRB				Tests
Gravity				Moderate	Yes			Pre-set			
Gravity				Moderate	Yes						
Gravity				Moderate	Yes						
Gravity				Moderate	Yes			Television			
Gravity				Moderate	Yes		Photoelect.				
Gravity				Moderate	Yes		Infrared (Offner)				
Gravity				Moderate	Yes						
Gravity				Moderate	Yes		Visual, Radio	Visual, Radio			
Gravity				Moderate	Yes			Dive Rad. Alt.			
Gravity				Zero	No	450	Infrared				
Gravity										2000	
Gravity				Large	No	100+	Photoelect.	Helicopter		1000	Idea

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SURFACE TO AIR GUIDED MISSILES
ARMY AIR FORCES

POLICY

1. General: Relative Importance Attached to Guided Missiles:

Guided Missiles are considered of great importance as the Army Air Forces instruments of future warfare. Inclosures No. 1 (original military characteristics for guided missiles, AAF ltr dtd [illegible] July 1944, subject "Military Characteristics for Remotely Controllable Rockets and/or Pilotless Aircraft.") from Assistant Chief of Air Staff, Operations, Commitments and Requirements, No. 2 (Military Characteristics from Special Assistant for Antiaircraft) subject "Military Characteristics for Anti-aircraft Guided Missiles," dated 20 September 1944. Further military characteristics are now under preparation by [illegible], assisted by AC/AS, [illegible], the Air Technical Service Command, and the Army Air Forces Board.

2. Research and Development Objectives:

a. Short Term: None

b. Long Term: To fulfill existing military characteristics, as outlined by Inclosures 1 and 2 and to insure that future aircraft designs are proof against attack by guided missiles.

3. Policy as to Division and Assignment of Research and Development Effort: This policy is established by the following:

a. Army Regulation No. 850-25, Paragraph 6, which assigns to the CG, AAF, responsibility for development and procurement of all items of military types of equipment peculiar to the AAF, and not assigned to other Services. This development is carried out by the Air Technical Service Command.

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b. AAF Regulation No. 65-3 "Priorities for Materiel and Equipment

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Projects" (Inclosure No. [illegible]).

c. Fundamental aeronautical research is carried on by the National Advisory Committee for Aeronautics, at the request of Air Technical Service Command.

d. The Office of Scientific Research and Development is called on for assistance, whenever necessary, in fields not covered by the [illegible].

e. The Research Board for National Security has been asked for assistance on materials and fuels. As the extent of the activities of this organization increases, additional projects will be submitted. This Board will be asked to continue certain of the projects presently carried on [illegible].

f. Other non-profit agencies as well as qualified commercial concerns are utilized as necessary.

[illegible]:

1. General:

The Army Air Forces program for ground-to-air guided missiles is intended to carry out the mission of the AAF in defense against attack by present day or future aircraft and guided missiles. It is not yet complete in its coverage, particularly against weapons of the V-2 type.

2. History:

On [illegible] July 1944, Military Characteristics for anti-aircraft guided missiles were [illegible] by the [illegible]; these were forwarded to Air Technical Service Command on 27 July 1944. Study of the problem was begun at this time. Military Characteristics were also recommended by the Special Assistant for Antiaircraft on 20 September 1944. Contractors were approached during this period, but no contractural arrangements were made until the [illegible] Ordnance-AAF study contract with Ordnance on 15 February 1945 and the study contract with [illegible] of 24 April 1945.

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5. Projects:

There are at present two projects:

a. The Bell Telephone Laboratories proposed missile resulting from the joint AAF-Ordnance contract with Western Electric Company, which was reported on 14 May 1945.

b. The Boeing Aircraft Company proposed missile, which is still in the early study stage. It cannot be determined at this time whether or not any physical articles will be procured under this contract.

c. There is also a project for the development of an air-launched antiaircraft missile, the JB-3, which may be considered supplementary in some ways to the ground-launched projects.

6 Incls:
Incl 1 - M/C characteristics for G. M.
Incl 2 - M/C characteristics for AA G. M.
Incl 3 - AAF Reg. 65-3, 23 Mar 45
Incl 4 - BTL Missile
Incl 5 - Boeing "Condor" Missile
Incl 6 - Additional Information

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OFFICE FOR EMERGENCY MANAGEMENT
NATIONAL DEFENSE RESEARCH COMMITTEE
OF THE
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P STREET NW.
WASHINGTON 25, D. C.

Reply to:

Harrison Laboratory
34th & Spruce Streets
Philadelphia 4, Pa.

May 21, 1945

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Commanding General
Army Air Forces
Washington 25, D. C.

Attention: AAF Liaison Officer/NDRC
AC/AS Materiel and Service
Materiel Division
Major R. J. Powers

Dear Sir:

In a recent conversation with Major R. J. Powers, I was asked to give an opinion concerning the possible development of a rocket-propelled bomb similar to the Tiny Tim. I shall do this from the standpoint of what Division 8 might have to offer in advising concerning the development of such a weapon. This will include a discussion of both the bomb and the propelling device as viewed from the activities of Division 8. I should like to add that this is a highly informal presentation. Before making any very definite statements on this subject, I would prefer to have this reviewed by our experts who have a much better knowledge of details than I. I think this presentation may lead to the appropriate conclusions and will serve as the basis for a discussion which we will have in the near future. I would not, however, guarantee that it is quantitatively correct.

1. Head.

At striking velocities in the region of 1000 ft/sec and above, more destruction will probably be attained by an armor-piercing head than by a shaped charge head. At about 1000 ft/sec, the penetration by an armor-piercing charge will probably be about the same as by the jet from a shaped charge bomb but the former may do more damage because of the detonation after penetration. Since velocities in the neighborhood of 1000 ft/sec are attainable with propelled bombs, it is therefore probable that shaped charge heads should not be considered in these weapons.

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CONFIDENTIAL

Commanding General, AAF May 21, 1945
Attn: Major R. J. Powers

There is only one consideration which might bring shaped charges into the picture. If a shaped charge were used, it would be in a bomb having a lighter case than an S.A.P. or A.P. bomb. Furthermore, in order to secure the stand-off necessary, a considerable air-filled cavity would be left in the nose of the bomb. A 500-lb. G.P. bomb case with a shaped charge would therefore weigh significantly less than the S.A.P. bomb head now used with "Tiny Tim". With a given rocket motor, the velocity of the projectile would therefore be greater with the S.C. bomb than with "Tiny Tim". This might be an advantage in firing at enemy positions heavily defended by anti-aircraft. As an alternative suggestion, the "Tiny Tim" motor could be used to give to a larger bomb the same velocity now obtained with the S.A.P. head. This might give greater penetration by the jet than obtained with the S.A.P. head and might be very effective against ships, particularly in cases where it penetrated to ammunition or fuel storage. Whether or not there is any real use for a S.C. head is questionable. I would not recommend it unless operational use of "Tiny Tim" has shown a need for one of the application mentioned above.

I should perhaps add a few words about the status of S.C. bombs. Bombs are either made or are being made with a S.C. in the standard 500-lb. G.P. bomb but no full-scale trials have been made. Full-scale trials have been made on 1000-lb. S.C. bombs. Since shaped charges must be initiated from the rear and since the fuze must be fast to preserve stand-off, serious consideration of using a rocket-propelled S.C. at high velocities would call for considerable experimental work on a fuze for the weapon.

2. <u>Propelling Charge.</u>

The only Division 8 propellant which is now ready for consideration is composite propellant. The situation may best be explained by considering the possibilities with the ACL-1 propellant grain used for launching JB-2 and developed under Project AC-75 from Army Air Forces. This grain is $8\frac{1}{2}$" in diameter with a $2\frac{1}{2}$" perforation. Five single grains are cemented together giving a "quint" $8\frac{1}{2}$" in diameter ($2\frac{1}{2}$" perforation) and about $37\frac{1}{2}$" long. This weighs 120 lbs. and burns in about 1.8 seconds. The impulse (thrust x time) is about 20,000 lb. sec. The rate of burning varies only slightly with temperature (in contrast to double base powder used in "Tiny Tim"). A considerable amount of smoke is produced when this powder is burned.

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Commanding General, AAF
Attn: Major R. J. Powers
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May 21, 1945

The motors designed for JB-2 launching were of heavy construction in order to permit re-use. They weigh approximately 220 lbs. We are now working on a 125-lb. motor which will be regarded as expendable. Let us first consider the possibilities of using these motors (with ACL-1 grains) attached to the present S.A.P. head used with "Tiny Tim".

	Heavy Motor	Light Motor
Weight of Head	578 lb.	578 lb.
Weight of Propellant	120 lb.	120 lb.
Weight of Motor	220 lb.	125 lb.
Total Weight of Unit	918 lb.	823 lb.
Average weight of Unit during flight.	858 lb.	763 lb.

$$\text{Velocity} = \frac{32 \times \text{Impulse}}{\text{Average wt. of projectile}}$$

$$\text{Velocity with heavy motor} = \frac{32 \times 20{,}000}{858} = 746 \text{ ft/sec}$$

$$\text{Velocity with light motor} = \frac{32 \times 20{,}000}{763} = 838 \text{ ft/sec}$$

The decision to use a "quint" for the ACI-1 charge was made solely because such grains deliver the proper thrust. We know of no reason why additional units cannot be added. It may, therefore, be of interest to consider grains made from six and seven singlets. We have not made motors for such grains and shall therefore assume light motors with the same ratio of weights as the ratio of weights of propelling charges.

	Six Singlets	Seven Singlets
Weight of head	578 lbs.	578 lbs.
Weight of propellant	144 lb.	168 lb.
Weight of motor (light)	150 lb.	175 lb.
Total weight of unit	872 lb.	921 lb.

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May 21, 1945

	Six Singlets	Seven Singlets
Average weight of unit during flight	800 lb.	837 lb.
Length of grain	45 in.	$52\frac{1}{2}$ in.
Diameter of grain	$8\frac{1}{2}$ in.	$8\frac{1}{2}$ in.
Burning time	1.8 sec.	1.8 sec.
Impulse	24,000 lb. sec.	28,000 lb. sec.
Velocity (calculated)	960 ft/sec.	1,070 ft/sec.

You can fairly easily make calculations similar to those given above, using various lengths of composite propellant grain. You may also wish to consider A.P. heads and bombs of different sizes. It may be worth while to add that the Longhorn Ordnance Works, due for production this summer, will produce ACL-1 grains and that heavy motors for "quints" will also be in procurement. If slightly longer grains (six or seven singlets) were desired, no changes in milling or pressing would be required. The assembly would be modified very readily, although very long grains (e.g. 10-12 singlets) might introduce difficulties.

In summarizing the above calculations, it may be concluded that an ACL-1 grain in a light motor will impart to the "Tiny Tim" head a velocity close to that now obtained by the standard "Tiny Tim" at low temperatures. Longer composite grain will give somewhat higher velocities. Any increase of velocity, over that obtained with "Tiny Tim", will not be spectacular unless larger grains or very long grains are used; in either case some development work would probably be required. Some consideration might be given to using two "quints" in one motor but this would also involve some experimentation.

Considering first the grains readily available, they possess no advantage over the current "Tiny Tim" from the standpoint of velocity. Any interest in them for this weapon should be based upon the following considerations:

1. They would give projectiles appreciably lighter than "Tiny Tim", but delivering the same payload at velocities in the same order of magnitude.

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Commanding General, AAF May 21, 1945
Attn: Major R. J. Powers
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2. They would give less variation in performance over a wide temperature range.

3. If the output of Longhorn is not used for the JB-2 and if there is a shortage of powder for "Tiny Tim", this might be a useful auxiliary.

The importance of these considerations is a subject on which the Services are more competent than I to judge.

Considering now the grains which might be produced, I think it probable that the best line of attack would be to develop propellant charges much longer than those considered above, or to consider using the "quints" as now prepared but loading more than one in a motor. Since this would involve procurement of new motors, I would estimate that this could not be done in less than three or four months. I do not believe that a great amount of development work would be necessary, but it would take this time before we would know whether or not the developments were practical. I do not believe such a development should be undertaken unless it is felt that there is a definite need for projectiles with a higher velocity than "Tiny Tim".

There is one other question which might occur to you and that is the possibility of using composite propellant in the standard "Tiny Tim" motor. I do have, at present, an accurate description of the "Tiny Tim" motor, but as I recall, it is about 10½" i.d. The present grains, which are 8½" in diameter, would not effectively fill this motor, but arrangements could undoubtedly be made for mounting them. The single grain of composite would present an advantage over the dry extruded grains now used because more powder could be introduced. This gain, however, is almost completely offset by the lower specific impulse of composite propellant and the overall increase in velocity by using composite would be in the order of only three or four per cent. Composite, therefore, offers no advantage in this motor and this also would seem a senseless way to use composite propellant. Since composite burns at a much lower pressure than double base, it is possible to use a much lighter weight motor, and if composite were to be used, it would seem logical to utilize this advantage. In "Tiny Tim" the ratio of motor weight to powder weight is about 3, which is a most unfavorable ratio. In the units which have been used for launching JB-2 with composite at Eglin Field, this ratio has been 1.8, and I believe that our light motor which will give a ratio of one will be perfectly satisfactory.

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May 21, 1945

Commanding General, AAF
Attn: Major R. J. Powers
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In summary, I am not able to say that I see definitely any place where we feel strongly that Division 8 can make a substantial contribution in a weapon of the kind under consideration. Determining factors are considerations of the kinds of targets to be encountered, the importance of weight reduction, availability of powder and importance of the temperature coefficient of the powder. Depending upon the attitude of the Services on these points, there might be ways in which Division 8 could offer substantial contributions.

Very truly yours

Ralph Connor

Ralph Connor
Chief - Division 8

cc: Dr. L. W. Farinholt
Dr. H. J. Fisher
Dr. L. P. Hammett
Dr. C. R. McCullough
Dean E. L. Moreland

P. S. I should have pointed out earlier that the velocities given above do not take into account the speed of the plane from which launching occurs, since this may be presumed to be constant in all cases.

R. C.

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1 June 1945

MEMORANDUM FOR THE CHIEF OF STAFF:

SUBJECT: Responsibility for the Operational Employment of Guided Missiles

DISCUSSION

1. On 2 October 1944, the War Department, recognizing the vast field of new weapon development, foreshadowed by the German employment of buzz bombs and long range rockets, promulgated a policy (see Tab A) establishing the responsibilities of the major commands for research and development in this field. This policy, still in effect, makes the responsibility of the major commands for operational employment of the new weapons a matter to be decided in each case upon the merits of each specific newly developed missile. The first such command decision was made in the case of the JB-2 buzz bomb, in which conflicting views of the AAF and the AGF were resolved by the decision that this weapon would be employed operationally by the AAF.

2. Although the policy of 2 October 1944 has proved adequate to assurethat there shall be no omission or duplication within the Army of effort touching upon the development of guided missiles and pilotless aircraft, this policy fails signally to eliminate duplication or omission of employment planning effort on the part of the major commands. Thus, in the case of the JB-2, both Air and Ground Forces developed Tables of Organization for JB-2 units and considered plans for employment of this weapon. Both Air and Ground Forces are now considering the operational employment of very long range rocket missiles.

3. While some good may accrue, in the case of radically new weapons, from the employment planning efforts of two separate commands, the disadvantages developing from the current situation have become amply clear. A recent ETO proposal that the V-2 be produced in Germany for use against Japan, and which invited the visit of a War Department delegation to the theater, raisedat once the question of whether Air Force, Ground Force or both Air and Ground Force officers might be included in such a delegation. Postwar organization and weapon planning within this Hq, and surely also within that of the AGF, would be greatly facilitated by a clarification of future responsibilities concerning operational employment of guided missiles. On 6 Feb 1945 this Hq forwarded to the Operations Division, WDGS a recommendation that the responsibilities of the major commands for operational employment of guided missiles be clarified, and offered a proposed directive to accomplish this result (see Tab B). Shortly thereafter, but independently, the G-3 Division, WDGS requested by memorandum (see Tab C) the comments of the major commands as a guide in establishing fundamental policy, necessity for which was clearly recognized in this connection. Sharply differing replies led thereafter to a conference of the interested agencies under G-3 auspices, at which no agreement could be reached in view of the basically different points of view held by the AAF and the AGF. The AGF concept, supported at the conference by the representative of Operations Division, WDGS, is that all weapons launched or fired from the ground should be an operational responsibility of the AGF. The AAF concept is that, in terms of the objective or target area to be attacked, the means of attack must be entrusted that force which normally has primary interest in the attack: thus in the case of strategic bombardment, the AAF should have operational responsibility for the employment of all applicable weapons.

[redacted]

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4. The policy suggested by G-3, WDGS to govern responsibility of the major commands for operational employment of guided missiles (Tab C), while less definitive than that proposed by this Hq (Tab E), is considered to present an entirely satisfactory present solution to the problem.

RECOMMENDATION

That a policy governing the responsibility of major commands for operational employment of guided missiles substantially like that suggested by the G-3, WDGS memorandum of 19 March 1946 (Tab C) be established by the War Department.

I. A. C. EAKER
Lt General, USA
Deputy Chief of Staff, AAF

[redacted]

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ATSC Form No. 10-505 (3 Jan 45)
(Old ATSC Form No. 43)

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

TSESE-4I/JPA/rm

TSENO (TSESE-4I)

2 June 1945

MEMORANDUM FOR TSGEN
Major General L. T. Miller

SUBJECT: Information on Guided Missiles Committees

1. The following information concerning committees on guided missiles was verbally requested by General Miller at the Division Chiefs' meeting, 31 May 1945.

2. There exist, at present, three committees outside of the Army Air Forces that are concerned with controlled missiles. Through cross-representation on each of these committees a liaison is maintained between the separate activities of each committee. This cross representation is mainly through the civilian membership of the committees, whereas the military membership is composed of Engineering Division personnel, Headquarters Army Air Forces personnel, and Army Service and Ground Forces personnel.

3. The Guided Missiles Committee of the Joint Committee on New Weapons and Equipment possesses the greatest degree of control over the guided missiles program, (see paragraph 4.) Division 5 of the National Defense Research Committee and the National Advisory Committee for Aeronautics Special Committee on Self-propelled Guided Missiles are both concerned with the engineering design and development of actual pieces of equipment rather than coordination and control as is exercised by the Guided Missiles Committee. The following paragraphs give more detailed information concerning these three committees.

Paul H. Kemmer

4. Guided Missiles Committee of the Joint Committee on New Weapons and Equipment.

a. Authorization. The Guided Missiles Committee was authorized during the fifty-eighth meeting of the Joint Committee on New Weapons and Equipment, which committee reports to the joint Chiefs of Staff.

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Memorandum to TSGEN, subject "Information on Guided Missiles Committees, dated 2 June 1945

b. Scope. The Guided Missiles Committee is established as an agency of the Joint Committee on New Weapons and Equipment, to formulate a broad program and to recommend measures for the coordination of research and development in the field of guided missiles and related subjects. Conventional torpedoes are excluded.

c. Functions. The functions of the Guided Missiles Committee are:

(1) To consult with the using branches of the armed services, to appraise probable targets, to survey the status of guided missiles currently under development, and to evaluate and recommend relative emphasis and priority among current programs and measures for the coordination of effort.

(2) To study and evaluate present techniques and proposals in the field of guided missiles, to study probable influence of guided missiles on trend in warfare, and to recommend national programs for the development of guided missiles, with appropriate allocation of responsibility for underlying fundamental research and development and of specific instrumentality of guided missiles, with the understanding that this program will be reviewed and modified during the development of the art.

(3) In addition, the Guided Missiles Committee establishes its own method of procedure and such supporting panels and consultant agencies as it may require to examine the several aspects of the field, and organizes its own secretariat.

(4) The Guided Missiles Committee is authorized to request all Services and Governmental agencies and activities for information and assistance which may be required in connection with its duties.

d. Personnel. The Guided Missiles Committee membership represents the following agencies.

(1) U. S. Army.

(a) Army Service Forces

Colonel G. W. Tirchel

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Memorandum to TBGEN, subject "Information on Guided Missiles Committees, dated 2 June 1945

(b) Army Ground Forces

Brig. General R. W. Girchlow, Jr.
alternate - Lt. Col. M. B. Lempl

(c) Army Air Forces

Brig. General J. F. Phillips;
alternate - Col. J. L. Travis

(d) G-3, (Planning)

Colonel R. W. Ward
alternate - Colonel G. P. Summerall

(e) New Developments Division, General Staff

Colonel J. S. Mills
alternate - Colonel H. P. van Ormer

(f) G-4, (Supply)

Colonel J. G. Shinkle
alternate - Lt. Colonel G. C. McDowell

(2) U. S. Navy

(a) Bureau of Ordnance

Capt. F. I. Entwistle

(b) COMINCH

Captain V. L. Pottle

(c) Bureau of Aeronautics

Capt. R. S. Hatcher

(d) OCR, Naval Operations

Capt. H. Temple
alternate - Capt. D. V. Gallery

(e) Executive Office of Secretary (EXOS)

Commander R. D. Conrad
alternate - Lt. Commander B. Old

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Memorandum to TSOMS, subject "Information on Guided Missiles Committees, dated 2 June 1945

(f) Bureau of Ships

Commander R. V. Kleinschmidt

(g) Navy civilian member

Dr. E. R. Gilliland (Deputy Chairman of Committee)

(3) Office of Scientific Research and Development, N.D.R.C.

(a) Mr. Bradley Dewey (Chairman of Committee)

(b) Dr. Warren Weaver

(4) National Advisory Committee for Aeronautics

(a) Dr. J. C. Hunsaker (also a member of N.D.R.C. Division 5)
alternate - Dr. G. W. Lewis

(5) Secretariat

(a) Dr. D. B. Langmuir, O.S.R.D.

(b) Dr. M. M. Flood, O.S.R.D.

(c) Major H. J. Taylor (Army Air Forces)

(d) Lt. S. D. Cornell (Navy Department)

5. Division 5, National Defense Research Committee.

a. Authorization. Executive Order, June 28, 1941, signed by the President of the United States.

b. Scope. The scope of Division 5, N.D.R.C., is to conduct research and development on controlled missiles through personnel and laboratories located throughout the nation. Division 5 is authorized to establish its own priority in regard to projects being conducted and is authorized to pursue its own projects in addition to those requested by the Army and Navy. The field of research falls within homing and controlled devices as well as coordination of the completed unit. Aerodynamic work is conducted in cooperation with the N.A.C.A., which agency is charged with this responsibility.

c. Functions. Division 5 is assigned projects by the main National Defense Research Committee. Contracts are then estab-

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lished with laboratories, universities, and scientific institutions throughout the country for carrying on controlled missiles work. Division 5 personnel supervise these contracts, lend scientific ability, and direct the work being conducted under the contracts.

d. Personnel. The membership of Division 5 is composed of civilian scientists without Army or Navy representation. Cross membership is indicated below.

(1) Mr. H. B. Richmond, Chief, Division 5

(2) Dr. Roger Cutting

(3) Dr. Albert F. Murray

(4) Mr. Hugh H. Spencer

(5) Dr. H. L. Dryden (also a member of N.A.C.A. committee

(6) Dr. L. O. Grondahl

(7) Dr. Oliver E. Buckley

(8) Dr. J. C. Hunsaker (also a member of the Guided Missiles Committee and of N.A.C.A. committee)

(9) Dr. J. C. Boyce (also a member of the N.A.C.A. committee)

e. General. In addition to the work of Division 5, the N.D.R.C., through other divisions, carries on research and development work on solid fuel propellants, homing devices, ballistics, all of which work in its application to controlled missiles is supplied to Division 5.

6. National Advisory Committee for Aeronautics Special Committee on Self-propelled Guided Missiles.

a. Authorization. This Committee is established under the N.A.C.A. which was established by act of Congress approved March 3, 1915 (U. S. C., title 50, sec. 151.)

b. Scope. The N.A.C.A. Special Committee on Self-Propelled Guided Missiles guides research and development work conducted by the N.A.C.A. laboratories on controlled missiles, aerodynamics, and liquid propulsive mechanisms. This Committee conducts

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research for the military services and the N.D.R.C. as an aid to projects being developed by these organizations.

c. Functions. This Committee reports directly to the main N.A.C.A. committee and has the authority to assign projects to the laboratories for research work to be accomplished. N.A.C.A. reports the results of this work to the military services and N.D.R.C., but the N.A.C.A. does not in itself design complete missiles.

d. Personnel. The N.A.C.A. Special Committee on Self-propelled Guided Missiles membership is composed of Army, Navy, N.D.R.C., N.A.C.A., and civilian scientists.

(1) Army Air Forces

General J. F. Phillips (also a member of Guided Missiles Committee)
Major Ezra Kotcher, ATSC

(2) Navy Bureau of Aeronautics

Captain R. S. Hatcher (also a member of Guided Missiles Committee)
Captain Bassieur

(3) National Defense Research Committee

Dr. H. L. Dryden (also member of Division 5, N.D.R.C.)
Dr. J. C. Boyce (also a member of Division 5, N.D.R.C.)

(4) National Advisory Committee for Aeronautics

Dr. G. W. Lewis (also a member of Guided Missiles Committee)
Dr. J. W. Crowley, Jr.
Mr. Abe Silverstein
Mr. R. E. Littell
Dr. J. C. Hunsaker (also a member of Division 5, N.D.R.C. and Guided Missiles Committee)

PHK
for
F. O. CARROLL,
Brig. General, U. S. A.
Chief, Engineering Division

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OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P Street NW.
Washington, D. C.
Refer: F:WHR

June 13, 1945

War Department Liaison Officer for the NDRC
Headquarters, Army Service Forces
4E-633, The Pentagon
Washington 25, D. C.

Subject: Project AC-36

Dear Sir:

I am again writing you regarding the transfer of $200,000 to cover the cost of part of the work being accomplished for the Army Air Forces under the subject project. The voucher for this amount was origianlly sent to Wright Field under date of November 25, 1944. Numberous inquiries and follow-ups have been unproductive as far as receiving the funds are concerned. I would therefore appreciate such action that you may be able to take towards bringing this matter to a speedy conclusion.

This Office has invariably encountered delays in receiving transfers of funds from the Air Forces. In addition to the transfer mentioned above, the following transactions are also pending:

Project No.	Amt. of Transfer	Remarks
AC-23303	$215,000	Voucher forwarded to Wright Field, May 12, 1945.
SC-60	$135,000	Voucher forwarded to Dayton Signal Corps Procurement District May 2, 1945, in accordance with instructions from your Office. It is understood that this activity was transferred to the Army Air Force in April, 1945.

Advances of funds to OSRD from the Signal Corps, Ordnance Department, or Chemical Warfare Services are never a companied by the delays that are involved in transfers from the Air Forces. It would appear that if these branched of the Army can accomplish transfers within a reasonable time, there should be no reason why the Air Forces could not do the same.

334.8 - NDRC - AC-36

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In view of the delays invariably encountered with transfers from the Air Forces, I am requesting that your office take some action towards insuring that OSRD will receive its transfers from the Air Corps, whereby the project request from your Office makes reference to the Order Number. If this procedure is not practical, it may be well to consider the advisability of having the Air Forces transfer to OSRD an estimated amount quarterly to cover the cost of "crash" procurements made during the ensuing quarter. Just what procedure is worked out is entirely up to your Office, but I feel strongly that some improvement be made.

Very truly yours,

Irvin Stewart
Executive Secretary

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Subject: Project A [redacted] 1313

SPROD-OSRD/AO-36 1st Ind 20 Jun 1945
(12 June 1945)

War Department, Washington 25, D. C.

To: Commanding General, Army Air Forces
Attn: Brig. Gen. J. F. Phillips, AAF LO for NDRC
Room 5D-943, The Pentagon.

1. Forwarded for appropriate action.

2. Your attention is invited to previous correspondence and discussions regarding procedures for processing OSRD vouchers for transfers of funds covering crash procurement.

3. It is understood the voucher for $200,000.00 involves a special case; however, it is felt some procedure should be established to cover other vouchers as a routine affair.

4. Several methods have been proposed in the past to expedite these transactions which, it is emphasized, are for advance payments prior to delivery of equipment. Some of these methods are as follows:

a. Transfer of estimated amounts at regular intervals with any necessary adjustments at a later date.

b. Transfer of funds at time request is forwarded to OSRD to accept crash procurement.

c. Execute blanket purchase orders.

d. Process Authority for Purchase (A for P) at same time request made to OSRD. When A for P is approved, purchase order will be issued and four (4) copies sent to OSRD who then forwards Form 1030 Voucher with copy of purchase order to Budget and Fiscal Office, Headquarters, Army Air Forces for payment.

5. Your attention is invited to the inclosed OSRD Memorandum stating conditions governing crash procurement in which it is stated specifically that OSRD is not bound by any of the normal Service regulations governing procurement or production.

F. MOYLE, Major, Ord. Dept.
Assistant War Department Liaison Officer
for the National Defense Research Committee

1 Incl.
Memo fr OSRD dtd 10 Oct 44

LIC:mhs
Ext. 5972

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1314

Subject: Project AC-36

2nd Ind. AFDAA-1B

Hq Army Air Forces, Washington 25, D. C. 27 September 1945

To: Commanding General, Air Techical Service Command, Wright Field, Dayton, Ohio. Attention: TSESE-4I

1. Forwarded as a matter of historical interest in view of the recent cessation of hostilities with the subsequent obviation of the need for crash procurements by the Army Air Forces to the National Defense Research Committee.

2. It is requested that this Headquarters be advised if any outstanding unpaid balances to the National Defense Research Committee exist at the present time on procurements initiated by your Command.

For the Commanding General, Army Air Forces:

ALDEN R. CRAWFORD
Brig. General, USA
AAF Liaison Officer
for the NDRC

1 Incl. n/c

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ATSC Form No. 10-504 (3 Jan 45)
(Old ATSC Form No. 43)

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADM'N.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
H. M. W. White
PROCUREMENT DIV.
READJUST DIV.
OTHER

Subject: Project AC-76

3rd Indorsement

Hq, ATSC, Wright Field, Dayton, Ohio TSEST-7D:MW:lw

To: Commanding General, Army Air Forces, Washington 25, D. C. Atten: AAF Liaison Office for NDRC, Colonel Wm. G. Brown, Room 5-D-943, The Pentagon.

1. A thorough survey of "red ticket procurement programs" with the NDRC has been made at this headquarters to determine if any outstanding unpaid balances exist. To date no form 1080 vouchers from the OSRD remain to be paid. However, this should not be construed to mean that future payments will not be necessary since this command has not been advised on final cost figures for such programs.

2. Red ticket procurement programs initiated by this command are being terminated in an orderly fashion which will require several months for completion, therefore, it is necessary that this command be advised by NDRC of the final cost figures involved at the termination of each individual program.

FOR THE COMMANDING GENERAL:

JBA

BARRON C. POWERS
Colonel, Air Corps
Chief, Engineering Standards Section
Service Engineering Sub-Division
Engineering Division

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Missiles - Army - German
D. M. Br., 02/a 8-4
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EXTRACT #340

FROM: Chapter, 3, German Techni[redacted] to Japan, 15 June 1945
Division of Naval Intelligence

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15-2/11

"Fox" - Mfg. AEG - 2 meter operation - simplified Kehedu; not jam proof. This is a very simple transmitting device containing only two tubes - one transmitter and one amplifier. There is no receiving antenna or circuit; the approach of the fuze to a reflecting body is measured by the variation of the load on the antenna. The range of sensitivity is between 6 and [illegible] meters. Developed by A.E.G. under contract to Henschel; tested extensively but never used in operations.

Infra Red Proximity Fuze - (See Physical and Optical Devices - "LIEGE")

"Fanlitz" .. It is understood the fuze was primarily designed for use in initiating war heads of rocket type missiles. A lead sulphide cell and amplifier are fitted to the nose section. Forward of the cell is a circumferential glass "window". The missile is fired so as to intercept the line of flight of the aircraft. As the missile approaches the target, the infra red radiation from the target striking the cell continues to increase in intensity. It suddenly decreases owing to the geometry of the glass window and the cell aperature. The corresponding drop in amplifier output is used to function the war head.

For a relative small charge of approximately ten (10) meters effective range no cooling of the cell is necessary. For heavier charges on the order of fifty (50) meters range the cell requires cooling. Dry ice within a double wall vacuum out [illegible] container is reported to be the method used for cooling the cell.

The device has been fired experimentally with success and was reported as being actively developed for operational use.

The homing device was described by Dr. [illegible] of [illegible] as the "[illegible]". [illegible] electric cell is placed at the focus of a mirror and the beam is interrupted by a rotating semi-circular shutter.

By measuring the phase of the rotation at which the signal arrives, the direction of its source (target) is established. This is transferred to the flight control of the missile. It is said the mechanism results in the target [illegible] the axis of the missile.

The device is reported to have been tested experimentally and with success.

"[illegible]" - The AEG have developed a similar device called [illegible] which uses a lens instead of a mirror.

Only German proximity fuze for shell is called an influence fuze and operated by interaction of electromagnetic [illegible] and target. From tests [illegible] millimeter guns at ranges [illegible] targets they claim action at [illegible] meters.

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about 1000 rounds. Score goes down markedly [illegible] that distance from screen corresponds to about [illegible] is quite uncertain. Would have been in [illegible] production [illegible] this year.

Nose of shell is split and capacity currents between [illegible] gering action. Shell becomes charged by [illegible] Nose split axially gives correct pattern [illegible] batteries. Electrical parts include [illegible] three condensers, and insulating [illegible] is used with three volt control [illegible] graph 1. Greater sensitivity is claimed [illegible] trials have been made. [illegible] thousands of rounds in electric [illegible] precharged condenser.

German safety includes acceleration switch [illegible] bore over ordinary method, [illegible] Present RG [illegible] bridge wire type with resistance of [illegible]

[illegible] of fuze and detailed report [illegible] be regarded as [illegible] of German [illegible]

[illegible]: As fewer than [illegible] only twelve turned over to the [illegible] are in a position to exploit this [illegible]

[illegible]

[illegible]

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[illegible]

[illegible]

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[illegible] correction of the [illegible] of the weapon, both in range and azimuth may be made by the bomb-aimer after its release, and this is achieved by a [illegible] of four "spoilers" arranged to disturb the airflow over tail fin surfaces. Roll, about the vertical axis, is countered by another pair of spoilers which are under the control of the gyroscope only. The unit consists of two gyroscopes in tandem, one measuring the roll angular displacement, while the other measures the rate of roll, and introduces damping into the system. There is no interconnection with the radio system. Both motors are identical, and are standard instruments in German auto-pilot and gyroscope equipments. When supplied with a three phase alternating current at [illegible] volts, [illegible] c/s, they spin at a rate of about 20,000 r.p.m.

There are two types of spoiler, which differ only as regards the solenoid windings. The four inner spoilers which are radio controlled and operate from the [illegible] supply, have two coils, each of [illegible] ohms resistance, while the two outer spoilers, which are gyroscope controlled and operate from the [illegible] supply, have coils of 100 ohms resistance.

The aerial consists of one section of the tail structure, and this is insulated from the framework by constructing the side members, which hold it to the structure of fibre. Two of the eight clamping plates of the tail framework are not metallic, and the tubular section held between these plates is connected by a brass strip into the fin nearest to it. It is apparent that the aerial does not approach a quarter wave-length at the frequencies involved ([illegible] mc/s) and must be highly capacitative, hence the inductive matching unit.

[illegible] Dimensions

Unit	Overall dimensions inches Length	Height	Width	Diam.	Weight lbs ozs.
[illegible]	[illegible]	[illegible]	7-[illegible]	-	17 [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	-	- [illegible]
[illegible]	[illegible]	-	-	[illegible]	[illegible]
[illegible]	[illegible]	-	-	[illegible]	6 [illegible]
[illegible]	[illegible]	[illegible]	16-1/2	-	25 [illegible]
[illegible]	[illegible]	[illegible]	[illegible]-1/2	[illegible]	12 [illegible]
[illegible]	[illegible]	-	-	18	24 8
[illegible]	[illegible]	-	-	[illegible]	6[illegible] 8
[illegible]	[illegible]	[illegible]	[illegible]	-	24 [illegible]

[illegible] appears to be a simple but effectively-controlled [illegible], provided that it is not subjected to deliberate [illegible] interference. [illegible] of the system, the [illegible] receiver, is of neat design [illegible], but [illegible] relays must always be the ultimate [illegible]. Since the whole operation depends upon

[redacted]

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the regular "ticking" of their movable contacts, the system may be easily upset by any signal which prevents this taking place. To [illegible] the control system, therefore, it is necessary only to put out a carrier on the correct frequency in the [illegible] mc/s band having amplitude modulation of either [illegible] c/s, 1500 c/s, [illegible] c/s or 12000 c/s. While the setting of the carrier frequency must be accurately placed on the control signal carrier it is sufficient if the modulation is accurate in frequency to [illegible].

- -

ITEM: [illegible]

INTELLIGENCE: Interrogation of Professor [illegible] WAGNER, head of [illegible] Research Organization, reveals that a Japanese delegation was shown test flights of HS293 at Military Testing Field, [illegible] early in 1943. The missile demonstrated was the old A-1 series and not the new A-2 in which the considerably improved steering device is incorporated. Professor WAGNER does not believe that the wire control feature was revealed at that time, nor the telescope device which had not been completed by the Germans until later in the year. Professor WAGNER's information is considered entirely reliable. Other source material confirms [illegible] statements. (A-2)

IDENTIFICATION: This radio controlled glider bomb is equipped with wings and tail unit so that it glides to ground with extended trajectory. HS293 were carried, one under each wing, of aircraft FW200, [illegible], [illegible], He177. Guided to definite target by transmitter in a/c and [illegible] receiver in HS293. Jet propulsion unit, [illegible] from base, operates during first 10-12 sec. of flight giving additional acceleration and range. Flare unit and electric lamp attached to tail for sighting. Aimed by eye alone. Radio control depends on a tone modulated radio frequency of [illegible].

Overall length - 13 ft.
Wing span - 10 ft.
Wing area - [illegible] sq. ft.
Total wt. - [illegible] lbs.
Wt. of bomb - 1322 lbs.
Average speed - [illegible] knots
Tail span - [illegible]"
Dia. of bomb - [illegible]"
Color - Sky blue
Expl. filling - Trialon or cured Amatol 60/40

Main parts:
1. Bomb (forms forward part of fuselage)
2. Control unit housing
3. Jet propelling unit
4. Main planes
5. Tail plane
6. Tail tracer unit

[redacted]

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[redacted]

CONCLUSIONS: In view of the appearance of suicide aircraft and the "Baka", which in a sense are guided missiles, it seems possible that the Japanese have decided that this method of attack presents less technical difficulties than the development of HS293. Tooling necessary for production of controlled missiles demands a high degree of precision. The "Baka" design is not dissimilar from HS293 and for the exception of the radio control feature and solid propellant, may actually have been inspired by it and represent the extreme limit of Japan's intentions along these lines. The latter seems particularly true in view of recent formalizing of the Suicide Corps in Japanese naval hierarchy.

APPROXIMATE DATE OF PRODUCTION: According to Professor WAGNER, at least 12 months of preliminary work and experimentation are required before production can be expected. Another 6 months for tests and adjustments are then considered the minimum. This, if the Japanese do intend developing this intricate equipment, would make possible the advent of HS293 in the early Fall, 1945.

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ITEM: GUIDED MISSILES, HS294

INTELLIGENCE: Interrogation of Professor Herbert WAGNER, Head of Henschel's Research Organization, reveals that discussions carried on between the German Air Ministry and Japanese naval representatives in December 1944 were on the subject of the HS294.

IDENTIFICATION: Enlarged version of HS293, also used for shipping attack. Elongated nose, semi-armor piercing steel. Further differences from HS293 are two propulsion units, one under each wing which drop away when bomb enters water.

Explosive charge	656 kg.
Wing Span	402 cm
Total Length	607 cm

Fired into water in straight line with target at level distance of from 4 km. (alt. 900-1000 m) to 14 km (alt. 2900-5500 m). Fired into water at angle of from 13° to 27°; the bomb's total speed at entrance is approximately 150 meters/sec.

- -

ITEM: GUIDED MISSILES, A-4

INTELLIGENCE: It is believed that the Japanese are familiar with the design of X-4. (F-0)

IDENTIFICATION: Two specimens of the X-4, German air launched anti-aircraft rocket, have been recovered from the Ruhrstahl AG Presswerke at

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Brackwede, and the Brinkman plant at Hovelhof in the Bielefeld region. Both firms had taken care to remove all documents concerning the rocket before Allied forces took over.

The X-4s recovered are believed to be partly assembled production models. The warhead, fuse, and some control items are missing on all of them. Control parts have since been obtained from another source, although only one wire control device was found. Electrical wiring of both missiles was reported to be rudimentary. Practice warheads similar in shape to the operational model have also been found.

Performance: The X-4 is a wire-controlled, rocket-propelled, fin-stabilized missile with a proximity-fused warhead. It was intended for launching from fighter aircraft against heavy bomber formations. From information obtained from documents found at the Schmidding plant in Cologne it was not clear what type of control the X-4 employed. It is now known that the crew of the launching aircraft was to control the flight of the projectile through visual observation aided by signalled correction from a control unit in the aircraft connected to the rocket's controls by two insulated wires.

The X-4 is propelled by a bi-fuel rocket motor manufactured by BMW (designated "109-548"), utilizing the reaction between fuels designated "Tonka" and "Salbei". Four large fins are fitted symmetrically to the body of the rocket as shown in the drawing, and four smaller fins on the tail are intended to stabilize the flight of the missile. The smaller fins incorporate solenoid-operated control surfaces through which two-dimensional control of direction is made possible. A small aluminum trim tab is fitted on the trailing edge of each of the four large fins, causing the missile to spin on its horizontal axis during flight.

Although the warhead of the X-4 has not yet been obtained, it is believed to consist of an uncased, molded, streamlined, dinitro-glycol-based explosive fitted with a combination acoustic proximity-impact nose fuse, which is also self-destroying. A conventional bomb carrier which has been modified to hold the X-4 is designated ETC 70A1.

Additional details of the X-4 were secured from its designer, who said that the missile in the form described above was considered a success after development trials. However, due to dangers inherent in its fuel system, the X-4 was not considered practical for operational use. Attempts were made to remedy the situation with a solid fuel propulsion system, and trials with the rocket used as a glider were also carried out. The measurements and capacity of the rocket in the original form were given as:

Overall Length	6 feet 6-3/4 inches
Length of Warhead	1 foot, 5-3/4 inches
Diameter of warhead (at base)	8.875 inches
All-up weight of missile before launching	132.2 pounds

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Weight of warhead	44.1 pounds
Estimated fuel tank capacity	
Salbei:	4 to 5 liters (approximately)
Tonka:	2 liters (approximately)

Warhead: Although accuracy of details on the X-4 warhead cannot be verified, it is believed to be of unique construction. The missile was developed on the theory held by some German experts that a weapon of high blast efficiency and little or no fragmentation could do great damage when detonated in the middle of heavy bomber formations. The explosive is drilled to take an offset fuse gaine and a five-core cable to the nose fuse of the warhead. The warhead is attached to the afterbody by wood screws and has an adaptor for the nose fuse attached in the same way.

Operation: The designer said that on release of the projectile from the launching aircraft, a pyrotechnic train in the fuse starts electrically, and seven seconds later it arms the proximity and impact elements. Should the missile fail to find the target, 28 seconds later the train initiates the self-destruction element. The armed acoustic element consists basically of a vibratory reed with a diaphragm tone filter sensitive to sound at 150 to 400 cycles per second. It operates a lever amplifier completing the circuit to the detonator when actuated at a range of around 50 feet by aircraft propeller noises. A delay of 1/50 second is incorporated in the detonator to enable the missile to close-up to the target before detonation takes place. If the projectile hits the target the armed impact element then detonates the warhead.

The afterbody of the missile consists of forward and tail portions. The forward outshell of cast machined aluminum houses the helical aluminum tube fuel tanks and combined two-compartment steel air bottle. Electric wiring passes through this portion to the fuse and air bottle opening valves. Four sharply swept-back plywood main stabilizing fins are fitted to the external case by angle aluminum brackets. A steel suspension lug for hook-type suspension is riveted to the body midway between two of the fins.

Two diametrically opposed fins carry torpedo-shaped containers, each housing a spool wound with nearly four miles of two-tenths millimeter insulated steel wire, to the end of which a plug is fitted to enable the wire to be connected into the aircraft con rol apparatus. Tabs which give spin to the X-4 are fitted on the trailing edge of each fin. The other two fins are each fitted with a tracer candle at the top and have similar and probably smaller spin-imparting tabs. Leads from the candles and the wire spool containers are led to the wiring inside the rear part of the rocket.

Tail: This portion of the X-4 is a thin pressed aluminum envelope made in four section,s spot wleded together. On the upper surface at the forward end is a seven-pin plug through which connection is made to the launching aircraft. At the rear end, the four tail stabilizing fins of aerofoil section

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are set at 45° in relation to the main stabilizing fins. Each tail fin is fitted with a double-acting solenoid-operated control spoiler, the surfaces of which are in the form of minute rakes. The tail portion houses the gyro control unit, nine-volt battery and box, and fuel leads from the tanks to the fuel combustion chamber located at the extreme rear of the tail section. The combustion chamber is held rigid by three adjustable steel tubes spaced equidistantly, connecting it to the forward portion of the afterbody. The venturi protrudes from the tail portion and is adjusted to take a pressed steel locking ring which holds the tail portion in position.

Motor: The BMW 109-548 rocket motor which propels the X-4 utilizes a self-igniting mixture of Selbei (98-100 percent nitric acid) and Tonka 250 (57 percent crude m-xylidine with 43 percent triethylamine). The motor is reported to be capable of delivering an initial thrust of 270 to 315 pounds, which falls progressively to 45 to 58 pounds after 30 seconds.

The motor consists essentially of a double compartment air bottle, which pressurizes two aluminum fuel tanks delivering fuel to a combustion chamber and venturi. The double compartment steel air bottle is located centrally within the helical fuel tanks. The after compartment is fitted with a charging valve, the connection to which passes through the forward compartment. A delivery valve is connected in the same way. The forward compartment is fitted directly with a charging valve and a delivery valve. The delivery valve of the forward and larger capacity compartment is connected by a short length of small bore steel tubing to the outer and larger fuel tank. The second delivery valve is connected in the same manner to the inner fuel tank.

The fuel tanks are close-fitting helically wound aluminum tubes of internal diameters of 2.8 and 2.2 centimeters respectively. In the forward end of each spiral a flesible aluminum fuel ejection piston is fitted, insuring that all of the fuel will be driven from the tanks into the combustion chamber when pressurization is effected. The outer tank, fuelled with Selbei, is connected by a length of small-bore aluminum tube to the outermost fuel inlet of the combustion chamber. The inner tank, using Tonka, is connected in the same way to the inner fuel inlet, from which entrance is made directly to the combustion chamber through a simple aluminum grid filter and three equidistantly spaced holes in the base of the combustion chamber. The latter is a steel cylinder ending in venturi orifice. The chamber is double-walled with a spiral tube inserted between the walls.

Selbei circulates by entering the outer inlet rhough the double wall, and acts as a coolant before it goes into the combustion chamber proper. This last is effected by six equidistantly spaced holes almost concentric with the three holes in the inner tank holding Tonka. The holes meter the delivery rate of fuel to the combustion area, where spontaneous combustion takes place.

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Control: The control system for the X-4 shows great similarity to the FX radio-corrected armor-piercing bomb, which was the work of the same designer. The rake-spoilers in the tail fins vibrate five times per second, moving as possible to each side with each vibration. Control of flight is effected by the variation of duration of stay at each limit of travel. When no control is applied the spoilers virbrate for equal time-durations to each side. When a turn is desired the spoilers are made to remain longer at one limit of travel with corresponding reduction of time of stay at the opposite limit. The control unit in the aircraft is a small instrument (10 centimeters square) carrying a single control stick which moves forward and back for elevation and from side to side for azimuth correction.

Inside the unit are two drums which revolve at a rate of five times per second. One drum controls elevation and the other controls azimuth. The control stick governs the position of a spring contact along each drum. Each drum is built up of two surfaces so that when the contact is at the mid-point it rests for equal time-durations on each surface, but when moved towards either end there is an increase in contact time on one surface with an equal decrease of contact time on the other surface.

The azimuth drum provides polarity change to a sensitive relay in the X-4 and the elevation drum current change to a second relay. Since current and polarity changes are passed simultaneously down the length of connecting wire, the elevation relay is fed through a rectifier and resistance bridge circuit so that it is unaffected by the polarity changes present in the signal, and reacts only to current change. To allow for voltage drop in the wires connecting aircraft to rocket, 190 volts DC are provided by a small power pack using the 36 volt 500 cycle supply which runs up the gyro prior to launching. The relays connect the small 1-1/2 watt solenoids in each tail fin to the nine-volt battery carried in the rocket. Time duration to each solenoid depends on the control being applied.

The rocket rotates about its axis at the rate of one rotation per second. This rotation causes symmetrical cancellation of errors in manufacture and consequent simplification of the stabilising mechanism. If a missile of this kind did not rotate it would require gyro-stabilization both in azimuth and elevation. In this way the X-4 is stabilised in line of flight by a single gyro.

Fixed to the gimbal mount is a segmented commutator. As the rocket rotates, the elevation and azimuth signals are applied to the appropriate fins in cyclic succession. The main segments are 60° with subsidiary segments of 15° spaced by 15° to each side. The application of 15° of counter control inserted in the timing cycle greatly increases the overall stability of the missile.

Launching of the X-4 was intended to be from FW-190 and Me-262 fighters. The one modified X-4 bomb carrier found was of a singlehook electrically-fired type, fitted with a mechanical jettison linkage. The usual fuse-

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steering arm had a seven-pin socket (fitted in place of a [illegible] head) to connect with the seven-pin plug on the rocket body. [illegible] connection current is supplied from the aircraft to [illegible] tracer candles. The [illegible] launched by separate control, [illegible] instant the pilot of the parent aircraft presses the [illegible] to launch the missile.

The carrier is also fitted with two arms, [illegible] of the carrier frame to which the [illegible] are attached. The electrical connections of the [illegible] carrier to the [illegible] of the aircraft [illegible]. [illegible] the carriers could be fitted [illegible] and on the fuselage or [illegible] of the [illegible] length.

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Rockets
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AFDMA-2B/GenPhillips/BHB/lm/2865/s/27 June 45
Rewritten AFDMA-1/GenPhillips/meh/71500/28 June 45

5 JUL 1945

Dr. Frederick L. Hovde
Chief of Division 3, NDRC
705 - 21st Street, N. W.
Washington 6, D. C.

40

Dear Dr. Hovde:

Your letter of 20 June 1945 has been received and all phases relative thereto have been thoroughly considered. Before going further into the details of your letter, however, I wish to congratulate you and your staff on the excellent work done in the most successful development of the 2¼" SCAR, 5" HVAR, and the 11.75" rockets. These rockets are just now beginning to demonstrate their value in actual combat.

We are fully aware of the importance of aircraft rockets, the part which it is anticipated they will play in the war with Japan, and the necessity for maintaining research and development facilities for this equipment in post war days. The 4146th Army Air Forces Base Unit (Air Technical Service Command) was established as an accelerated development and test station to function for the duration of World War II, after which it was planned to transfer the activities to a more suitable location for post war work.

We are in agreement with the basic recommendations as contained in Dr. Anderson's report to you dated 9 June 1945, and the following action is being taken toward this end:

(1) Air Technical Service Command is at present endeavoring to obtain the services of several thoroughly qualified men who have been instrumental in the development of rockets and launchers at California Institute of Technology. This should insure continuity of the program as recommended by Dr. Anderson.

(2) Investigation is now underway to obtain the most suitable research and development station for post war work after the work now being carried on at Dover terminates. The possibilities in this connection are as follows:

a. Enlarging the facilities now available at Muroc Lake, California.

OFFICE SYMBOL	1. AFDMA-1	2.	3.	4.	5.
GRADE AND SURNAME OF COORDINATING OFFICERS					

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Rockets
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AFDMA-2B/GenPhillips/BHB/lm/2865/27 June 45
Rewritten AFDMA-1/Gen.Phillips/meh/71500/28Jun 45

Ltr to Dr. Frederick L. Hovde

b. Utilizing the facilities provided at the Army Air Forces Proving Ground Command, Eglin Field, Florida.

We feel that it is highly desirable that wherever the post war base is established the propellant and metal parts research facilities be also established so that development of rockets, sights, launching equipment and airplane modification can be carried on simultaneously under a coordinated program.

Until such time as definite arrangements can be made toward the establishment of a permanent base, it will be necessary for us to continue work at Dover and Muroc Lake, with such additional expert civilian personnel being given these activities as can be secured. This, we feel, will allow us to get the 5" HVAR and the 11.75" rockets into effective use in the war against Japan.

Resident Air Technical Service Command liaison officers have been established at California Institute of Technology and NOTS, Inyokern, for the purpose of improving the entire liaison and coordination program between interested agencies.

Your interest in the furtherance of the war effort and the future well-being of the Army Air Forces, as manifested by the suggestions contained in your letter, is appreciated.

Sincerely yours,

Signed

IRA C. EAKER,
Lt. Gen., U. S. Army,
Deputy Commander, Army Air Forces.

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ARMY AIR FORCES
MATERIEL COMMAND

MEMORANDUM REPORT ON [illegible]

Date 7 July 1945

SUBJECT: Use of Controllable Bombs

[illegible] Aircraft [illegible] Contract or Order No.

[illegible] [illegible]-23-1151 [illegible]

A. Purpose.

1. To present pertinent [illegible] and recommendations in connection with the use of controllable bombs.

B. [illegible] Data:

1. [illegible] of successes achieved to date in theaters of operation [illegible] use of controllable bombs and the unusual results now being obtained in [illegible] tests [illegible] at Wendover Army Air Base, Wendover, Utah, it appears that controlled bombs will have increased importance in the future, and [illegible] the use of such bombs [illegible] the design of air-[illegible] the future.

2. [illegible] bombing requires accurate [illegible] only up to and [illegible] angle and beyond that point, synchronization is unimportant. For that reason, the [illegible] is not designed for rearward vision [illegible] bombardier's sighting window is likewise limited as to rearward vision.

3. [illegible] the use of Razon, the Norden bombsight is synchronized to follow the target rearward [illegible] impact of the bomb. A small mirror known as "[illegible] Modified" is set to view the bomb at a set trail angle of 40 mils. This view is then superimposed upon the view of the target and the bomb is controlled by keeping the view of the bomb centered on the target. The setting of 40 mils trail was arbitrarily made because that is approximately as far rearward as the Norden bombsight will view without racheting. The normal trail of the Razon bomb is in the order of [illegible] mils and must be sailed to make [illegible] mils trail angle. Naturally this produces some error.

4. [illegible] Research and Development Company personnel have developed a [illegible] corrector which operated on the bombsight rate knob and automatically takes care of lengthened time of fall induced by control being applied to the bomb. This corrector now referred to as "JA[illegible]" is in the development stage and can be attached to the standard bombsight in a matter of [illegible] minutes and will constitute no obstruction to the normal operation of the sight.

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5. If controlled bombs are to be extensively used in the future, a design of a special bombsight with the corrector built in and having line of sight up to 150 to 200 mils trail should be considered.

6. In present aircraft, the use of Razon has necessitated the use of special brackets to place the bombsight far enough forward to allow a rearward view of 40 mils trail. It is expected that this equipment will be placed in the B-24, B-29, B-17, and B-25, in that order. None of these aircraft allow sufficient vision rearward without special mounting of the bombsight.

7. Figures to date indicated that controlled bombing achieves an accuracy several times that of conventional bombing so it is conceivable that one squadron operating with controlled bombs could do the same damage to a target that several conventional bombing squadrons are able to do at present. This was ably proven by results of Azon in the China-Burma Theater. This would indicate that the use of controlled bombs warrants special equipment and personnel separate from equipment and personnel of normal bombing squadrons. For this reason, it would be advantageous to have a table of organization prepared for Razon equipped squadrons to include personnel competent to handle all Razon equipment and in addition one man capable of maintaining and servicing bombsights within the squadron. In addition, equipment should be prepared that will contain everything necessary for servicing and operating all Razon equipment and bombsight equipment.

C. Conclusions:

1. Controlled bombs have reached a state of development where consideration of their use should be made in designing both aircraft and bombsights.

2. The value of controlled bombs is sufficient to warrant the formation and training of special personnel (including a bombsight expert) for controlled bomb squadrons.

3. Squadrons using controlled bombs should each be provided with all equipment necessary for servicing controlled bomb equipment and bombsights.

D. Recommendations:

1. Design of a bombsight be started solely for use with controlled bombs.

2. Aircraft in the future be built to accommodate this sight or present modified sights.

3. A table of organization for each controlled bomb squadron be formulated to include not only maintenance personnel for the controlled bombs but also to include at least one bombsight expert who can perform all work necessary within the squadron.

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W. R. TSESE-2G-1194
7 July 1945

4. Sufficient equipment for controlled bombs be provided to each controlled bomb squadron to operate the squadron. This equipment to include such tools and equipment necessary to service all bombsights in the squadron.

5. Each controlled bomb squadron to be so equipped with personnel and equipment that it can operate without outside assistance in so far as its special equipment is concerned. This equipment to include the bombsight.

John A. Dilworth
Prepared by JOHN A. DILWORTH, Capt. AC

F. Kotcher Maj AC
Approved by for B. S. KELSEY, Colonel, AC
Chief Airc. Proj. Sect.

F. Kotcher Maj AC
Approved by for F. O. CARROLL, Brig. Gen. USA
Chief, Engineering Division.

Concurrence:

AC/AS, M&S (2)
TSEAL-2D - Eval. Br., Tech. Data Lab.

Distribution:

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Chief, Radio Section

14 July 1945

Status of Development of Control Equipment for Guided Missiles.

1. Microwave Control Systems.

Several microwave control systems are in various stages of development:

a (1) The most advanced from the development standpoint is the system which uses an SCR-584, MC-627 and a pulse repetition frequency kit at the ground control point and an AN/APW-1( ) beacon and control set in the missile. The single pulse coded beacon and control equipment, AN/APW-1 and AN/APW-1A is in production at the Aircraft Radio Corporation. Control of the missile using this equipment is obtained by varying the pulse repetition frequency of the SCR-584. A more secure system, the AN/APW-1B and AN/APW-1C, which uses double pulsed coded signals, will go into production within several weeks at the Belmont Radio Corporation and the Aircraft Radio Corporation. Deliveries of the AN/APW-1 and 1A have started; the AN/APW-1B and 1 C are expected to start in October 1945. Belmont has a development contract from the Special Projects Laboratory for fifty (50) AN/APW-1B's, and deliveries of these should be completed in the next three or four months. The development of the pulse repetition frequency kit is about 90% complete. Two such kits have been built. Several circuit constants have to be determined and several adjustments made before development can be considered complete. Tests are being conducted with the airborne equipment installed in a C-45, B-24 and in the JB-2's.

(2) Any S-Band equipment of sufficient power and proximity so that its signal exceeds that of the control point will interfere with the operation of the AN/APW-1 and 1A. No tests have been made yet to determine the vulnerability of the AN/APW-1B and 1C to interference. It is known that at present, the Japanese do not have any effective airborne S-Band equipment. It would not be economical or practical to build kits to convert the single pulse to a double pulse coded equipment.

(3) The development of the pulse repetition kit and the AN/APW-1B and 1C should be completed in another month. Service test models should be available in about three months. The airborne equipment is easy to install and operate; the ground equipment, essentially the same as used for close support bombing, is complex and bulky but no difficulty is anticipated in its operation.

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b. The Radiation Laboratory (Dr. L. L. Davenport) is working on the development of a much more secure system than the AN/APW-1( ). Essentially the same ground equipment will be used. The airborne equipment, AN/APW-3, will be more complicated than AN/APW-1 but will afford much more security due to the use of five (5) coded frequencies. It should also be less susceptible to jamming and have a high traffic handling capacity. A model of the ground equipment and twenty (20) airborne sets are to be ready for testing in October of this year.

c. General Projects Laboratory is working on a system for control of [illegible] against ground targets, the AN/APW-5 and 6. This system, being built around the AN/APQ-13 (the AN/APQ-7 may be used in place of the AN/APQ-13), will interrogate on "S" and "X" bands, the beacon will respond on "S" [illegible] will be transmitted on "S" band. It will use a [illegible] six control pulses, the presence or absence of some of which will cause the controls to function. The controlling equipment will be installed in another plane such as the B-17. This plane can carry the missile and launch it near the target or can meet the missile there and control it to its destination. Range of control should be satisfactory to about fifty (50) miles. Security and traffic handling capacity will be much better than that of the system using AN/APW-1( ). The development work is about 30% complete; the computer and coder are the only two components that have to be developed from scratch. Sylvania Electric Products Company is interested in doing this development work which will require nine (9) to ten (10) months to complete from date of placement of contract.

d. Systems operating in the microwave region are limited, under normal conditions, by propagation to the line of sight (equal in miles to 1.23 $\sqrt{\text{altitude}}$ in feet); for example, a missile flying at 7000 feet could be tracked and controlled from a ground point to about one-hundred (100) miles. A missile, such as the [illegible], can have its controls preset when it reaches the limit of transmission; however, at most, this will not extend the range of the missile more than fifty (50) miles. Using the AN/APW-5 and 6, the missile can be launched or set near the target and guided to it. The range of control could be extended by releasing a relay balloon from the missile or by flying one or more relay aircraft equipped with suitable radio or radar relay equipment. However, any system of this type would be elaborate and costly, its weight considerable, and sufficient information is not available as to whether the technical arts have been advanced sufficiently to make such systems practicable.

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Chief, Radio Section 14 July 1945

Status of Development of Control Equipment
for Guided Missiles, Cont'd.

2. Low Frequency Control Systems.

a Navigation systems such as Gee, Loran, Shoran, Oboe, etc., if used for guiding missiles, can be easily intercepted and jammed; their accuracy is limited; they are elaborate and costly.

b The Special Projects Laboratory is developing under a low priority, a system comprised of the following:

(1) Control Adapter AN/ARA-14. This is a modulator and selector which can be attached to any standard radio set. It provides six (6) control functions; the number of controls can, by means of a stepping switch, be increased indefinitely. For long range control, two (2) frequencies would have to be used; a low frequency with ground wave control to the minimum sky wave range, and high frequency control using sky wave. Photoswitch of Cambridge, Massachusetts, is building a preproduction model of this equipment in accordance with an ATSC design.

(2) A direction finding system which would indicate the azimuth. Several types of these are available. These, however, require extremely good sighting.

(3) A repeat-back system for determining the range to the missile. A tone modulated signal from the ground station is received by the missile and retransmitted on a different frequency. The difference in phase between the transmitted and received signals at the ground point give the range to the missile. A model of the ground station has been built by ATSC, but not tested. In order to get long range low frequencies, (450 Kc.) must be used.

Any low frequency systems are easy to intercept and jam. The signals cannot be confined to beams, and only a limited number of channels are available. The accuracy of tracking is not too good. Such systems, if used, would be short lived.

3. Seekers: Heat and light seekers have a very limited range and can be used only for the last stage of any missile. If used, an operator would have to lock the missile on the target. Radio and radar signals could be used for homing; however, such targets that those signals would represent, as radio towers, radio

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Chief, Radio Section 14 July 1945

Status of Development of Control Equipment
for Guided Missiles, Cont'd.

sets, etc., would not be worth the expenditure of a controlled missile. An effective countermeasure against such a missile would be the shutting-off of the signal. Send-Receive Bomb, Radar Homing Bomb and Moth are the three different types of bombs for which controls were worked on at one time or another at ATSC. At present, no active development work on radio or radar seekers is being carried on at ATSC. The projects are dormant pending determination of their operational value.

4. Magnetic Navigation.

a It has been discovered that horizontal and vertical geomagnetic lines form intersecting line systems over certain areas of the earth's surface. These lines of about 0.2 gauss (1 gauss = 100,000 gammas) magnitude, have been plotted for certain areas such as Japan. They vary, however, over periods of time and have to be rechecked. A considerable amount of work in this field has been done at the Carnegie Institute of Washington. Equipment has been developed which is sensitive to one (1) gamma. This equipment can be used for navigation but could not operate on intensities of less than ten (10) gammas, as the inherent magnetic noise of the earth often exceeds one gamma. There is no limit on the range of such equipment, and its accuracy should be the same at all ranges, which is expected to be to within a circle of three (3) miles in diameter. Such equipment is considered unjammable and has unlimited traffic handling capacity.

b A missile equipped with a magnetic navigation device would be preset to travel along a horizontal (or vertical) geomagnetic line of a certain intensity until it reached a vertical (or horizontal) line of certain magnitude at which the controls would cause it to dive.

c A development contract has been placed by ATSC with the Carnegie Institute of Washington to modify the existing equipment for use as a control for JB-2's. About 30% of the work has been completed. It will require two (2) months from this date to build a model of this equipment, and about four (4) additional months to obtain service test models. The airborne equipment should not be larger than the AN/APN-1( ) and not more complicated; a magnetometer, to work with the compass, will have to be installed in the nose of the missile. No ground equipment will be required.

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Chief, Radio Section 12 July 1945

Status of Development of Control Equipment
for Guided Missiles, Cont'd.

5. Conclusions.

Several systems are being developed for control of guided missiles for ranges to one-hundred (100) miles. The systems will be as good from the standpoint of vulnerability to jamming, accuracy, and traffic handling capacity as the present status of radio technique will permit. With the exception of the magnetic navigation system, no other long range control for guided missiles is being considered, either by NDRC or at ATSC. The magnetic navigation system is being developed under a low priority.

6. It is recommended that:

a A statement as to requirements for long range navigation of guided missiles be obtained from CC&R. MC's should, if possible, be enclosed.

b ATSC be directed to prosecute the development of the magnetic navigation system more vigorously, and a higher priority be assigned to the project.

c ATSC be directed to develop a long range control system based on any technique, such as gyro precessing with latitude, cosmic ray distribution, etc.

J. S. LAMBERT
Major, Air Corps

AFDMA-27/2
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ATSC Form No. 43 (16 SEP 44)

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COORDINATION
TOR OR DEP.
AIR INSPECTOR
MOT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MA..... DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

"Coordination Agreement Between the AAF and BuAer on Matters Affecting Research Development, and Production of Guided Missiles"

cal
TSESE

1st Ind. TSESE/CDS/cal

HQ ATSC Wright Field Dayton, Ohio. 14 July 1945

TO: Commanding General, Army Air Forces, Washington 25, D. C.
Attn: Asst. C/AS, M&S, Material Division

1. This Command is in agreement with the idea of forming an AAF - BuAer Guided Missile Committee and recommends: (1) that the agreement be as outlined below and (2) that if the Assistant Chief of Air Staff, Materiel and Services, desires representation on the Committee, that each Service be allowed three members, in order that this Command may be represented by the Chief of the Pilotless Aircraft Branch and the Chief of the Special Weapons Branch, both of the Engineering Division, Air Technical Service Command.

2. The functions proposed by this Command for the Committee are as follows:

a. Review current experimental and production projects for guided missiles and their component parts under the cognizance of the AAF and BuAer to determine what undesirable duplication exists and that the needs of both Services are fulfilled.

b. Make recommendations to the respective Services in order to correct undesirable conditions as found in paragraph a above. These recommendations would normally include cancelation, expansion, revision or merging of current projects where undesirable duplication is found to exist or where the needs of both Services are not being fulfilled.

c. Insure at the inceptive or preliminary design stage that proposed experimental and production projects concerned with guided missiles and their component parts provide, insofar as possible, for the needs of both Services and that those projects which are of interest to both Services are administered in a mutually acceptable manner.

3. A mandatory procedure will be set up within each Service which will insure the submittal at frequent intervals of information to the Committee and to the other Service on all current and proposed experimental and production projects which involve guided missiles and their components.

FOR THE COMMANDING GENERAL:

cc. TSEPL-3
TSESE-29

Incl. n/c

CENTRAL FILE COPY

F. O. CARROLL,
Brig. General, U.S.A.,

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HEADQUARTERS ARMY GROUND FORCES
ARMY WAR COLLEGE
Washington 25, D. C.

15 JUL 1945

471.94 (S) 15 JUL 45
GNRQT-5/3465

SECRET
Auth: CG, AGF
Initials: JEH
Date: 13 July 45

SUBJECT: Guided Bombs for Close Support of Ground Troops

TO: Director, New Development Division
War Department General Staff
Washington, D. C.

1. There are many instances where it is impractical or impossible to emplace heavy artillery so as to bring fire to bear on enemy installations. In many instances, also, the nature of the enemy's fortifications makes it impractical to reduce them with existing calibers of Field Artillery armament. At the same time, the efficacy of aerial bombardment is questionable, due in part, to the large dispersion of the bombs and to the difficulty of identifying from the air the specific ground target (s) which it is desired to destroy.

2. The feasibility of guiding bombs during their descent, thereby reducing the dispersion and increasing the probability of securing direct hits on small targets, has been demonstrated with Azon and Razon type bombs.

3. Target identification remains a major problem, especially when bomber aircraft are employed in close support of ground troops. Close support bombing, even with Azon or Razon, may well jeopardize ground troops if the ground target cannot be identified positively.

4. Ground troops are in the best position to locate and determine the actual ground position of important ground targets impeding their advance.

5. Know bomb trajectories, it appears to be feasible to develop a fire control system consisting of the following:

a. A radar-computor equipment to determine the optimum bomb release point.

b. Associated radio equipment for ground-to-bomber communication.

c. Ground radio release and control equipment for guided bombs. With this system the ground troops, haveing located a vital target and determined its ground coordinates, would call for air support. As the support

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471.94 (S) (15 JUL 1945)
GNRQT-5/34265 (cont'd)

bomber approached the target area it would be detected and tracked by the radar-computor and directed onto the proper course through the radio communication link. The computor portion of the radar would determine the release point for the bombs and, thereafter, the ground troops, by means of the radio control equipment, would apply necessary changes in the course of the falling bomb to insure its striking the target.

6. The matter has been discussed informally between representatives of this headquarters, New Development Division, War Department Special Staff (Lt. Col. Allis), and Dr. H. Spencer, Chief of Division 5, National Defense Research Committee. Dr. Spencer stated that if there were an urgent requirement, the computor for the system outlined above could be developed and a few procured on a crash program in approximately six (6) months.

7. The nature of present hostilities makes it necessary to locate and demolish large field fortifications and extensive cave systems dug into hills and mountains, often necessitating the destruction of the whole face or top of a mountain. This requires demolitions of major proportions, a mission difficult to accomplish with existing means available to ground troops.

8. There is an urgent requirement in Army Ground Forces for equipment which will permit ground troops to control the drop and guidance of Azon, Razon or similar type bombs carried by close support aircraft, as well as of bombs in the class of the Tall Boy (12,000 pounds) and Grand Slam (22,000 pounds). In addition to the modification of these large bombs to permit control, they should be modified to insure deep penetration.

9. It is requested that:

a. A project be initiated immediately for the development of equipment to provide the fire control system and guided bombs required for tye type of operation outlined in paragraph 5, above.

b. Applicable portions of the development be allocated to Army Air Forces, Army Service Forces and National Defense Research Committee (Division 5) in accordance with the special development capabilities of each.

c. This project be accorded a sufficiently high precedence to insure the availability of at least a limited number of complete systems

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471.94 (S) (15 JULY 1945)
GNRQT-4/34265 (cont'd)

for operational employment during the 1st quarter of 1946.

d. This headquarters be advised of your actions on the above requests.

FOR THE COMMANDING GENERAL:

/S/ W. A. Tracy
W. A. TRACY
Capt. A.G.D.
Asst Ground Adj. Gen.

[redacted]

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Div 5
15-V5PP
NDRC

1594

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DIV.5

15 July 1945

Monthly Spending Rate Based on Last Vouchers (in Ink under Contract)

Contract | **INFORMATION**

(1) OEMsr-240
Mass. Inst. of T.
#15,000

If Navy negotiations break down with M.I.T., this would be desirable AAF contractor. Feel that following key personnel would be valuable:

Dr. Perry Stout, Research Physicist....background in soil chemistry....very good development support man in microwave. Will return to a California University.

Mr. E. R. Toperick...very good man in microwave... background and future plans unknown.

Mr. R. A. Lamm....very good engineer (mechanical and electrical)...is fully familiar with specifications which military equipment have to meet.

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Above men have currently been receiving $5,000 to $7,500. Probably no personnel from this group should be approached until negotiations for a contract with M.I.T. are broken down.

Under the overall consulting phase of this contract, M.I.T. recently hired T/Sgt. A. E. Norgaard on his release from the army. It is planned to send him to Manila to put an overall service man in FEAF on VB-1, VB-3, and VB-6. He might be available after release.

(2) OEMsr-1445
Bendix
No inf.

(A)

This is a development contract for a radio link including servo amplifier for ROC. It is run by a small research team headed by W. S. Leitch who has come to know more about proportional radio control than almost any other man. The group is effective, rapid, and could probably be interested in continuing development work along these lines. As an OSRD project, it is contingent on the evaluation of ROC which should take place in the early fall. W. S. Leitch is the best man—His salary level is unknown.

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Div-5
15-3/5M
NDRC

1595

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Contract	INFORMATION
3 NDCre-183 Gulf $20,000.	B Gulf will continue through December 31 at which time development on Tarzon should be complete. Thereafter, the contract will be continued as an OSRD contract to make such people as O'Donnell, Molnar, and L.D. Palmer, and possibly others available to assist in the use of VB-1, VB-3, VB-13 in the theater. The group is probably the most effective Guided Missiles contractor under Division 5 and overall missiles. They have indicated no interest in continuing this work after the war. This might be shifted by discussion with Mr. Paul Foote, Director of Gulf Research Laboratory...in view of new change of Air Forces contract philosophy. Key men are: Mr. R. D. Wyckoff Mr. J. P. Molnar Mr. T. O'Donnell Mr. L. D. Palmer Mr. J. W. Fitzwilliam These are all physicists. Fitzwilliam's experience is principally aerodynamic...the others overall. Above is not comprehensive list of personnel, all of whom would be useful on GM work.
4 OEMsr-441 R.C.A. ~~Television~~ $15,000.	C Contract will continue pending evaluation of ROC. See Bendix above. RCA probably would continue to do development work with the Army as in the past.
5 OEMsr-327 Douglas ~~ROC~~ $50,000	D The ROC vehicle will be evaluated in the early fall. The organization is eager to undertake development contracts in the GM field. The new philosophy should make this easier, although it should be noted that the administrative difficulties with Douglas have arisen from the fact that its management is well used to normal Air Force contracts and feels selfconscious under the somewhat flexible arrangements which OSRD can make. W. B. Klemperer E. P. Wheaton Everett Pier are leading personnel, although the project draws on the entire scientific and engineering resources of the Douglas organization. Pier is probably Douglas' best electronics man. Wheaton is a physicist. Klemperer is a physicist with good electrical and mechanical engineering insight.

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Div 5
15-3.5PP
NDRC

1596

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INFORMATION

Contract

(6) NDCrc-180
M.I.T. Felix
$12,000

(E) This contract will continue if the Felix evaluation currently in progress is afirmative, as seems now highly probable. The personnel will be used almost in their entirely for assistants to the Air Force in the theater. Key personnel are:

A. C. Bemis--infrared measurements and homing
W. E. Buck--former geo-physicist--entered the project to be principally electronics man. Largely responsible for the Felix amplifier and is Associate Director of the Laboratory.
Roy Prince--background unknown--probably the best man on the project for the overall job of making the device work.
Jennings, Travers--background unknown--especial forte evaluation of targets for use with Felix.
Dr. Dane the best man in the Laboratory on bolometers.
T/Sgt. Robert J. Meltzer was in the Laboratory, drafted, and reassigned to the Lab...Very good man...initial difficulty in meeting people has been much improved by his military experience.

(7) OEMsr-1002
~~Bendix Amplifier for BOG~~
$3,000.

(F) See remarks on foregoing Bendix contract (¶2).

(8) OEMsr-1013
Mass. Inst. of Tech. Servo Mechanisms Lab.
$20,000

(G) This contract was entered into to provide a better stabilization and servo system for Pelican and Bat. Development work is now substantially complete. Contract is being continued to provide consultation on a crash procurement by the Navy of approximately 50 Servo Mechanisms before production at Western Electric can commence. M.I.T. plans to continue the Servo Mechanisms Laboratory and will probably entertain the idea of development contracts in their field. Their only competitors with approximately equivalent qualifications are Bell Telephone Research Labs. ~~Key personnel could probably not be touched.~~

9 OEMsr-1454
Schwien Eng. Co.
$1500.

(H) This is a very broad contract for all sorts of instrumental work in connection with GM. L. N. Schwien, President, is a very able engineer with plenty of creative imagination. He recently added H. A. Van Dyke, former development engineer of Foxboro Instrument Co., and later employee of Franklin Institute to his staff. Under contracts with Division 7 of NDRC, the Franklin Institute staff and Van Dyke in particular picked up a good deal of servo background by working under the direction of Division 7 personnel who had also been closely associated with the

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Div 5
15-4 SPP
NDRC

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Servo Mechanisms Laboratory. Believe this group should be encouraged to take on additional work.

(10) Symbol #6099 Specialties, Inc.	This contract will probably continue as long as Division 5 operates to develop simulated techniques in the GM field. The idea is to develop electronic computers particularly computers which are capable of solving rapidly differential equations of a high order with nonlinear coefficients. The key man is Mr. Loebe Julie who is now employed by Columbia University, and will transfer to Specialties. The contract was made with Specialties to implement Julie's abilities with better model shop and laboratory facilities than Columbia was able to provide. It should be an effective contract to continue, provided we are able to keep Julie from being drafted when he transfers from Columbia to Specialties when the contract will probably be terminated.
(11) OEMsr-1287 Fairchild Camera Scanner Expires 31 July 1945	This organization is eager to do development work, but their performance has been disappointing. The reason is not wholly obvious, because the ideas suggested have been good, and the facilities for doing good work seem to be there. The problem seems to be managerial rather than technical. Mr. Henry Blackstone could probably be approached in the P-7, P-8 range. He will be very valuable to develop almost any type of gadgets, particularly if he were picked up by a model shop with a foreman who is interested in good quality work. It is my opinion that several of Blackstone's good ideas have been sabotaged because their embodiment were of poor quality.
(12) OEMsr-1301 General Instrument	This organization will probably undertake development contract work in any of the electronic fields. Our experience with them has been excellent, although ARL regards them less favorably. ~~Management tops.~~
(3) OEMsr-187 Remington Rand Electronics Div.	This organization would be interested in continuing development work in the electronics field, particularly television. The television group in Division 5 has been unimpressed with the quality of the work.
OEMsr-921 Electro-Mechanical Research Corp.	Key man appears to be Dr. C. B. Aiken. This may be taken over by Wright Field. Aiken might be worth looking into at about the P-7 or P-8 grade.

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Div 5
15-3 SPB
NDRC

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Contract	INFORMATION Div. 5
14 OEMsr-798 Eastman-Kodak (M)	We understand this organization is now beginning to look for development jobs. We strongly urge the use of recording cameras to instrument new guided missiles.
15 OEMsr-1068 General Mills (M)	General Mills has a very excellent research and development team, particularly mechanical engineering, and should be considered in the stabilization and servo field. They are currently getting ready to build the Hall Servo Mechanism for Bat under subcontract from Western Electric. Might possibly consider research contracts in this field.
16 OEMsr-1348 General Electric (O)	This was a very good contract in which the contractor, for a relatively small amount of money and with almost negligible supervision, developed exactly what he was told to develop; namely, a sealed bolometer with an extremely small space factor.

Division 5
Personnel

Dr. Albert F. Murray...postwar plans unknown...has a very good electronics background.

Mr. A. J. Wollan...Technical Aide, P-4, physics background ---spectroscopy...has been in the high-angle guided missiles business for a long time.

Dr. E. W. Phelan, physical chemist...University of Georgia, now P-4.

Dr. G. A. Philbrick...could be an extremely valuable man in any development program...postwar plans somewhat vague... was formerly with Foxboro Instrument Co.

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9 August 1945

MEMORANDUM FOR RECORD:

SUBJECT: Guided Masles Division

1. Guided Missiles Division is to be headed by a General Officer directly responsible to the AC/AS-3. The functional breakdown is in three branches:

Materiel and Equipment Branch

Tactics and Training Branch

Personnel and Organization Branch

As now organized, in addition to the one General Officer, there will be eight officers, all specialists in the various fields of guided missiles.

2. The functions of the Division with respect to guided missiles of the ground-to-air, air-to-ground, air-to-air, and ground-to-ground type are:

a. Formulate policies covering development, test, and employment.

b. Establish military characteristics.

c. Monitor experimental development and technical tests.

d. Monitor operational tests and employment of guided missiles as do not become the responsibility of a Branch of the Requirements Division

e. Cooperate with Requirements Division in monitoring operational tests and employment of such guided missiles as become their responsibility.

f. Establish personnel and equipment requirements pertaining to development, test, and employment of guided missiles.

3. The current organization consists of one Colonel and two Lt Colonels. Although the present routine work of this Division is limited and the personnel required to carry out the functions is small in number, it is considered that the inclusion of a General Officer as chief is of extreme importance. The increasing role which guided missiles will undoubtedly have in the Air Force in the future indicated the necessity for authoritative representation in contracts with other agencies such as the WDGS, Navy, and civilian research and manufacturing organizations. This General Officer should be a man with an excellent technical background who is known for his progressive attitude toward new developments in warfare. Leadership by this type of officer will permit both freedom from conventional thought and methods as well as rapid development of guided missiles by elimination of lost time in getting staff decisions.

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4. At the present time, military characteristics of various guided missiles are being proposed by this organization. These requirements are based on a time factor of 5 to 7 years for development. The requirements for an air-to-ground missile may be taken as an example of the type of weapon being proposed in this program. This particular requirement calls for a missile which will be launched froma bomber flying at altitudes between 20,000 and 45,000 feet at distances up to 100 miles from the target. This type of missile, launched at great distances from the target, will not force the carrying bomber into the effective range of ground-to-air guided missiles which may be developed by the opposing nation. The air-launched missile will be controlled from the carrying aircraft for a major part of its trajectory with a homing device envisioned to direct it the last portion of its journey to the target.

5. A number of guided missiles are now under various stages of development. One of these, the Abusive project, a radio controlled aircraft, has been employed operationally in the European theater. Although any type of plane could be used, as a missile, war weary B-17's were filled with approximately 20,000 lbs of TNT in the ETO. This plane is taken off by a volunteer pilot, who bails out after making certain that an accompanying aircraft has control by radio. An outstanding attack was made by this missile against Heligoland Isle through heavy anti-aircraft fire. The JB-2, a Chinese copy of the German buzz bomb, is now undergoing advanced tests. This missile has a number of improvements over the German original, the most outstanding beingradar control. Tests are now being conducted at Wendover, Utah, with this radar control. Present estimates of the overall accuracy are at least 50% within a quarter-mile square at 100 miles range. General Kenny in the Pacific has shown extreme interest in this missile. The logistical problem is the outstanding factor as to whether this weapon will be used in the Pacific. Information is now being prepared for General Kenny on just how shipping is required to put this weapon in the field and it may very well be that our own buzz bombs will be falling on Japanese targets in a few months.

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HEADQUARTERS ARMY AIR FORCES
Office, Asst Chief of Air Staff, Materiel and Services

Inter-Dept Memorandum

MEMORANDUM FOR RECORD DATE: [illegible]

SUBJECT: AAF's Guided Missile Division

1. Received informal information that the proposed Guided Missile Division has been approved by General Vandenberg, and is to be established effective 1 September 1945. At present the Guided Missiles activities are handled chiefly by the Deputy for Tactics and Plans [illegible], and particularly by the Tactics and Plans Unit of [illegible], Requirements Division, [illegible].

2. It is understood the new Division will handle only Guided Missiles, will be headed by a General Officer as Division Chief, and will consist of approximately six officers. Brigadier General Gordon P. Saville is understood to be under consideration for the position of Division Chief.

J. H. Vogel
MAJOR [illegible]
[illegible]-20

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HEADQUARTERS ARMY AIR FORCES
WASHINGTON

16 August 1945

MEMORANDUM FOR CHIEF OF AIR STAFF:

SUBJECT: Countermeasures Against German V-2 Missiles.

1. It is understood that a considerable number of German V-2 missiles are being returned to the continental US and that a program for firing these missiles is being prepared. It is the opinion of this headquarters that full opportunity should be taken of this firing to test countermeasures against such missiles. Such countermeasures are deemed of first importance.

2. It is believed best results could be obtained by firing not less than four 90mm and/or 120mm antiaircraft batteries at these missiles. It might also be possible to fire one or more prototypes of antiaircraft armament which are now developed. It appears that the AAC of Great Britain, with limited means, was able to assemble a radar that satisfactorily tracked these missiles. It is also understood that the British had modified an American M9 computer to generate firing data against these missiles. These modifications, however, involved greatly extending the range used in the computer and this resulted in a poor scale factor.

3. In view of the above, it is believed practicable in a reasonable time to construct four or five radars and four or five computers suitable for firing existing antiaircraft guns at these missiles. Such radars and computers would also be very useful in the development of the guided missile program.

4. It is recommended that a project be set up on the highest priority for the construction of the necessary radars and computers to carry out the above program and that the firing of the majority of these missiles be deferred until this equipment is constructed.

/s HOYT. S VANDENBURG
Lt Gen, USA
AC/AS-3

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ARMY SERVICE FORCES
ORDNANCE DEPARTMENT
FRANKFORD ARSENAL
PHILADELPHIA 37, PENNSYLVANIA

IN REPLY
REFER TO

SPOBA

20 August 1945
471.6/1810(s)

SUBJECT: Guided Missile

TO: Chief of Ordnance, ASF
Washington 25, D. C.

Attention: SPOTU (Lt Col J G Bain)

1. Reference is made to RAD Order #4325, and to the recent trip to California by RCA personnel and representatives of this office on the same project. For your information, a copy of the trip report dated 11 August is inclosed herewith.

2. As outlined in the report two radically different proposals for the required vehicle have been obtained. An airplane type supersonic missile was suggested by the Douglas Aircraft Company, as illustrated in the report. Fortunately, a great deal of the fundamental work on this missile is being done for the Air Corps in the development of their MX-656 aircraft. RCA intend to include this type missile, essentially as sketched in the report, as the vehicle for their proposed seacoast system. They will make the necessary arrangements with the Douglas for the required work. It is therefore requested that your office obtain the necessary clearance from the Air Corps for Douglas to disclose detailed information on the MX-656 to Mr. Vance of the RCA Laboratories.

3. To permit Douglas to work most efficiently on this Guided Missile project, as well as NIKE, they should become familiar with other current projects in this field. Accordingly, it is reqested that your office invite and clear the following personnel to visit the ORDCIT projects at the California Institute of Technology:

Messrs F. R. Collbohm, E P Wheaton, E F Burton, H Luskin, S Kleinhaus
Drs Klemperer and Clauser.

4. During the visit to Cal Tech, the RCA representative explained his tentative views on the system under consideration and the requirements of the vehicle in question. Dr. Milliken and his associates expressed considerable interest in the device and proposed a missile quite unlike the one proposed by Douglas. The projectile suggested is an adaptation of an apparently successful German design by Oswatitch. A sketch and discussion of this missile is included in the inclosed report.

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SPOEA
Subj: Guided Missile

20 August 45

5. Because of the great amount of speculation that exists at this time concerning ram jet motors it appears advisable to analyze the complete system with both of these widely different proposals. Such a duplication was, of course, not contemplated by RCA when their proposal was made, and is outside the scope of the present contract. Because of this and the fact that Dr. Milliken expressed a wish to avoid the complication of an additional contract, it is recommended that this work be accomplished by the Ordnance Department as a part of the current ORDCIT contract. It is understood from Dr. Milliken that this contract is broad enough to cover this type of work and that its execution would in no way affect current projects at CIT.

6. The time schedule for the information which can be obtained on both of the missiles discussed above is such as to prohibit RCA from submitting their report in accordance with the existing schedule. Since the final data on both vehicles required for the report will not be available until the end of November, it will be impossible for RCA to make an oral report on their findings until 1 January 1946. It is requested that this change in delivery be approved by your office.

7. For the reasons advanced in the above paragraphs and the attached report, it is requested that the communications and requests contained in paragraph 2, 3, 5, and 6 above be effected by your office.

FOR THE COMMANDING OFFICER:

/s/ Louis Rossetto

LOUIS ROSSETTO
Lt Col, Ord Dept
Assistant

1 Incl
Report

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SAVE

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON
25

BUY UNITED STATES WAR BONDS AND STAMPS

IN REPLY REFER TO:
(AFDLA-2G)

SUBJECT: Countermeasures Against Guided Missiles

[redacted]
By Authority of
The Commanding General
Army Air Forces
28 Aug. '45 L.B.
Date Initials

TO: Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: TSEX

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1. It has become increasingly apparent that the future defense of the United States must include adequate measures for dealing with surprise saturation raids by guided missiles of the V-2 or similar type. At present, no effective countermeasure against such weapons exists. Probably the most nearly effective countermeasure was evolved by the British, who had worked out radar methods of tracking and were preparing to fire antiaircraft guns at V-2's at the time that the launching sites were captured and firings against Britian ceased. A completed summary report on British activities in this regard was forwarded to your Command on 8 August 1945.

2. There is existing at Air Technical Service Command a project on countermeasures against guided missiles, bearing 2C priority, and for which the basic guidance is that expressed in the letter from this office to the Commanding General, Materiel Command, dated 5 June 1943. This is interpreted as directing the development of countermeasures concurrently with the development of any Allied or enemy guided missiles.

3. It is directed that the Air Technical Service Command initiate, in accordance with the coordination policy specified in the succeeding paragraphs, and under the existing project for countermeasures against guided missiles, development of specific countermeasures against missiles of the V-2 type. This development should encompass three phases:

a. Development of new guided missiles, or other means, together with necessary auxiliary equipment and including guided missiles air defense control centers and systems, specifically intended to counter missiles approaching at extremely high speeds, from extremely high or low altitudes, and in large numbers. Military Characteristics to provide more specific guidance to this development will be prepared and forwarded in the near future.

b. Adaptation, modification and improvement of existing Air Force equipment, weapons, and techniques, including radar warning, and modification of Air Force gun laying equipment.

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SUBJECT: Countermeasures Against Guided Missiles.

c. Referral to Army Service Forces of such projects as Army Air Forces research indicates is desirable.

4. It is expected that a comprehensive study of this problem considering all aspects of active and passive air defense will indicate certain desirable modifications or developments of Army Service Forces equipment normally part of an air defense system. It is desired that it be clearly understood that this directive does not authorize the development in the Air Technical Service Command of antiaircraft guns or any other devices normally the province of the Army Service Forces; that modification or development of such devices as your study indicates is warranted is to be conducted by the service having the basic technical ability in research; and that all guided missiles development is to be in strict accordance with the directive of the Deputy Chief of Staff, subject "Guided Missiles", dated 2 October 1944, a copy of which has been forwarded.

5. The initiation of this development is considered to be of great importance in establishing the position of the Army Air Forces in the future air defense of the United States.

By Command of General ARNOLD:

Alden R. Crawford

ALDEN R. CRAWFORD
Brigadier General, U.S.A.
Chief, Materiel Division
Office, Asst Chief of Air Staff
Materiel and Services

1 Incl
Cpy Ltr, 5 Jun 43.
(Retained by TSTEV)
fca

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Division of Army Responsibility on Guided Missiles Research and Development.

AC/AS-3, Office of Guided Missiles [illegible]

AC/AS-4, Production Division AFDRD-22/1a Col [illegible]/2100

1. In confirmation of the conversation of 21 August 1945 between Dr. von Karman, Colonel [illegible], Lt Colonel [illegible], Lt Colonel [illegible], Lt Colonel [illegible], and Dr. Vincent [illegible], there is attached a copy of the 2 October 1944 Memorandum from the Deputy Chief of Staff, subject "Guided Missiles".

2. The Army Air Forces has interpreted paragraph 2 of the 2 October Memorandum as assigning development to the Army Air Forces of all air launched guided missiles, and of all ground launched guided missiles either capable of horizontal flight or which depend more on aerodynamic sustenance and propulsion for desired range results than on momentum.

3. The Army Service Forces, however, in their "Nike" surface-to-air project are developing a missile capable of a direction deviation acceleration of 5 g. Such a missile can not only be controlled to correct for errors in aiming, but can actually out-maneuver a bomber target -- in short, it acts as an interceptor aircraft. The Army Service Forces are also attempting to approximately double the range of their "Corporal" project rocket missiles by the addition of wings. Trials with the wings have all resulted in flight failures. Further work on airframes for this project has now been assigned to Douglas Aircraft Company.

4. The Army Air Forces has interpreted paragraph 3 of the 2 October Memorandum as a directive to assign actual development action to the service having the basic technical ability in regard to warheads, non-integral launching devices, ground components of control systems supplementary to the primary control link, etc. Action has been taken accordingly in assigning the Army Service Forces the development of warhead and non-integral launching equipment components for Army Air Force missiles.

5. The Army Service Forces, however, have followed the policy of a completely integral development by the developing agency. Although the Army Air Forces is the technical service having the basic technical ability in research for aerodynamics and for the mechanical stabilization and direction control of airplanes, the Army Service Forces have not come to the Army Air Forces for assistance. In both the Army Service Forces "Nike" and "Corporal" projects, the prime contractors plan direct subcontracts with the Douglas Aircraft Company for vehicles.

6. This office is now considering a request to the New Developments Division, WDGS, to revise the 2 October 1944 Memorandum in such a manner that guided missiles development basically concerned with aerodynamics will remain in the hands of the Army Air Forces.

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Division of Army Responsibility on Guided Missiles Research and Development

AUG 27 1945

AC/AS-3, Office of Guided Missiles

AFDAS-20/1A Col Stone/bjs/2100

AC/AS-4, Production Division

1. A number of suggestions have been made for changes to paragraph 2 of the 2 October Memorandum, several of which were discussed in the 24 August meeting. None of these suggestions are considered entirely adequate, and a satisfactory change is still lacking.

2. The following paragraph has been recommended as a revision to paragraph 3 of the 2 October 1944 Memorandum:

" The developing service will call upon any service having a basic technical ability for assistance in the development of guided missiles components. The developing service is charged with the responsibility of determining the extent of such assistance necessary to most efficiently promote the overall missile development project. "

3. In connection with the study planned by the Scientific Advisory Group on Military Characteristics for the long term AAF Guided Missiles program, it is requested that the comments of the Scientific Advisory Group be secured on the following:

a. A rewording of the division of guided missiles responsibility between the Army Service Forces and the Army Air Forces.

b. A recommendation on the manner in which component development for a missile should be integrated or assigned to various Army development services.

1 Incl:
Cy Memo, 2 Oct 44.

ALDEN R. CRAWFORD
Brigadier General, U.S.A.
Chief, Production Division
Office, Asst Chief of Air Staff -4.

[redacted]

Defense Systems and Countermeasures G.M. Br., AC/AS-4 28 1/2

W-5-08

HEADQUARTERS ARMY AIR FORCES
WASHINGTON

Rolly R

29 August 1945

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MEMORANDUM FOR ASSISTANT CHIEF OF AIR STAFF-3

SUBJECT: DIARY OF SPECIAL ASST FOR ANTIAIRCRAFT

1. AAF POLICY FOR POST WAR AIR DEFENSE.

Coordination of the various Assistant Chiefs of Air Staff was secured on a draft of a letter to be sent to the Hq. Army Air Forces and to the Commanding General's of numbered Air Forces and higher air force commands dealing with the AAF policy for post war air defense.

In brief, this letter points out that air defense will be of major importance to the post war period. To attain efficiency, economy of force and unity of command, it is the policy of this headquarters to secure at the proper time integration of the AAA into the AAF. The organization of integrated air defense is tentatively planned to include air defense commands which will have complete responsibility in the co-ordinated air defense in the area assigned, with an air defense command in each air force having an air defense mission or a mission of training air defense units. Such commands will have a composite staff including flying officers, AA and Signal officers. Flying officers, qualified AA officers and Signal officers will be eligible to command such commands and sub-divisions thereof providing that a flying officer is in direct control of the flying of assigned aircraft or the issuance of flying operations orders. When a non-flying officer is assigned as an air defense commander a flying officer will be assigned as a deputy commander and vice versa. In future operations when AGF units are deployed in contact with enemy troops, it is recommended that an air defense command under the supreme air commander of the theater should be established for the protection of the communication zone with a brigade or group of AA from the air defense command to be attached to each Tactical Air Command. A separate air defense command will be assigned to tactical air forces when required. AA units will be assigned to AGF organizations on a scale to be determined for each operation for the defense of field forces and their mobile installations in the forward areas.

It is contemplated that AA officers will be assured by law of advancement to general officer grades in approximately the same ratio to their total number as applies to flying officers. Initially, it is planned to provide a special staff officer for AA and a small staff as adviser to commanders of higher AAF Hqs. AA officers will have an equal opportunity with air force officers for assignment to appropriate staff sections of all higher echelons of the AAF. An AA Training Command is planned as part of the Air Force Training Command and an AA School is con-

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templated for the technical training of officers and enlisted specialists peculiar to AA. AA units will be trained in manning air-to-ground guided missiles as well as AA guided missiles. The development, procurement, storage and issue of armament or materiel will be the same for AA units as for other units of the Air Forces. (Col Sharpe - 74095).

7

H R Oldfield
H. R. OLDFIELD
Major General, U. S. Army
Special Asst for Antiaircraft

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C-2(419)

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Inclosure #2

Extract from President's Message
taken from the Congressional Record-House
Dated Thursday, September 6, 1945

* * * * * * * * * * * * * * *

12. RESEARCH

Progress in scientific research and development is an indispensable condition to the future welfare and security of the Nation. The events of the past few years are both proof and prophecy of what science can do.

Science in this war has worked through thousands of men and women who have labored selflessly and, for the most part, anonymously in the laboratories, pilot plants, and proving grounds of the Nation.

Through them, science, always pushing forward the frontiers of knowledge, forged the new weapons that shortened the war.

Progress in science cannot depend alone upon brilliant inspiration or sudden flights of genius. We have recently had a dramatic demonstration of this truth. In peace and in war, progress comes slowly in small new bits, from the unremitting day-by-day labors of thousands of men and women.

No nation can maintain a position of leadership in the world of today unless it develops to the full its scientific and technological resources. No government adequately meets its responsibilities unless it generously and intelligently supports and encourages the work of science in university, industry, and in its own laboratories.

During the war we have learned much about the methods of organizing science, and about the ways of encouraging and supporting its activities.

The development of atomic energy is a clear-cut indication of what can be accomplished by our universities, industry, and Government working together. Vast scientific fields remain to be conquered in the same way.

In order to derive the full profit in the future from what we have learned, I urge upon the Congress the early adoption of legislation for the establishment of a single Federal research agency which would discharge the following functions:

1. Promote and support fundamental research and development projects in all matters pertaining to the defense and security of the Nation.

2. Promote and support research in the basic sciences and in the social sciences.

3. Promote and support research in medicine, public health, and allied fields.

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4. Provide financial assistance in the form of scholarships and grants for young men and women of proved scientific ability.

5. Coordinate and control diverse scientific activities now conducted by the several departments and agencies of the Federal Government.

6. Make fully, freely, and publicly available to commerce, industry, agriculture, and academic institutions, the fruits of research financed by Federal funds.

Scientific knowledge and scientific research are a complex and interrelated structure. Technological advances in one field may have great significance for another apparently unrelated. Accordingly, I urge upon the Congress the desirability of centralizing these functions in a single agency.

Although science can be coordinated and encouraged, it cannot be dictated to or regimented. Science cannot progress unless founded on the free intelligence of the scientist. I stress the fact that the Federal research agency here proposed should in no way impair that freedom.

Even if the Congress promptly adopts the legislation I have recommended, some months must elapse before the newly established agency could commence its operations. To fill what I hope will be only a temporary gap, I have asked the Office of Scientific Research and Development and the Research Board for National Security to continue their work.

Our economic and industrial strength, the physical well-being of our people, the achievement of full employment and full production, the future of our security, and the preservation of our principles will be determined by the extent to which we give full and sincere support to the works of science.

It is with these works that we can build the highroads to the future.

* * * * * * * * * * * * *

HARRY S. TRUMAN.
THE WHITE HOUSE, September 6, 1945.

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[illegible]
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By Authority of
The Commanding General
Army Air Forces

9-6-45	GRW
Date	Initials

MEMORANDUM FOR COLONEL MAC GUBBIN

SUBJECT: The Role of Guided Missiles in the Future

6 SEP 1945

1. The Army Air Forces has long been aware of the potentialities of new and unconventional types of weapons, roughly grouped together under the term "Guided Missiles". The idea of a pilotless aircraft has long been the dream of pilots who have experienced the hazards of flying. The idea of a bomb which could be controlled during flight has long appealed to the bombardier who has become weary of applying "body English" to erratic bombs.

2. The AAF was the only agency of the allied powers to use Guided Missiles operationally in World War II. Radio controlled conventional type bombs were employed, as well as remotely controlled bombers equipped as robot missiles and glider bombs controlled by television and radio. The experience gained from the operational use of these weapons has given us a basis on which to plan for new types of Guided Missiles which are expected to play such a vital part in any wars of the future.

3. AAF research on Guided Missiles in the post-war may be broken down into the following categories:

(a) Ground to Ground Missiles.
(b) Ground to Air Missiles.
(c) Air to Air Missiles.
(d) Air to Ground Missiles.

Missiles in the above categories may be again subdivided into those with supersonic velocities and those with subsonic velocities. Missiles with supersonic velocities will employ some form of jet propulsion such as rockets, turbojet or ram jet engines, or will utilize some form of atomic power. Ranges up to 6000 miles are visualized for such weapons. Subsonic Guided Missiles will include radio controlled standard bombs, glider bombs incorporating various types of target seekers, and pilotless aircraft powered by rockets, internal combustion engines, or jet engines.

4. Another important field of research which must be fully exploited is the problem of effective countermeasures against enemy Guided Missiles. This will involve extensive research on search and jamming equipment, as well as the design of Guided Missiles specifically for the destruction of enemy Guided Missiles.

5. It is reasonable to assume that in the event of another war, the nation which gets there "firstest with the mostest" Guided Missiles will prevail. The next war should be of fairly short duration. It is entirely conceivable that even a relatively small nation with a stock of good Guided Missiles at its command could defeat a first class power. In order for the United States

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to maintain its present position as the number one nation, it will be necessary for the Congress to provide liberal funds for the subsidization of research in Guided Missiles by military establishments and civilian and educational institutions. The fact that we now possess the Atomic bomb should not allow us to sit back and rest on our laurels. Other nations may reasonably expected to have Atomic bombs within the next two years. Finally, the appearance of the Atomic bomb does not remove the requirement for Guided Missiles. On the contrary, Guided Missiles may be considered as the medium for carrying Atomic destruction to our enemies.

GEORGE R. WEINBRENNER
Lt. Colonel, Air Corps

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Procurement Division (TSBPR3H1)

Hq., Air Technical Service Command, Wright Field, Dayton, Ohio

COMMANDING GENERAL
ARMY AIR FORCES
WASHINGTON, D. C.

SEP 6 1945

ATTENTION: AC/AS, M&S
(Major Vogel)

Wash.spec.mail pouch

R. H. CARNEY
Capt. [illegible]
[illegible]

AC 12461

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TSBPR3H1-9-5 . . . . . RE TEL [illegible] 56821, DATED 29 AUGUST 1945, AND AIR TECHNICAL SERVICE COMMAND LETTER TSE[illegible]-2[illegible]/[illegible] G/[illegible], DATED 31 AUGUST 1945: 1. FOLLOWING AMENDED INFORMATION IS SUBMITTED SUPPLEMENTING PART C OF REFERENCE LETTER REGARDING PRODUCTION FACILITIES FOR GUIDED MISSILES.

a. VB-1: FACILITY IS UNION SWITCH AND SIGNAL COMPANY, SWISSVALE, PENNSYLVANIA. PRODUCTION BEGAN ON THIS ARTICLE IN MAY 1944, FOUR HUNDRED (400) PEOPLE EMPLOYED IN FABRICATION OF CONTROLLABLE BOMB TAIL ASSEMBLY. TOTAL OF TEN THOUSAND SIX HUNDRED (10,600) VB-1'S COMPLETED AT COST OF $[illegible],287,000.00. APPROXIMATELY 65,000 SQUARE FEET FLOOR SPACE WAS DEVOTED TO THIS WORK AND 25 MANHOURS WERE REQUIRED TO PRODUCE ONE VB-1.

(1) AN ADDITIONAL QUANTITY OF THREE THOUSAND (3000) VB-1'S WERE PLACED ON CONTRACT AT AN ESTIMATED COST OF $1,221,000.00. PRODUCTION BEGAN IN MAY 1945 AND ON 14 AUGUST 1945 AFTER ONE THOUSAND (1000) OF THIS QUANTITY HAS BEEN COMPLETED THE REMAINING TWO THOUSAND (2000) WERE TERMINATED. ACTUAL COSTS FOR THE ONE THOUSAND (1000) ARTICLES PRODUCED WILL NOT BE AVAILABLE UNTIL THE TERMINATION SETTLEMENT HAS BEEN MADE.

416 - Guided Missiles

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TSBPR3H1-3-5 (Continued)

b. VB-3: FACILITY IS UNION SWITCH AND SIGNAL COMPANY, SWISSVALE, PENNSYLVANIA. PRODUCTION BEGAN ON THIS ARTICLE IN JULY 1945, ONE HUNDRED SIXTY (160) PEOPLE EMPLOYED IN FABRICATION OF CONTROLLABLE BOMB TAIL ASSEMBLY. PROCUREMENT INITIALLY PLACED FOR TWENTY-THREE THOUSAND (23,000) VB-3 AND ON 18 AUGUST 1945, TWENTY THOUSAND (20,000) WERE TERMINATED. THE REMAINING THREE THOUSAND (3000) ARE DUE TO BE COMPLETED BY FEBRUARY 1946. ESTIMATED COST FOR THE TWENTY-THREE THOUSAND (23,000) WAS $16,200,000.00 PLUS $15,000.00 FOR FACILITIES. ACTUAL COST OF THREE THOUSAND (3000) TO BE PRODUCED WILL NOT BE AVAILABLE UNTIL TERMINATION SETTLEMENT MADE. APPROXIMATELY THIRTY THOUSAND (30,000) SQUARE FEET OF FLOOR SPACE WAS DEVOTED TO THIS PRODUCTION AND FIFTY-ONE (51) MANHOURS WERE REQUIRED TO PRODUCE ONE VB-3.

c. VB-6: FACILITY IS REMINGTON-RAND, INC., BRIDGEPORT, CONNECTICUT. PRODUCTION ON THIS ARTICLE BEGAN IN MAY 1945, TWO HUNDRED FIFTY (250) PEOPLE EMPLOYED IN FABRICATION CONTROLLABLE BOMB NOSE AND TAIL ASSEMBLY. ONE THOUSAND (1000) VB-6'S WERE PRODUCED AT A COST OF $4,200,000.00 INCLUDING $10,000.00 FOR FACILITIES. APPROXIMATELY SEVENTY THOUSAND FIVE HUNDRED FORTY-FIVE (70,545) SQUARE FEET OF FLOOR SPACE WERE DEVOTED TO THIS PRODUCTION AND ONE HUNDRED FIFTY (150) MANHOURS WERE REQUIRED TO PRODUCE ONE VB-6.

d. GB-1: FACILITY IS AERONCA AIRCRAFT CORPORATION, MIDDLETOWN, OHIO. PRODUCTION BEGAN ON THIS ARTICLE IN DECEMBER 1942. ABOUT SEVENTY-FIVE (75) PEOPLE WERE EMPLOYED IN THE FABRICATION OF GB-1 AIRFRAMES AND INSTALLATION OF CONTROL EQUIPMENT. ABOUT FOUR THOUSAND (4000) GB-1'S WERE PRODUCED AT A COST OF $5,200,000.00. APPROXIMATELY FIVE THOUSAND (5000) SQUARE FEET OF FLOOR SPACE WAS DEVOTED TO THIS WORK AND ONE HUNDRED (100) MANHOURS WERE REQUIRED TO PRODUCE ONE GB-1.

e. GB-4: FACILITY IS THE KLASSEN COMPANY, LOS ANGELES, CALIFORNIA. PRODUCTION BEGAN ON THE GB-4 IN JUNE 1944. ABOUT ONE HUNDRED NINETY-ONE (191) PEOPLE WERE EMPLOYED IN THE FABRICATION OF GB-4 AIRFRAMES AND THE INSTALLATION OF CONTROL

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TSBPR3H1-9-5 (Continued)

EQUIPMENT. THE PROCUREMENT OF TWO THOUSAND (2000) UNITS WAS PLACED INITIALLY FOR $1,654,720.00. EIGHT HUNDRED (800) OF THIS QUANTITY WERE TERMINATED IN OCTOBER 1944 AND THE TWELVE HUNDRED (1200) REMAINING WHICH WERE COMPLETED COST APPROXIMATELY $1,140,000.00. ABOUT 52,000 SQUARE FEET OF FLOOR SPACE WAS DEVOTED TO THIS WORK AND TWO HUNDRED TEN (210) MANHOURS WERE REQUIRED TO PRODUCE ONE GB-4.

f. <u>GB-8:</u> FACILITY IS AERONCA AIRCRAFT CORPORATION, MIDDLETOWN, OHIO. PRODUCTION BEGAN ON THE GB-8 IN APRIL 1944. SIX HUNDRED (600) PEOPLE WERE EMPLOYED IN FABRICATION OF GB-8 AIRFRAMES AND INSTALLATION OF CONTROL EQUIPMENT. INITIALLY TWO THOUSAND (2000) WERE PLACED ON CONTRACT AT A COST OF $622,891.00. IN OCTOBER 1944, ONE THOUSAND (1000) OF THIS QUANTITY WERE TERMINATED. THE ONE THOUSAND (1000) THAT WERE PRODUCED COST $393,650.00. ABOUT ONE HUNDRED AND SIXTY THOUSAND (160,000) SQUARE FEET OF FLOOR SPACE WAS DEVOTED TO THIS PROJECT AND NINETY-FIVE (95) MANHOURS WERE REQUIRED TO PRODUCE ONE GB-8.

g. <u>JB-2:</u> FACILITY IS REPUBLIC AVIATION CORPORATION, FARMINGDALE, LONG ISLAND, NEW YORK WITH WILLYS-OVERLAND MOTORS, INC., TOLEDO, OHIO AS MAJOR SUBCONTRACTOR. PRODUCTION BEGAN ON THIS ARTICLE IN SEPTEMBER 1944, APPROXIMATELY TWELVE HUNDRED (1200) PEOPLE WERE EMPLOYED IN FABRICATION OF JB-2 AIRFRAMES AND INSTALLATION OF CONTROL EQUIPMENT. A TOTAL OF TWO THOUSAND FIFTY (2050) JB-2'S WERE PROCURED INITIALLY AT AN ESTIMATED COST OF $4,464,450. ON 14 AUGUST 1945 THE QUANTITY WAS REDUCED TO ONE THOUSAND FOUR HUNDRED FIFTY TWO (1452) BY TERMINATION AND ON 4 SEPTEMBER 1945 WAS FURTHER REDUCED TO ONE THOUSAND THREE HUNDRED SEVENTY-FIVE (1375) TO BE PRODUCED. THE ONE THOUSAND THREE HUNDRED SEVENTY-FIVE (1375) JB-2'S HAVE BEEN COMPLETED AT AN ESTIMATED TOTAL COST OF $5,575,000.00. APPROXIMATELY FORTY THOUSAND (40,000) SQUARE FEET OF FLOOR SPACE WAS DEVOTED TO THIS WORK AND ABOUT FIVE HUNDRED (500) MANHOURS WERE REQUIRED TO PRODUCE ONE JB-2.

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TTBPh3H1-9-5 (Continued)

(1) WILLYS-OVERLAND MOTORS, INC., TOLEDO, OHIO WAS ALSO GRANTED A CONTRACT IN APRIL 1945 FOR FIVE THOUSAND (5000) JB-2'S, AT AN ESTIMATED COST OF $26,950,000.00. ON 14 AUGUST 1945 PRIOR TO THE PRODUCTION OF ANY JB-2'S UNDER THIS CONTRACT, THE PROCUREMENT WAS TERMINATED. ACTUAL COSTS OF ANY WORK DONE UNDER THE SUPPLY CONTRACT FOR FIVE THOUSAND (5000) JB-2'S WILL NOT BE AVAILABLE UNTIL THE TERMINATION SETTLEMENT HAS BEEN MADE. A FACILITIES CONTRACT FOR $237,318.40 WAS ALSO GRANTED THIS CONTRACTOR FOR PLANT REARRANGEMENT. AS OF 31 JULY 1945, $10[illegible],243.77 WAS OBLIGATED UNDER THIS FACILITIES CONTRACT IN PREPARATION FOR PRODUCTION OF JB-2'S.

2. THE FOLLOWING IS A RESUME OF THE MAJOR GOVERNMENT FURNISHED EQUIPMENT PRODUCERS FOR GUIDED MISSILES MENTIONED ABOVE:

a. JB-2 LAUNCHING CARTS:

(1) PRODUCED BY NORTHROP AIRCRAFT COMPANY, HAWTHORNE, CALIFORNIA (1000 UNITS) AND GENERAL TIRE AND RUBBER COMPANY, AKRON, OHIO (100 UNITS).

(2) NORTHROP UTILIZED FIFTEEN THOUSAND (15,000) SQUARE FEET OF SPACE WHILE ITS SUBCONTRACTORS UTILIZED THIRTY THOUSAND (30,000) SQUARE FEET IN CONSTRUCTION OF THE CART. IN SO DOING NORTHROP HAD A MAXIMUM OF THIRTY-FIVE (35) PEOPLE AND THE SUBCONTRACTORS SEVENTY-FIVE (75). THESE COMBINED TO WORK ONE HUNDRED FIFTY (150) MANHOURS PER UNIT.

(3) GENERAL TIRE AND RUBBER COMPANY UTILIZED ELEVEN THOUSAND SQUARE FEET WITH A MAXIMUM OF TWENTY-FIVE (25) EMPLOYEES DEVOTING A TOTAL OF SIXTY (60) TO SEVENTY (70) WORK HOURS PER UNIT TO THE CARTS.

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TSBPR3H1-9-5 (Continued)

(4) FOR THE TOTAL OF ELEVEN HUNDRED (1100) CARTS THE COST WAS $725,000.00 WITH EACH NORTHROP CART COSTING THE GOVERNMENT $575.00 PLUS MODIFICATION COSTS AND EACH GENERAL TIRE AND RUBBER COMPANY CART COSTING $671.00.

b. JB-2 ENGINES:

(1) PRODUCED BY FORD MOTOR COMPANY, DETROIT, MICHIGAN WITH A MAXIMUM OF TWO HUNDRED FORTY-FIVE (245) PEOPLE AVERAGING 154.5 MANHOURS PER UNIT AND WERE PRODUCED IN AN AREA OF EIGHTY-SEVEN THOUSAND (87,000) SQUARE FEET. INITIALLY TWO THOUSAND FIFTY (2050) ENGINES WERE PROCURED. THERE WERE FIFTEEN HUNDRED (1500) ENGINES ACTUALLY BUILT AT A TOTAL COST OF $6,000,000.00. TERMINATION OF THE UNPRODUCED BALANCE OF FIVE HUNDRED FIFTY (550) WAS MADE ON 14 AUGUST 1945.

(2) FIVE THOUSAND (5000) ADDITIONAL ENGINES WERE PROCURED, FOURTEEN HUNDRED (1400) FROM FORD AND THIRTY-SIX HUNDRED (3600) FROM CONTINENTAL AVIATION AND ENGINEERING CORPORATION, DETROIT, MICHIGAN. THESE PROCUREMENTS WERE TERMINATED 14 AUGUST 1945 PRIOR TO PRODUCTION OF ANY ENGINES AND ACTUAL COSTS WILL NOT BE AVAILABLE UNTIL TERMINATION SETTLEMENT HAS BEEN MADE.

c. JB-2 CONTROLS: PRODUCED BY JACK AND HEINTZ, CLEVELAND, OHIO FOR USE ON THE JB-2 JET BOMB UTILIZING A MAXIMUM OF SIX HUNDRED (600) PEOPLE FOR AN AVERAGE OF THREE HUNDRED NINETY-TWO (392) MANHOURS PER UNIT. THESE WERE PRODUCED IN AN AREA OF SIXTY-TWO THOUSAND (62,000) SQUARE FEET WITH AN APPROXIMATE UNIT COST OF $2,000.00 OR A TOTAL COST OF ~~$450,000.00~~ $4,500,000.00 ON THE FIRST CONTRACT OF TWO THOUSAND TWO HUNDRED AND FIFTY (2250) UNITS. A SECOND CONTRACT FOR FIFTY-FIVE HUNDRED (5500) CONTROLS WAS

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TERMINATED 14 AUGUST 1945 WITH NO PRODUCTION AND COSTS WILL NOT BE AVAILABLE UNTIL COMPLETION OF THE TERMINATION SETTLEMENT.

d. AN/APW-1 RADIO: PRODUCED BY AIRCRAFT RADIO CORPORATION, BOONTON, NEW JERSEY FOR USE ON JB-2 JET BOMB UTILIZING A MAXIMUM OF ONE HUNDRED SEVENTY-FIVE (175) EMPLOYEES FOR 31-1/2 MANHOURS PER UNIT. THESE WERE PRODUCED IN AN ESTIMATED FLOOR SPACE OF TWENTY THOUSAND (20,000) SQUARE FEET WITH AN AVERAGE UNIT COST OF APPROXIMATELY $850.00 OR A TOTAL OF $1,776,116.60 FOR TWO THOUSAND (2000) UNITS. ONLY ONE THOUSAND THREE HUNDRED FIFTY (1350) HAVE ACTUALLY BEEN PRODUCED AT WHICH POINT PRODUCTION WAS SUSPENDED. PENDING TERMINATION SETTLEMENT AN ACTUAL COST FIGURE IS UNAVAILABLE.

e. HAMMOND CONTROLS USED ON GB-1, GB-4, AND GB-8: PRODUCED BY HAMMOND INSTRUMENT COMPANY, CHICAGO, ILLINOIS. THE FOLLOWING ARE PRODUCTION ESTIMATES:

(1) CONTROLS FOR GB-1 EMPLOYED NINETY (90) PEOPLE AT TWENTY-SIX (26) MANHOURS PER UNIT. NINE THOUSAND (9000) SQUARE FEET OF FLOOR SPACE WERE UTILIZED WITH COSTS AS FOLLOWS: $174.50 PER UNIT, TOTAL COST FOR FOUR THOUSAND (4000) UNITS PRODUCED - $698,000.00.

(2) CONTROLS FOR GB-4 EMPLOYED FORTY-FIVE (45) PEOPLE AT SIXTY (60) MANHOURS PER UNIT. THREE THOUSAND (3000) SQUARE FEET OF FLOOR SPACE WERE UTILIZED WITH COSTS AS FOLLOWS: $380.00 PER UNIT, TOTAL COST FOR TWELVE HUNDRED (1200) UNITS PRODUCED - $4[illegible]6,000.00.

(3) CONTROLS FOR GB-8 EMPLOYED SEVENTY-FIVE (75) PEOPLE AT SIXTY-FIVE (65) MANHOURS PER UNIT. FIVE THOUSAND (5000) SQUARE FEET OF FLOOR SPACE WERE UTILIZED WITH COSTS AS FOLLOWS: $392.00 PER UNIT; TOTAL COST FOR TWO THOUSAND (2000) UNITS PRODUCED - $784,000.00.

f. ABUSIVE PROJECT:

(1) THE AN/AXR-1 TELEVISION TRANSMITTER WAS PRODUCED FOR $4,318.00

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BPR3Y 9-5 (Continued)

PER UNIT AND THE ATK TELEVISION RECEIVER WAS PRODUCED FOR $3,509.00. SINCE THESE WERE PRODUCED BY RCA AND FARNSWORTH FOR THE NAVY AND GIVEN BY THE NAVY TO THE ARMY, FURTHER PRODUCTION DATA IS UNAVAILABLE.

(2) ARMING MOTORS WERE PRODUCED BY WHITE-RODGERS ELECTRIC COMPANY, ST. LOUIS, MISSOURI FOR [illegible] ON ABUSIVE PROJECT UTILIZED A MAXIMUM OF ONE HUNDRED FIVE (105) EMPLOYEES IN AN AREA OF TWELVE THOUSAND (12,000) SQUARE FEET. THE UNIT COST WAS $4.50. THUS THE APPROXIMATE CONTRACT COST FOR NINE HUNDRED NINETY (990) UNITS WAS $4,450.00.

(3) WHITE-RODGERS ALSO PRODUCED TRIM BRAKE AND THROTTLE MOTORS UTILIZING THE SAME EMPLOYEES AND AREA. THE UNIT COST ON THESE ITEMS WAS $250.00. THUS THE APPROXIMATE CONTRACT COST FOR THE FIVE HUNDRED FIFTY (550) UNITS WAS $137,500.00.

(4) THE AN/ARN-1 RADIO RECEIVER PRODUCED BY WELLS-GARDNER COMPANY, CHICAGO, ILLINOIS FOR THE ABUSIVE PROGRAM UTILIZED A MAXIMUM OF EIGHTY-SIX (86) EMPLOYEES FOR SIXTY (60) HOURS PER UNIT IN AN AREA OF FOURTEEN THOUSAND (14,000) SQUARE FEET. THERE WERE A TOTAL OF FIVE HUNDRED FIFTY (550) UNITS PRODUCED AT A UNIT COST OF $1200.00 FOR A TOTAL COST OF $660,000.00.

(5) THE AN/ARW-18 RADIO TRANSMITTER PRODUCED BY WELLS-GARDNER COMPANY, CHICAGO, ILLINOIS FOR THE ABUSIVE PROJECT UTILIZED A MAXIMUM OF EIGHTY-FOUR (84) EMPLOYEES FOR SIXTY (60) MANHOURS PER UNIT IN AN AREA OF FOURTEEN THOUSAND (14,000) SQUARE FEET. THERE WERE A TOTAL OF ONE HUNDRED THIRTY (130) UNITS PRODUCED AT A UNIT COST

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OF $2,000.00 FOR A TOTAL COST OF $200,000.00.

(6) CLOCKS PRODUCED BY [illegible] ILLINOIS FOR THE [illegible] PROJECT UTILIZED [illegible] IN AN [illegible] (5000) [illegible]. THE UNIT COST WAS $97.25 OR A TOTAL OF [illegible] FOR A TOTAL OF FIVE HUNDRED (500) UNITS.

(7) [illegible] COMPANY, DAYTON, OHIO FOR THE [illegible] PROJECT UTILIZED [illegible] OF TWENTY (20) [illegible] OF ONE THOUSAND (1000) [illegible] FEET. [illegible] UNIT COST OF [illegible] FOR A TOTAL OF FIVE HUNDRED (500) UNITS.

CC:
[illegible]

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Defense Systems and Countermeasures
[illegible], AC/AS-4
57-1

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HEADQUARTERS ARMY AIR FORCES
AC/AS-4

Inter-Desk Memorandum

[illegible] RECORD AND [redacted]

DATE: [illegible] 1945

Lt Col [illegible]
Signal Corps
[illegible] Signal Laboratory

Telephone. [illegible] Signal Corps [illegible] AAF request is [illegible] complete [illegible], tracking, and [illegible] system. [illegible] of [illegible] very little [illegible] [illegible]

~~[illegible] networks, Fighter and Air Defense.~~

~~J.N.~~

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COPY [redacted] [Approx. 15 Sept. 1945]

AAF POLICY FOR THE DEVELOPMENT AND EMPLOYMENT OF GUIDED MISSILES

PROBLEM

1. To determine an AAF policy regarding research, development, and operational employment by the AAF of guided missiles.

FACTS BEARING ON THE PROBLEM

2. On [illegible] October 1944, the Deputy Chief of Staff, U.S. Army, issued a directive to the AGF, ASF and the AAF stating in substance that:

a. The AAF would be responsible for the development of:

(1) All guided or homing missiles launched or dropped from aircraft.

(2) All guided or homing missiles launched from the ground which depend for sustenance primarily on the lift of aerodynamic forces. (This has been popularly interpreted to mean the Air Forces has all guided missiles with wings.)

b. The ASF are responsible for the development of all guided or homing missiles launched from the ground which depend for sustenance primarily on the momentum of the missile. (This has been very liberally interpreted by Ordnance - there is a difference in interpretation regarding the terms "wing" and a "fin.")

b. The AGF would be responsible for the operational employment of guided missiles when:

(1) [illegible] to supplement artillery:

(2) Launched from surface [illegible] against ground targets.

c. The Commanding General, Army Air Forces and the Commanding General, Army Ground Forces would be responsible, as interested, for the operational employment of guided missiles when:

(1) Used to supplement tactical air bombardment:

(2) Used as anti-aircraft weapons.

4. Later a memorandum by General Hodes, Assistant Deputy Chief of Staff, on [illegible] June 1945 stated that:

a. The overall assignment of guided missiles would be withheld for the present time.

b. Each missile would be assigned to a command (AAF, AGF) only after the characteristics could be compared with the mission of that major command.

c. Those missiles previously assigned to the major commands will remain in those commands pending their overall assignment.

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5. The Army Air Forces under the directives is establishing research and development of all types of guided missiles of short, intermediate, long, and super-long range.

6. Present studies indicate that the most practical means of obtaining control and long or super-long range with guided missiles is through the use of wing type surfaces to give control and aerodynamic lift.

DISCUSSION

7. It is envisaged that with the passage of time there will be a gradual transition in the military field from piloted aircraft to pilotless aircraft or guided missiles and probably finally jet propelled pilotless aircraft with an atomic warhead. Since the AAF is the one command or department most conversant with research and development of conventional combat aircraft and the one which will logically follow through the piloted aircraft era into the age of pilotless aircraft it is believed that the AAF should be charged with the future development and operational employment of guided missiles.

CONCLUSION

8. In view of the fact that in the present development period any ground launched guided missile must have wings to permit accurate control and secure long ranges, it is believed that the present directives place no basic restriction on the AAF regarding the research and development of guided missiles.

RECOMMENDATION

9. It is recommended that the following policy be adopted as the AAF position on the research, development and employment of guided missiles:

a. The Army Air Forces will undertake research and development of all types of guided missiles regardless of range and base of launching.

b. The Army Air Forces will call upon any service or department having basic technical ability for assistance in the development of guided missiles components. The Army Air Forces developing agency will be charged with the responsibility of determining the extent of such assistance necessary to most efficiently promote the overall missile development project.

c. Concurrently with the development of such guided missiles the Army Air Forces will make plans and preparations for the operational employment of same.

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452.1 Guided Missiles (1/2 pp)

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AFDMA-2G/Gen Crawford/VAS/bja/2100
Written 11 September 1945

18 SEP 1945

Army Air Forces Long Term Guided Missiles Program.

Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attn: TSCEN

1. It is increasingly evident that the Army Air Forces should place high priority on the establishment of a carefully planned and implemented post-war research and development program on guided missiles and defense against guided missiles, with a view toward fully and energetically exploiting both this new field of weapons, and the necessary defenses against them.

2. The Army Air Forces guided missiles development program, up to the present time, can generally be considered as only an interim approach to the effective use of guided missiles in post-war.

3. The Army Air Forces overall development program has given top priority to developments to effect the successful conclusion of recent hostilities. This has resulted in the establishment of a wide of experience in ground guided missile development, but in a comparatively minor effort ~~af~~ on actual development programs for the missiles considered necessary for the post-war effort. General Arnold, in his Press Release of 17 August 1945 (inclosure 3), discussed the future of guided missiles in post-war. As yet, however, the Army Air Forces has no actual development program or any guided missiles with the characteristics discussed by General Arnols, and no comprehensive programs on the basic research and overall actions required to secure them before initiated.

4. It is evident that the progress of other guided missiles development agencies have advanced beyond the Army Air Forces longterm guided missiles program. The Army Ordnance have concentrated their work, planning and placing of contracts entirely on post-war guided missiles development. The Navy has a number of active programs on jet propelled missiles and radar seekers and extensive short and long term expedited programs on anti-aircraft guided missiles for the defense of their ships.

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15 Sept 1945

Subject: Army Air Forces Long Term Guided Missiles Program.

5. The Air Technical Service Command on 27 July 1944 was requested to establish Military Characteristics for a complete program of powered guided missiles. The Military Characteristics prepared by the Air Technical Service Command at that time or approved and returned on 21 September 1944, with a directive to proceed with the utmost urgency on the characteristics suggested. This directive also further instructions concerning necessary supplementary action to these Military Characteristics (Inclosure 2). It became evident, however, that these Military Characteristics did not constitute a complete long term program, and the Air Technical Service Command office forwarded proposed new Military Characteristics for consideration on 12 April 1945. Suggested revision to these characteristics were prepared in a meeting of 22 May 1945. The present status of these Military Characteristics is given in a directive to the Air Technical Service Command, subject "Goals for Long-Term Guided Missiles Program," (Inclosure 4).

6. Prompt and efficient Army Air Forces action is necessary in the establishment of an adequate long term guided missiles program--both in the interests of national defense and in the desire to maintain Army Air Forces supremacy in the aerial weapons field.

7. It is directed, therefore, that not later than 10 November 1945, a complete program be forwarded to this Headquarters of existing and contemplated action by the Air Technical Service Command on the long-term development and research program for guided missiles and defense against guided missiles. It is further directed that the report on the program included comments and recommendations on all the items included in Inclosure #1, subject "Important Considerations in Establishment of AAF Long-Term Guided Missiles Development Program".

By Command of General ARNOLD:

(Signed) E. M. POWERS

E. M. POWERS
Major General, U. S. A.
Assistant Chief of Air Staff-4

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SUPPLEMENT TO PROJECT B-7
POSTWAR RESEARCH AND DEVELOPMENT PROGRAM, FIVE YEAR PERIOD
25 JUNE 1945 ISSUE

The Research and Development projects and plans contained in the 25 June issue of Project B-7 Postwar Research and Development Program, Five-Year Period, were conceived and planned at the time Germany collapsed and our war effort against Japan was being increased. Also, a Research and Development Program for the F.Y. 1946 had been prepared as a continuation of the current war research with new projects initiated to cope with war requirements. Because of the shortage of research facilities and technicians caused by the higher priority all-out War Production Program, it was deemed impracticable to plan a total program in the required proportions to accomplish results now authorized by the latest established policy, i.e. President Truman's 8 August 1945 letter to the Secretary of War directs that the AAF immediately develop schedules for procurement after VJ-Day of aircraft and related items and a program of research and development that will be required to maintain this country's supremacy in military aviation.

The F.Y. 1946 Research and Development Program under date of 30 August 1945 was revised out of necessity, as a result of the occupation of the homelands of our enemies, learning of the magnitude of the research and development programs and elaborate facilities our enemies had in operation and under construction, technological facts obtained by means of inspection tours of the AAF Scientific Advisory Groups, such as the one headed by Dr. Von Karman, and the more liberal new policy.

The Project B-7 is also inadequate to accomplish the results called for by the changing methods of warfare and the governing policy quoted above, and is augmented by the following recommended expanded projects.

With reference to phasing of the yearly periods of the planned research and development programs, the revised F.Y. 1946 Program, released under date of 30 August 1945, has become the "First Year" of the Postwar Five-Year Research and Development Program, Project B-7. During the remaining four consecutive years it is planned to augment the Research and Development Program by placing greater effort on pilotless aircraft, aircraft power plants, electronic control devices, radio and radar projects, and all weather operation projects, all of which requires additional action if the superiority status of these essential items of equipment is to be attained. To execute such plans, additional personnel and funds in the amounts stated will be needed.

To produce the results that will give the AAF air supremacy, time, as well as personnel, facilities and adequate funds, are required. If the essential conditions required to accomplish the great task are not provided now, developments that could have been created during any period of time of restricted effort are lost. Excessive spending and production of unsuitable and out-dated equipment cannot give the necessary results. To be prepared for any future war operation with which our nation may be confronted and to prevent, insofar as possible, any of the other nations that may become our enemy from taking the lead in the development of weapons of war, personnel, facilities, and funds must be provided. It is very

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doubtful if the time required to make war preparations after the conflict has started will ever again be available, since the type of weapons to be employed can prevent effective preparations being made. If this nation is to maintain its independence among the other nations, we must be continuously prepared and with the most highly developed equipment for the AAF. This can only be accomplished by getting adequate funds appropriated each succeeding year and the cost to comply with the established policy will be only a small fractional part of the expense to the nation when preparing for war if a seemingly more conservative defense and war preparation plan is permitted to be established. The plans for these projects are as follows and cover the remaining four years of the Postwar Five-Year Period.

(A) PILOTLESS AIRCRAFT

During the recent war the Engineering Division has limited the expenditure of all effort (consistent with the existing airplane program) to the design and development of pilotless aircraft, for use as a means of destruction, to those devices that might possibly have been used in this conflict. Now that this war is over, the development program for pilotless aircraft has been revised to use a larger number of the research and development organizations on the development of pilotless aircraft of all types, both offensive and defensive. The revised program has been divided into seven main categories as follows:

1. Ground-to-Ground
2. Ground-to-Air
3. Air-to-Air
4. Air-to-Ground
5. Retrievable Aircraft
6. Research
7. Countermeasures

These seven types are further explained in the following paragraphs.

The development of ground to ground pilotless aircraft is contemplated in four stages. If additional requirements exist, then specific designs can be developed to meet these requirements; however, it is considered that the four development phases will be sufficient to gain engineering experience in this type of development.

a. The first ground to ground pilotless aircraft to be undertaken is anticipated to be a vehicle with a speed of from 1,000 to 1,500 mph and a range of 200 to 500 miles. It should be launched from a mobile

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ramp and should be guided to the target either by remote control or by internal devices. This pilotless aircraft should carry at least a 2,000 lbs. warhead.

b. The next ground to ground pilotless aircraft which should be begun after some experience is gained from the development of (a) above should have a speed above 1500 mph and a range of 500 to 1500 miles. This missile would probably require a fixed ramp and would require the development of a new navigation system or "mechanical brain" of some type. This pilotless aircraft should have a warhead of at least 2000 lbs.

c. Possibly simultaneously with the development of the pilotless aircraft described in (b) above, the design can be initiated on a vehicle traveling above 2000 mph with a range of 1500 to 5000 miles. This missile will probably require a fixed ramp and be guided in a manner similar to the 1500 mile missile. This design should include at least 2000 lbs. warhead.

d. The most remote development presently contemplated and one which will require a considerable advancement in the present state of the art is a missile traveling at speeds in excess of 3000 mph over ranges from 5000 to 12,500 miles. This missile would be capable of reaching any point on the surface of the earth. It is contemplated that it will be launched from permanent launching installations. It will probably require both a new system of navigation and an elaborate "mechanical brain."

Ground to air pilotless aircraft development divides itself into two categories: vehicles intended to attack conventional pilotless aircraft and vehicles intended to attack long-range ground to ground or air to ground pilotless aircraft.

a. The present ground to air program calls for the design of a pilotless aircraft traveling at speeds of about 1500 mph and capable of intercepting and destroying a hostile aircraft traveling at 700 mph at 50,000 feet. It will be launched from a portable ramp and will probably be guided to the target by a radar beam following device until within range, permitting the use of a radar target seeker for the final approach. It will carry a warhead of approximately 100 lbs.

b. It is contemplated that a ground to air pilotless aircraft reaching speeds of 5000 to 7000 mph and capable of intercepting and destroying a hostile pilotless aircraft traveling at 5000 to 6000 mph at 150,000 feet altitude will be required. It will be launched from a fixed ramp and will require newly developed guiding and target seeking equipment. The design of such a ground to air pilotless aircraft can be attained only in the future and probably will require the development of several interim projects in order to advance the state of the art sufficiently to make it possible.

The development of air to air pilotless aircraft divides itself into two categories, namely: offensive missiles and defensive missiles. It is contemplated that projects of each type can be initiated in the very near future as soon as the results of the present JB-3 (Tiamat) are available.

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a. Military characteristics have been prepared on an offensive air to air pilotless aircraft which will travel at speeds above 1500 mph capable of intercepting and destroying a 700 mph aircraft. This missile will be launched from a fighter-type aircraft and will be guided to the target by some type of radar seeking device.

b. A military characteristic is being prepared on a defensive air to air pilotless aircraft which will travel at speeds up to 1000 mph and will be capable of destroying a 700 mph fighter at ranges up to 3000 yards. This missile will be carried internally and be launched from bombers. It will be guided to its target probably by a radar seeker of some type. It will carry approximately a 50 lb. warhead.

c. No long-range development of air to air pilotless aircraft is contemplated at this time, inasmuch as they probably will not be required if the other phases of pilotless aircraft development program progress as rapidly as is hoped.

A military characteristic has been written for an air to ground pilotless aircraft reaching speeds of approximately 1200 mph and having a range of 100 miles. It is intended for use against either fixed land targets or maneuvering marine targets. It must be carried internally and be launched from a very heavy bomber. It will be guided either remotely or by some type of internal device. It will carry a 2000 lbs. warhead. Further development of air to ground pilotless aircraft will not be required if satisfactory extreme range ground to ground vehicles prove successful.

The development of retrievable aircraft is being initiated on existing types of subsonic aircraft to provide pilotless photographic aircraft capable of taking pictures of a remotely located area and returning to base. The development of the final retrievable aircraft capable of taking off, carrying out combat missions, and returning to the home base and landing - all under remote control - is considered more remote than any of the first three categories. Considerable development must first be made in remote television and other types of control equipment before this type of aircraft will be practical. Two types of eventual retrievable aircraft are contemplated for eventual use.

a. The first type of retrievable type of aircraft contemplated is a 600 to 1500 mph vehicle with a 1000 mile combat radius intended for use in intercepting conventional aircraft and for strafing ground installations. It is contemplated that this aircraft will be controlled through some type of radio link by a pilot on the ground who obtains his necessary information by remote radar and by a television set capable of giving him full spherical visibility. This airplane will probably have mounted thereto normal standard craft, machine guns, cannons, and rockets.

b. A second retrievable aircraft is contemplated with a combat radius of 6000 miles and speeds of the order of 600 mph., to be used for bombing and for photo reconnaissance. It will probably require a control system in general similar to that needed for the long-range ground to ground pilotless aircraft.

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The development of the above described pilotless aircraft will require a vast amount of basic research and the new development of many items of associated equipment.

a. Intensive research will be required in the fields of supersonic and transonic aerodynamics. This will include the development of shapes, airfoil sections, wingplane forms, spoiler controls, etc.

b. Intensive research will be required in the fields of jet propulsion and rocket propulsion. Consideration must also be given to the possibilities of the development of atomic power for the propulsion of pilotless aircraft.

c. Research will be required for the development of more effective explosives and for better fragmentation. The most important development in the field of explosives, however, is the adaptation of the atomic bomb to pilotless aircraft.

d. Improved radio-control, radar tracking and television equipment is necessary. This equipment must be developed for increased range and with greater security against enemy jamming.

e. Systems of independent navigation must be developed. Possible navigation systems might use magnetic information, celestial information, an air-position indicator, or some method not presently known.

f. Considerable development is necessary in the fields of automatic pilots which will have a response which is rapid enough for the extreme speeds contemplated. Along this line a development of a "mechanical brain" capable of guiding the missile to its target will be required. This device will require extremely rapid computing mechanisms.

Simultaneous with the development of pilotless aircraft, a parallel program for the development of adequate countermeasures must be carried on. Although some types of pilotless aircraft may be considered as a countermeasure against other types, a comprehensive program for the development of additional countermeasures will be required. Not only will the development of these countermeasures offer protection in the case of enemy use of similar missiles, but will also aid our own designers in making their systems more secure against enemy countermeasures.

a. Present electronic jamming equipment will require further development. The present radar pickup in tracking equipment will require considerable improvement in order to effectively detect enemy long-range high-speed pilotless aircraft.

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b. Constant search must be made for possible countermeasures other than electronic jamming of radio equipment.

c. Consideration should be given in the future to the development of a system for releasing and directing large quantities of destructive power in the form of beams, rays, etc. This type of a countermeasure has been impossible in the past because of the vast amount of power required to make it effective. However, if atomic power becomes available, such a device may prove possible.

The development of all the above pilotless aircraft is to be started carrying a predetermined weight of warhead. It is anticipated that at a future date practically all these devices will be revised to permit the installation of an improved version of the atomic bomb.

In addition to the above developments, the Engineering Division anticipates the development of Air Defense Control Centers and systems specifically intended to counter enemy piloted or pilotless aircraft approaching at extremely high speeds from any altitude and in any quantity.

To accomplish the foregoing projects, additional funds will be required to the funds asked in the Project B-7 chart, page 154, for each of the last four postwar years, in the amount of $21,500,000.00

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Special Projects - Guided Missiles

1. Summary.

a. The application of radio to remote control of bombs and planes had been considered by military and civilian scientists long prior to World War II. Not until relatively early in the war however, was a specific and broad program for development of guided missiles initiated. In a directive from AC/AS Plans signed by O.A. Anderson, Brigadier General, dated October 4, 194[illegible], to Materiel Command, a "Program for the Employment of Controllable Bombs" was outlined. This program called for [illegible] of electronic equipment, particularly television, in production quantities up to 100 per month commencing January 1945. At that time the Directorate of Communications became interested in the program from an electronic standpoint and it soon became apparent that the completion dates would not be met, due, it was felt, to lack of a centralized control agency having overall responsibility. [illegible] was supposed to exercise that function, but actually the responsibility was passed on and rested with the Special Weapons Group, at Wright Field. This group was not on a high enough echelon of authority, in consideration of the rapid expansion of the Army. 60

b. The situation was surveyed, and a staff study was presented to Plans early in 194[illegible], asking the appointment of a single agency in Headquarters charged with overall responsibility for the Army Air Forces Guided Missiles program. This recommendation was vigorously opposed by the Special Weapons Groups and those in Washington Headquarters sympathetic with the Wright Field setup, and as a consequence no action was taken until November 194[illegible], when the Air Communications Officer was given full responsibility.

c. The Special Projects Branch was established in ACO and immediate action started to get into production and operation, those weapons which were sufficiently developed. The Azon, GB-4, GB-8 and Willie projects were quickly produced and put into field theater operations. As the potential importance of guided missiles became apparent, however, other agencies began an opposition campaign based on the fact that ACO was primarily an electronics and communications functional agency, and therefore overall responsibility for the program was usurping the prerogatives of AC/AS, Requirements, Materiel and Services, and Personnel and Training. As a result, ACO was relieved of the original responsibilities in January 194[illegible] as described in attached detailed report.

d. Considerable time, materiel and personnel would have been saved had the overall responsibility been properly placed in a high level central agency, as recommended early in 194[illegible], or allowed to remain with ACO, once that decision was made. It is further felt that the present responsibility in AC/AS Requirements is proper organizationally, for the Air Forces, providing sufficient importance is credited to the program.

2. Conclusions:

New weapons which have evolved from this war can no longer be termed radical and impractical just because they do not conform to more familiar and accepted methods of making war. The development and use of special weapons is not a transient affair but an integral part of our necessary defense measures.

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3. Introduction:

a. At this writing it is contemplated to dissolve the Special Project Branch of ACO, since the cognizance of guided missiles is now the responsibility of AFRDB. This transfer of responsibility from ACO to AFRDB was effected 1[illegible] March 1945 by R&R. In this R&R it was stated that ACO would retain responsibility of Razon and Felix until such time as they are released for operational use. This fact is now interpreted "until such time that AAF Board submits a report". The AAF Board is now conducting tests on both the above mentioned projects and reports will be forthcoming shortly. The services of the Special Projects Branch are not required to assist the AAF Board in compiling these reports. Hence, for all practical purposes AFRDB also has responsibility for Razon and Felix. One other important point discussed in this R&R was that ACO will carry out normal staff functions in respect to electronic control equipment necessary for all guided missiles established by AFRDB directives. It is felt within ACO that a Special Projects Section is neither necessary nor desirable since the branches handling radio and radar equipment could easily take on the additional work [illegible] which might accrue from any guided missiles projects.

b. However, in case a Special Projects Branch might [illegible] come into existence, it is felt that it would be worth while to list the various agencies that have been interested in guided missiles.

(1) Division five of NDRC was interested in many research and development projects for both the Army and Navy. In a few cases NDRC initiated production contracts, although this was not the usual procedure since NDRC's interest was [illegible] the completion of projects for possible use by the Armed Services.

(2) Within the Army Air Forces, ATSC developed and procured guided missiles upon directives which were initiated by [illegible] (now AC/AS-3) and processed through M&S (now AC/AS-4).

(3) The BuOrd and BuAir of the Navy Department were quite interested in guided missiles and had a large program in progress. The Assistant Chief of Naval Operations monitored all Navy projects.

(4) The Army Ground Forces had recently shown much interest in guided missiles, so much so, in fact, that it was necessary for the Chief of Staff to initiate a directive delineating the responsibilities of the Air and Ground Forces. This was known as the McNarney directive and is dated 2 Oct, 1944.

(5) From time to time the Signal Corps has become interested in countermeasures for guided missiles, but so far have been unsuccessful in crashing into this field. It has always been the opinion of the Air Forces that the agency developing a missile was most suitably equipped to develop countermeasures also.

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4. Description of Equipment:

a. No attempt will be made to describe the equipment and status of equipment in this memorandum since ATSC has recently (1 June 1945) prepared a complete status of all guided missiles projects. This report is titled "Pilotless Aircraft as Guided Missiles" and is in loose leaf form so that additions and changes may be easily made. The table of contents for each missile is as follows:

Summary
Description
Characteristics
Tests and Operational Use
Training Program
Assembly, Maintenance and Test Equipment
Packaging and Shipping
Handling Equipment
Availability
Costs
Comments
Bibliography

b. Guided Missiles is a broad subject and anyone charged with monitoring such a program should not only be well versed in mechanics and electronics, but also know the tactical situation. A missile might be developed representing the acme of perfection technically, but not be suitable tactically. Hence it is strongly recommended that personnel chosen for the monitoring of a guided missile program be allowed <u>to [illegible] of the existing problems, and not be subject to any [illegible]</u>.

5. Special Projects Branch:

a. Since it is contemplated that the Special Projects Branch will cease to exist shortly, the following information is offered for the record only.

b. This branch was created [illegible] Nov 1943 when a directive from the Commanding General AAF made the [illegible] responsible for all phases of guided missiles.

c. Under this directive, the Branch was responsible for guiding research and development, establishing requirements, determining training requirement, organizations of special units and their dispatch to theaters.

d. This branch was responsible for the theater introduction of VB-1 (Azon, Azimuth control of 1000 lb. bomb), GB-4 (television controlled glide bomb) GB-1 (radio controlled glide bomb) and War Weary aircraft.

e. After theater introduction of the above mentioned missiles, the branch slowly disintegrated since it did not have personnel or facilities for the complete monitoring of guided missiles projects. Furthermore, there was continuous bickering with other headquarters offices because of the "out of channel" procedure forced upon us by the direction mentioned in c above. Finally, an attempt was made to channelize the Guided Missiles Program and OC&R (Now AC/AS-3, AFRDB) was made the office of primary responsibility, see paragraph one.

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6. Prenatal Projects:

a. NDRC carried the ball during the initial phases of guided missiles projects. Usually, their ideas were basically sound, but invariably their enthusiasm ran out of bounds, and projects were offered to the AAF for acceptance tests before they were out of the development stage. This situation caused much consternation within the AAF, and, as a result, the AAF eventually became wary of any proposals submitted by NDRC.

b. Upon completion of development work on a project by NDRC, it was given to ATSC. This organization was responsible for guided missiles projects, under the direction of AC/AS-4 (now AC/AS-4). However, ATSC could also initiate their own guided missiles projects. In an exuberant attitude, ATSC initiated so many projects that the manpower shortage became critical and there were not enough technically trained personnel to handle the work. As a result, practically all projects proceeded at a slow pace.

c. The Navy has always indicated a willingness to cooperate with the AAF and usually did cooperate on research and development projects. However, when it came time to allocate production assignments, the Navy didn't know that AAF existed.

7. Trend:

a. Writing philosophically, we as a Nation are not an aggressive one. Because of this fact it is imperative that we have at all times precise and current intelligence on guided missiles developments of our so-called friendly neighbors in order to keep abreast of the developments of effective countermeasures.

b. The enemy, although they barely scratched the surface of this field, have effectively proved that guided missiles are extremely potent weapons. The Germans had their V-1, V-2, HS-293, FX-1400 and others. The Japanese did much destruction with their Kamikaze crew and aircraft. Countermeasures will be required which will be effective against electronically and humanly controlled missiles.

c. To fight a war effectively, we must not only have countermeasures for enemy guided missiles, but also be ready to become aggressive and use guided missiles. For those who appreciate the potentialities of guided missiles, there is not much doubt that the nation excelling in this field might well determine the destiny of other nations. For this reason, we must be the leaders.

d. Future missiles will undoubtedly be required and developed in following categories:

(1) Azon and Felix -- to be used as interim measures.
(2) Jet Propelled -- Radar or Loran and/or Infra Red controlled and equipped missiles to be launched from Ground to Air.
(3) Long Range -- Large Size Rockets, Radar controlled or controlled by a system similar to Loran.
(4) Television -- holds little promise for practical application except in telemetering testing. With other methods of direction to target and increasing speeds, television will not be adequate or necessary.

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ADDRESS REPLY TO 113
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON, D. C.

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WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON, D. C.
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By Authority of
The Commanding General
Army Air Forces
18 Sept. '45 R.B.
Date Initials

21 SEP 1945

SUBJECT: Guided Missiles of the German A-9 and A-10 Type

TO: Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: TSEEN

1. Reference is made to letter, subject, "Military Characteristics for Ground-to-Ground Type Guided Missiles", dated 17 September 1945, from this Office to the Air Technical Service Command (TSENG), transmitting Military Characteristics for four (4) types of ground-to-ground guided missiles.

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2. The subject letter does not recommend or suggest the German A-9 or A-10 types of missiles as means for filling the requirements described by the referenced Military Characteristics. However, it should be understood that development of these types falls within the purview of the Army Air Forces. It should also be emphasized that long range missiles of these types were considered decidedly promising by the Germans and that the Army Air Forces Scientific Advisory Group also considers that this development field should be thoroughly explored and exploited. For [redacted] information, there is attached an extract from "Where We Stand", the first report to General of the Army, H. H. Arnold, by the Scientific Advisory Group, AAF.

3. It is directed, therefore, that missiles of both airplane type trajectories and trajectories of the A-9 and A-10 general type be developed as means of fulfilling the referenced Military Characteristics for ground-to-ground guided missiles.

By Command of General ARNOLD:

John G. Moore
JOHN G. MOORE
Colonel, Air Corps
Deputy Asst. Chief of Air Staff-4

1 Att:
Extract fr.
"Where We Stand".

12:08

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Extract from "WHERE WE STAND", First Report to General of the Army; H. H. Arnold, on Long Range Research Problems, by Scientific Advisory Group, Army Air Forces.

"Our endeavors in pilotless aircraft in the proper sense include in addition to the successful reproductions of the V-1 type a few promising beginnings. However, the Air Forces should realize that the task is far beyond the scope of inventing gadgets and trying to make them work. There is urgent need of a systematic analysis of the various tasks which manned airplanes equipped with bombs, guns and rockets perform, and which now may be performed by pilotless craft.

"In other words two developments have to meet for successful solutions of the problems: the tactical viewpoint must lead to the choice of the types of pilotless aircraft, on the other hand physical science will proceed to offer more and more extended ranges and improved accuracy.

"However, beyond that the implications of the accomplishments of the German Peenemünde group and of the recent development of the atomic bomb by United States and British scientists on future methods of aerial warfare call for a reconsideration of all present plans. A part, if not all, of the functions of the manned strategic bomber in destroying the key industries, the communication and transportation systems, and military installations at ranges of from 1000 to 10,000 miles will be taken over by the pilotless aircraft of extreme velocity. The use of supersonic speeds greatly reduces errors due to wind drift and other atmospheric conditions and the tremendous zone of damage of the atomic bomb diminishes the required precision. Hence the difficult control problem is made easier.

"For the future long-range strategic bomber, the Scientific Advisory Group foresees two types of pilotless aircraft, both with wings; one with a high trajectory reaching far into the outer atmosphere, and the other designed for level flight at high altitudes. The first one can be considered as a further development of the V-2 rocket. In fact, this was planned by the German scientists. By using two or more step-rockets for the acceleration, a very high speed is imparted to a missile, perhaps as high as 17,000 miles per hour or more, to give ranges of several thousand miles. In this case, the wings are required mainly for control purposes, but they also serve to extend the glide path in the lower atmosphere. The German scientists have suggested a second type of trajectory, requiring less initial energy, in which the wings are caused to curve the path of the missile when it returns to the region of increasing air density so that it rebounds to great heights. After a number of rebounds the winged missile settles down to a steady glide. Such a trajectory would seem difficult to control accurately.

"The second future strategic bomber is a supersonic pilotless aircraft, flying at altitudes of from 20,000 to 40,000 feet. It appears to us now that the speed will be about twice the speed of sound and that the aircraft will be powered by a turbojet motor. An intermediate step might be a pilotless aircraft traveling at high subsonic speeds with a Mach number of about 0.9 (about 600 mph at 40,000 feet). [redacted]

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... hostile aircraft, ... automatic radar ... tried by ...

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HEADQUARTERS ARMY AIR FORCES
AC/AS-4
Inter-Desk Memorandum

MEMORANDUM FOR RECORD AND STAFF: DATE: 1 October 1945

Maj. Gen. Barnes, Ord.
Dr. Millikan of C.I.T.
Conference group of 50

Conference, called by Chief of Ordnance, to report on the progress of the Orcit program and on propellents in general to a group including about a dozen General Officers of ASF and AAF. Dr. Milliken briefly described rockets, solid and liquid; thermal jets, turbo jets, and rammed jets. He explained the limitation and probable application of each to guided missiles. He mentioned that the German effort on their V-2 program alone (which represented 1/3 to 1/2 their total effort on guided missiles), covered a period of time twice as long as our total American effort on guided missiles and they devoted 20 times as much man power and 60 times the money on the V-2 ~~that~~ as allotted to our total American guided missiles program. The four general problems facing guided missile research are propulsion systems, aerodynamics launching and controls. The need for very extensive research on each of these problems was emphasized. For propulsion systems much research is still necessary on fuels, combustion chamber design, cooling and metals to withstand high temperatures, and fuel transfer and injection systems.

There are 250 to 300 persons working on the present Orcict project in facilities valued at over $1,000,000 and consisting of 60 structures, 20 test pits and a supersonic wind-tunnel. Several smaller uncontrolled tests missiles have been tested and a final type missile (Corporal) is expected ready for tests in early 1946. The corporal is expected to eventually be a missile of approximately 6 tons, 36 feet long, with an 80 mile range, a payload (warhead) of 1,000 to 2,000 pounds, and incorporate a much lighter internal fuel transfer pumping system than the present heavy pressure system.

On future development Dr. Milliken stressed the need for continued effort on pure rocket type missiles for short ranges and winged missiles powered by rammed jets for longer ranges. He also stated that guided missiles field is the one most justified to use atomic power.

Dr. Milliken stated C.I.T. feels they should remove themselves from the complete missile field and concentrate their efforts on basic research which has application to guided missiles. They also desire to act as consultants to private industry and continue offering courses on guided missiles subjects.

J. F. V. COOl

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8 October 1946

" TAB D "

Peacetime Development Budget for the Army Will Not Permit Competitive Programs.

1. The development of guided missiles is extremely costly. Research and development in many basic related fields are necessary in order to [illegible] each new missile. The facilities required for research in aerodynamics, jet propulsion, stabilization and control servo and gyro mechanisms, radar, [illegible] acoustic or light homing equipment, radar for guidance, offensive and defensive control systems, and launching systems are large and costly. The German utilized a fantastic portion of manpower of their leading scientists and research facilities to accomplish these developments. It has been estimated that the development effort on the V-2 alone involved a period of time three times as long, twenty times the manpower and sixty times the money as the total American guided missiles program of the entire war. This effort resulted in the tactical [illegible] of missiles with performance characteristics of speeds greater than [illegible] miles per hour, and altitudes of 350,000 ft. This performance is far in excess of any of the results of the American guided missile program. In order for our Army to catch up and surpass these enemy developments, adequate development facilities and a comprehensive program of research and development must be established. These facilities and development programs will necessarily be [illegible]

2. The Army Air Forces have a complete guided missile program covering basic research, specific missiles and defenses against guided missiles. This program is divided into seven main sections as follows:

a. Ground-to-ground guided missiles.

b. Ground-to-air guided missiles.

c. Air-to-air guided missiles.

d. Air-to-surface guided missiles.

e. Retrievable guided missiles.

f. Research (in the fields of supersonic aerodynamics, jet propulsion, radar control and guidance, etc., and all other components)

g. Defenses against guided missiles.

The details of this program are briefly outlined in the inclosed copy of the Air Technical Service Command supplement to Air Forces Postwar Research and Development Program. The Air Force program covers all phases of the basic research necessary for guided missile development and a program of missiles to gradually supplement and in time possible supplant interceptor fighters, tactical bombardment aircraft, strategic bombardment aircraft, and reconnaissance aircraft.

3. The Ordnance program covers a narrower field of surface-to-surface and surface-to-air missiles. The contractors are as follows:

a. California Institute of Technology - basic research and a family of surface-to-surface missiles.

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b. General Electric Co. - development of guided missile components, especially in propulsion and control - surface-to-air and surface-to-surface missiles.

c. Bell Telephone Laboratories - development of a specific surface-to-air missile.

d. Radio Corporation of America - studies on tracking radar and guided surface-to-ship missile.

4. There is an overlapping of effort in the Ordnance missile development.

a. As the Air Forces have a program of surface-to-surface missiles with ranges from 20 to over 1,500 miles to supplement both tactical and strategic bombardment aircraft, the Ordnance program duplicates the surface-to-surface program.

b. The Air Forces have a program of surface-to-air missiles for defense against both conventional aircraft of maximum theoretical performance and enemy guided missiles. The Ordnance program will include similar missiles.

c. Ordnance is duplicating Air Forces effort in the aerodynamic field as most of the Ordnance missiles have aerodynamic control surfaces and wings.

(1) One of the Ordnance winged missiles had completely unsuccessful flight trials and the contractor then brought an Air Force aircraft contractor into the development picture.

(2) The Bell Telephone Laboratories missiles has wings and control surfaces so that it can outmaneuver a bomber. The Bell Telephone Laboratories have a subcontract with Douglas Aircraft Company for aerodynamic work.

(3) The Radio Corporation of America engineers are at present inspecting an Air Force development at Douglas Aircraft Company of a supersonic aircraft to see if it can be utilized as a vehicle for a proposed surface-to-ship missile.

(4) General Electric is planning to get an aircraft contractor to provide all engineering work in aerodynamics.

d. In some fields, competition promotes development. However, in this case, there is no such healthy competition, since Ordnance is simply coming to the Air Forces sources of aircraft contractors. Ordnance normally goes to firms capable of ballistic development and the Air Force to firms capable of aerodynamics development. In the missiles field, however, the aerodynamic development agencies are the aircraft contractors who are the only logical sources, because of their backgrounds in aerodynamics, propulsion, gyro control, radar launching, etc. Duplication by Ordnance in the aircraft field can only be wasteful.

e. The Ordnance guided missiles program for 1946 amounts to approximately $8,600,000. The Air Forces requested $16,000,000 and $8,000,000 was granted. The Air Forces program for the following four years calls for special funds

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each year on direct guided missile work supported by the general research and development program of the Air Forces facilities at Wright Field involving a requested budget as follows:

	Total Research & Development	Guided Missiles
FY 1947	* [illegible],000	[illegible],500,000
FY 1948	242,[illegible],000	26,500,000
FY 1949	[illegible]17,[illegible],000	24,[illegible]
FY 1950	[illegible],000	[illegible],200,000

* A substantial portion of the total Air Force research and development funds will be used in the guided missiles field:

a. Components for guided missiles developed by the Power Plant Laboratory, Radio and Radar Laboratories, Equipment Laboratory, Aircraft Laboratory, etc.

b. Research projects such as supersonic and [illegible] work, [illegible] sonic piloted aircraft, and trans-sonic aircraft.

c. The activities outlined in related fields of propulsion, radio and radar in the Supplement to Project B-7, Postwar Research and Development Program, 18 September 1946, copy attached.

The question of possible duplication with Navy guided missile projects makes it imperative that the Air Forces and Ordnance have a clear-cut basis for operations. (Note: Navy has a budget of $94,000,000.00 for a single guided missiles project for next year, plus their other guided missiles budget requests).

8. Since the budget for 1948 requested by both Air Forces and Ordnance has been cut, it is very probable that the funds for research and development will also be cut. Duplication between Ordnance and Air Forces with insufficient funds for an adequate program for either would be unfortunate.

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AFDMA-[illegible]/Lt Col Stace/bjm/7100
8 October 1945.

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- TAB B -

The A.A.F. has the Basic Experience on Guided Missile and Guided Missile Component Development.

1. In regard to backgrounds of experience, the following facts are now apparent on guided missiles component development within the Army:

a. On maneuverable airframes with lift surfaces for control and sustenance, the Air Force has the basic experience.

b. On the automatic pilots, the stabilizing systems, and the other various gyro and servo control systems, the Air Forces has the basic experience.

c. On conventional engines and unconventional engines (turbo-jet, gas-turbine, and intermittent jet), the Air Force has the basic experience.

d. On the ram-jet engine the Air Force started the first project and in conjunction with [illegible] and N.A.C.A. and other agencies is energetically pursuing research and development in this field for potential use in piloted and pilotless aircraft.

e. On [illegible] rocket motors and fuels, both liquid and solid, the Air Forces [illegible] has the basic experience in development with aircraft power units [illegible] take-off rockets.

f. On launching, the Air Force has the basic experience through developing assisted take-off rockets and catapults despite the fact that development of all detachable or [illegible] A.A.F. and launching devices is now considered the responsibility of the Army Service Forces.

g. On remote control systems, including radio and radar control, and all types of seekers, the Air Force has the basic experience.

h. On navigation, the Air Force has the basic experience.

i. On warheads and fuzing, the Ordnance has the basic experience. Since the whole guided missile is designed to deliver the warhead to a desired spot, the warhead itself is an extremely important component. Little prospective action has been publicized for warhead research and development. Ordnance, by concentrating on this component could perform their greatest service to the guided missiles program.

j. On the firing of a projectile following a purely ballistic trajectory, the Ordnance has the basic experience.

2. In regard to the actual development of guided missiles, the Army Air Forces has been in the field since 1917. They have pioneered for the Army in practically every phase of guided missiles development:

a. Surface-to-Surface: This pilotless aircraft phase has been carried on with many variations:

(1) Pilotless two engine expendible bombers were developed for this war (XPQ-1, 2, 3, 4, & 6), but were never used because more effective means had been discovered before they were complete.

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- TAB B -

(2) The Abusive project permitted any aircraft (war-weary or otherwise) to be used with remote control as a guided missile. It was divided into several phases:

(a) Control by another airplane. This was used with limited success in Europe with the earlier items of equipment developed. Improvements such as radar navigation to the target with television for final approach, strafing protective rockets, and others were becoming available at the close of the war.

(b) Radar control from the ground to distances of [illegible] to 100 miles was developed and made available for use during early 1945 against German cities. Combined Chiefs of Staff action stopped the prospective use.

(c) Visual ground control against strong points visible or invisible from the air was a procedure developed in July 1945 and proved very successful in tests. This procedure would have enabled precise hitting of Japanese strongpoints with explosive concentrations of up to 50,000 lbs.

3. Several types of target aircraft that approach guided missiles were developed by the A.A.F. and used very successfully in this war - the catapult launched OQ's, and the man-carrying-size PQ's.

4. The JB-2 was the first jet-propelled guided missile built in quantities. Originally patterned after the German V-1, decided improvements were made including radar control to 100 miles, development work on a computer to permit push-button control requiring no human guidance after the missile is fired, rocket-assisted launching from a horizontal ramp, launching from a portable 50 foot ramp, launching from a steam ramp, launching from a multiple-cartridge ramp (developed by Ordnance at request of A.A.F.). The JB-2 was in quantity production for potential use in early 1946.

5. The JB-10 (JB-1) is the first flying-wing type, jet propelled missile, with the first wing installation of an intermittent jet engine. Tests are still underway.

6. The JB-4 was the first plywood frame jet propelled missile. It was dropped in favor of the JB-2.

7. Designs had been completed on other subsonic jet propelled missiles with ranges up to approximately 600 miles.

b. Surface-to-Air: - The A.A.F. has finished several study contracts but has carried a complete development project of such a missile at secondary priority until the condusion of the fighting. They well underway, however, on a lot of the basic development such as:

(1) The P-79, a rocket propelled interceptor, under development for several years has many similar problems.

(2) The A.A.F. has projects well underway on trans-sonic and supersonic aircraft. These aircraft will be a major step

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- TAB B -

in solving the difficult aerodynamic design and control problems in these new speed ranges.

(3) The A.A.F. has the only Army radar seeker project for anti-aircraft use well underway for the JB-3.

(4) The AAF has radar beacon and control sytems completed and others underway for radar navigation and control of such missiles.

c. Air-to-Air: - The A.A.F. with the JB-3 has the only Army anti-aircraft guided missile to reach the vehicle test stage. This is a subsonic missile used for [illegible] to the follow-on supersonic types, but will work out many of the [illegible] propulsion and control problems. The radar seeker will be available for test [illegible] 1946.

d. Air-to-Surface: - Since the guided missile program of this country was based largely on securing greater accuracies and aerial attacks, with less anti-aircraft danger, the developments in this field were very extensive:

(1) In vertical bombs, the Azon (azimuth control only) was used very successfully, the Razon (range and azimuth) was in quantity production with a high priority requirement and the Felix (heat seeker) was in quantity production and about to be furnished for a theatre trail. Extensive studies had also been made on television and radar seekers and on the Roc (medium angle) in television, heat, and radar versions.

(2) In Glide Bombs, the preset GB-1 and preset GT-1 (torpedo carrier) were used successfully in combat. Other extensive development programs were conducted on seeker glide-bombs with radar, flare, light-contrast, and heat seekers. The GB-4 television glide bomb was tested unsuccessfully in combat, but further development to use radar navigation with television for final approach only was considered promising.

(3) In jet-propelled missiles, the JB-2 was launched successfully from a B-17.

e. Anti-Ship Missiles: - Most of the seeker type glide bombs (radar, light-contrast, and heat) were considered effective against ship targets. The A.A.F. also with the GT-1, developed the only guided missile carrying a torpedo. The A.A.F. also developed water-borne guided missiles that were on their way to the theater when the fighting stopped.

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- TAB C -

High Priority Long Term AAF Guided Missiles Program

1. The AAF priority system was based on the assumption, founded on experience, that both the development and manufacturing facilities of this country are limited and that any major incorrect distraction would have unfortunate results. During the fighting, therefore, high priority was only assigned to those developments that had promise of shortening the war.

2. The only guided missile developments to which the AAF assigned major effort, therefore, were those with promise of being used effectively in this war.

3. The Germans followed a different policy by making major distraction of effort to guided missiles, without an apparent realization of the length of time required for successful use. It is believed by most analysts that if they had concentrated on developments with a high probability of successful use in this war, that their overall effort would have been decidedly more successful.

4. The AAF, realizing that the policy during the fighting was an emergency policy, are now returning to their customary development policy of concentrating on effective new weapons for use in preventing or shortening future wars. This development will include both piloted and pilotless aircraft.

5. The pilotless aircraft development program will include:

a. A family of surface-to-surface missiles with ranges varying from [illegible] miles to over [illegible] miles.

b. Surface-to-air missiles (probably of several different types) for use against piloted aircraft and guided missiles to supplement or supplant piloted interceptors.

c. Air-to-air missiles of several types for use on interceptor piloted or pilotless aircraft against enemy bombers or missiles, and for use on piloted aircraft as a protection against piloted aircraft and guided missiles.

d. A family of air-to-surface missiles covering precise, deep penetration large missiles, missiles launched from outside anti-aircraft [illegible] range, and missiles launched from outside interceptor range.

e. A family of retrievable guided missiles, including bomber, fighter and observation types.

f. Anti-ship missiles of various type, including provisions for under-water hits.

g. Defense centers against guided missiles, including early warning systems, firing and fire control systems, and the actual piloted and pilotless aircraft used.

h. Offensive center including firing and fire control systems, and the actual piloted and pilotless aircraft used.

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- TAB C -

6. The Army Air Forces will also continue with their development program on piloted aircraft. It is evident that the actual extent and timing of re-placement of piloted aircraft by pilotless aircraft will depend on the develop-ments in both fields. The replacement must be efficient and orderly in order to keep the national defense program at the highest level of effectiveness. The Army Air Forces is evidently in the best position to determine and carry-out this policy of replacement.

7. In the progress of the development of piloted and pilotless aircraft there are many components that are so similar that development should logically be carried on by the same agency. These include:

a. Airframes for subsonic, transonic and supersonic speeds.

b. Propulsion systems and fuels for subsonic, transonic and supersonic speeds, and for use both inside and outside the atmosphere.

c. Direction control and stabilization systems for subsonic transonic and supersonic speeds.

d. Navigation and communication systems.

e. Launching Systems.

f. [illegible] and defensive flight control systems.

g. [illegible] flight control systems.

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9 OCT 1945

Memorandum for the [illegible] of Air Staff.

SUBJECT: [illegible] of a Firm Plan for an AAF Guided Missiles Program

The Problem: 1. There exists today no central organization in the Army Air Forces having sole responsibility for the establishment and implementation of a guided missile program. Such an organization is believed absolutely essential. This paper is an attempt to summarize current thought on this subject and to present a solution.

Discussion: 2. The [illegible] guided missiles will play in World War III (or in preventing a World War III) is generally acknowledged by all personnel concerned with planning [illegible] post-war Air Force. Various agencies both within and without the War Department have submitted reports concerning research and development policies as they affect the future security of the Nation. Among the more important of these reports are the following:

(a) The Air Scientific Advisory Group Report "Where We Stand"

(b) Dr. Vannevar Bush's (O.S.R.D.) report to the President "Science, the [illegible] Frontier".

(c) [illegible] General [illegible] Streets' recommendations contained in a letter to the [illegible] Air Forces dated [illegible] August 1945, subject: "Establishment of a Firm Plan [illegible] and Development.

The trend of thought [illegible] the above cited papers is the same - the necessity for a central [illegible] research and development. They differ only in emphasis and in [illegible] the level of organization to which such central agency should be assigned.

3. [illegible] plans for research and development in [illegible] fields of science on a national scale are being discussed by the Congress and the Executive Department of the government. It is not believed desirable for the Air Forces to wait until such plans are crystallized. We must take the initiative in reorganizing our own house to best meet the requirements for the future. It is understood that AC/AS-5 is now preparing a paper recommending that the AAF undertake research and development of all types of guided missiles regardless of range and type of launching, and that concurrently with the development of such guided missiles, the AAF will make plans and preparations for the operational employment of such missiles.

4. There are today numerous agencies both within and without the Air Forces which are interested in guided missiles to varying degrees. To mention a few there is the Air Communications Officer, AC/AS-4, A.T.S.C., AC/AS-3 Antiaircraft Division, AC/AS-3 Guided Missiles Division, New Developments Division WDGS, the Office of the Chief of Ordnance, Headquarters, Army Ground Forces, the Guided Missiles Committee of the Joint Chiefs of Staffs, as well as numerous Naval agencies. While it is probably beyond our scope to make recommendations as to any interservice organization, it is believed

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timely to review our present situation within the AAF, and make appropriate recommendations. It is not believed that the present staff system is satisfactory or sufficient forhandling the guided missiles program for the AAF. There is no one staff section to which one can go and get a definite answer on policy for these missiles. Because of the radically new nature of guided missiles, it is not believed logical to separate planning from research and development, as is done now. A.T.S.C., while theoretically functioning under AC/AS-4, is for all practical purposes another independent agency. The establishment of a central organization to handle all phases of the guided missiles program is certainly not without precedent. The office of the Air Communications Officer on airborne electronic equipment, and the Manhatten District on the atomic bomb, have both demonstrated the rapidity with which progress can be made when a program is set up on a "project" basis under central control organization. It is believed that guided missiles lend themselves ideally to development on a project basis.

Conclusions:

5. The following conclusions have been drawn on this subject:

(a) That the future security of the nation depends largely on the establishment of a sound guided missiles program.

(b) That the normal staff divisions of responsibility are not satisfactory for the implementation of a sound AAF guided missile program.

(c) That time is of the essence.

Recommendations:

6. It is recommended that an Air Staff Division (AC/AS-6) for Guided Missiles be established without delay, under a general officer of outstanding foresight, tact, and organizational ability, such as
Such an Air Staff would be charged with monitoring, controlling, and directing all research and development on guided missiles for the Air Forces, and in addition would be charged with testing, training, and the development of tactics for the employment of guided missiles of all types.

[redacted]

AFAAA
General Oldfield/el/7457

MEMORANDUM FOR THE CHIEF OF AIR STAFF:

Subject: Countermeasures Against German V-2 Missiles.

1. Attention is invited to a memorandum this office, above subject, dated 16 August 1945, with attached disposal slip, stating that this is an AA responsibility. This is granted. The Air Forces are, however, sufficiently responsible for overall air defense to warrant pressing this matter. The Air Forces are likewise basically responsible for early warning against such missiles and should be responsible for location of launching sites and countermeasures against such sites.

2. Informal information indicates that the Army Ground Forces have already requested the Army Service Forces to develop radars capable of detection, tracking, and locating launching sites of enemy guided missiles. A request has also been made by the Army Ground Forces on the Army Service Forces to develop a means of destroying aircraft and guided missiles by the preparation of some form of energy. The Air Communications Officer in a recent conference with the Chief Signal Officer has determined that the Army Air Forces has a distinct interest in 15 out of 17 development projects now being undertaken by the Signal Corps. The line of demarcation between the responsibilities of the Air Forces and of the Ground Forces and Service Forces for new developments is not clear-cut and it appears that the Air Forces are at present in a disadvantageous position in this matter.

3. In view of the above, it is recommended that the attached memorandum to the Chief of Staff recommending the creation of a coordinating committee including members from the War Department Special Staff, Army Air Forces, Army Service Forces, and Army Ground Forces to monitor and control developments of countermeasures against supersonic missiles be signed and dispatched.

4. The Assistant Chief of Air Staff - 4 does not concur in the above proposals for reasons stated in attached R&R which states essentially that the functions recommended for the proposed committee are now charged to the New Developments Division. It is maintained that, pending a clear-cut decision on division of responsibilities, the action proposed seems best designed to allow the Air Forces to have a voice in this vital matter.

3 Incls.
1 - R&R, 15 Oct 45
2 - Memo for ACAS
3 - Proposed Memo for C/S

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HEADQUARTERS, ARMY AIR FORCES
WASHINGTON
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[redacted]
By Authority of
The Commanding General
Army Air Forces
25 Oct. 45 F.B.
Date Initials

IN REPLY REFER TO:
(AFDMA-2G)

OCT 24 1945

SUBJECT: N.A.C.A. Five-Year Program for Guided Missiles Research

TO: Commanding General
Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: TSEAG

1. During the meeting of the N.A.C.A. Special Committee on Self-Propelled Guided Missiles on 17 October 1945 at Langley Field, it was apparent that the formulation of the subject N.A.C.A. five-year plan is suffering for lack of guidance in the form of definite statements from the Services.

2. As you know, the N.A.C.A. is charged with responsibility for conducting fundamental research in aeronautics; this responsibility cannot be discharged to the best advantage of the Services without sufficient knowledge of the needs, plans and programs of the Services. Further, in view of the current Congressional policy of budget restriction, it is necessary to derive the very maximum of benefit from N.A.C.A. and similar agencies which can be used to supplement the Air Technical Service Command budget and which are eminently qualified to carry out the extensive fundamental research still undone in this field.

3. In view of the above, it is recommended that the Air Technical Service Command take prompt action to:

a. Transmit to N.A.C.A. complete information on the current A.A.F. guided missiles program.

b. Arrange procedure for keeping N.A.C.A. promptly informed of changes in the program.

c. Point out specific fields of activity and projects in which N.A.C.A. can be of assistance.

d. Make available to N.A.C.A. such A.A.F. equipment or facilities as are necessary for proper execution of the N.A.C.A. program.

e. Maintain in the Air Technical Service Command the central control and coordination of the A.A.F. guided missiles research and development program, including the various component portions carried out by N.A.C.A. by contractors, and other research and development agencies.

CENTRAL FILES
Taran - 1/JH/mte
25 Jan 46

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ADDRESS REPLY TO: COMMANDING GENERAL, ARMY AIR FORCES, WASHINGTON 25, D. C.

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SUBJECT: N.A.C.A. Five-Year Program for Guided Missiles Research.

4. During the demonstration of N.A.C.A. test missiles on the afternoon of 17 October 1945 at Wallop's Island, the instrumentation of the test firings was noted as being extremely thorough and well-planned. N.A.C.A. derives the very maximum of engineering data from every missile fired. It is recommended that the Air Technical Service Command test personnel observe the methods and equipment used by N.A.C.A. with a view toward possible adaptation for Air Technical Service Command purposes.

By Command of General ARNOLD:

Alden R. Crawford

ALDEN R. CRAWFORD
Brigadier General, U.S.A.
Chief, Production Division
Office, AC/AS-4

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ENCLOSURE "B"

NACA DRAFT APPROVED OCTOBER 25, 1945
SUPERSEDED BY ENCLOSURE "C", NOVEMBER 5, 1945

To: The Joint Chiefs of Staff

From: National Advisory Committee for Aeronautics

Subject: Overall Program of Military Research and Development

1. The National Advisory Committee for Aeronautics, at its annual meeting today discussed the problem of coordinating aerodynamic research, in particular the effective and economical utilization of present wind tunnel equipment located throughout the country, and the further supplementary of this equipment as the program may require. It became evident that a unitary program, with appropriate allocation of responsibilities, is essential if a situation is to be avoided in which judgment as to the support of programs becomes exercised on insufficient understanding of the overall situation.

2. With this in mind the Committee was inclined to initiate action to resolve the matter in special fields of its interest. However, it was evident that this would solve only part of a large problem, and, moreover, that this part could be solved most readily if it were approached as one aspect of a general resolution of the entire problem. This same situation obtains in many other fields of research and development.

3. Accordingly the National Advisory Committee for Aeronautics recommends that the Joint Chiefs of Staff initiate means for producing an integrated program on all aspects of military research and development, to include the work of all departments or agencies carrying on such activities.

4. It is clear that full success in this task can be attained only if the body which undertakes it has full authority to determine allocations of responsibility and the relative priority of projects and programs. For this reason it appears that creation of a body by the President, on recommendation of the Joint Chiefs of Staff, together with definite instructions from the President to the agencies involved, or alternatively with prior agreement by all agencies to be governed by the results, indicated.

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[redacted]

Subject: Control for Series of Heavy Bombs

Basic dtd 29 Oct 45 1st Ind AFDRE-3/R
HqAAF, Washington 25, D. C.

To: Commanding General, Air Technical Service Command, Wright Field, Dayton, Ohio. Attention: TSESA-7

1. The requirement for a series of very large, deep-penetration, vertical controlled missiles continues to exist. The advent of bombs of great blast effect makes the requirement for penetration bombs more firm. The enemy may be expected to place his most vital targets underground. These installations will also be of very heavy construction quite similar to those constructed by the Germans during this war. The present 12,000 lb bomb is proving to be ineffective against these targets in tests now being conducted in Europe.

2. It is recognized that for conventional bombs over 12,000 lb in weight, the usual methods of aerodynamic control are less effective. This is not regarded as a reason for withdrawing the requirement, however, but rather as a reason for redoubling development effort to overcome difficulties, and for investigation of other methods of control, such as jets or rockets for course alteration or new aerodynamic shapes of warheads. However, it is preferable to work out methods applicable to conventional bombs, if possible.

3. ATSC is therefore directed to:

a. Continue to investigate the possibility of applying satisfactory control to conventional bombs of the large sizes.

b. If it is determined that control cannot be applied satisfactorily to conventional bombs, action must be taken to design warheads, fuzes and components that will permit the desired control.

c. If it is determined that aircraft now in development are unsatisfactory for carrying the newly designed bomb, steps should be taken to develop a suitable aircraft for that purpose. ~~Thought should be given to expendable and towed aircraft with a cheap power unit to assist in take off and to provide greater speed on the target run after release.~~

4. Regarding the better accuracy obtainable from the larger sizes of bombs with conventional bombing, this has been discussed with ATSC on numerous occasions in the past. There are certain inherent errors in conventional bombing due to bombsight, aircraft motion, the human element, and other causes, which may only be eliminated by controlling the bomb down to its target. The need for correction of these errors, as well as reduction of ordinary bombing errors, is considered to warrant the development involved.

By command of General SPAATZ:

ALDEN R. CRAWFORD
Brig General, U. S. A.
Chief, Research & Engineering Div
Office, Asst Chief of Air Staff-4

[redacted]

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A-2/MA-2G/Lt Col Stace/bja/2100

HEADQUARTERS ARMY AIR FORCES
AC/AS-4
Inter-Desk Memorandum

TO: Office of Technical Information DATE: [illegible] 1945

SUBJECT: British Firing of V-2 in Operation "Backfire".

1. The Operation "Backfire" was established as a means of securing the maximum knowledge of the German V-2 through working with the German V-2 technical and operational personnel in actual assembly and firing operations. It was originally a SHAEF operation, but became entirely British. The project was sponsored by the War Office (Director of Royal Artillery), and was directed by Major General A. M. Cameron.

2. The operation started in March, near Cuxhaven, Germany, at a former German Ammunition Testing Center. The British gathered together approximately six hundred (600) Germans (including 2 technicians - Lt. Zimmerman of the Regiment in charge of the German operations had previously supervised 300 operational launchings,) five British Technicians from Ministry of Supply, 25 British Officers and approximately 2,000 British Troops. A construction program was required including assembly and test buildings, and a simple, but extensive, assembly installation resulted.

3. A great deal of difficulty was encountered in securing complete parts and in matching parts, and a lot of fabrication had to be done. A total of eight (8) were finally completed. After several failures to get the V-2 off the ground, the first was fired successfully on 4 October 1945, and landed within three miles of the aiming point in the North Sea, 150 miles away. SCR-584 radars along the shore and opposite the target area were used to plot the course. The second took off successfully, but only went 20 miles. The third and last was demonstrated before a large group of observers from England and the United States, plus several observers from the Russian and French Armies. The demonstration was successful and the V-2 landed 6.3 miles short and 2.5 miles right of the 150 mile aiming point. The integrating accelerometer was not used in these tests. No further firings were planned, and the remaining V-2's were to be taken to England.

4. Colonel J. H. Weber, (Rocket Development Division, Aberdeen), was the American Ordnance liaison officer with this project before and during the firings. Colonel Weber secured complete pictorial coverage, and drawings. He will also secure a copy of the first draft of the British report (ready approximately 15 November). Colonel Weber is also completing arrangements to bring to the United States approximately 20 of the German technicians to work with the Ordnance and German technicians already in this country for the Ordnance V-2 launching program. There was no resident AAF liaison with the project. The only RAF resident liaison officer was Wing Commander J. Newman.

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SUBJECT: British Firing of V-2 in Operation "Backfire".

5. Rumors were persistent at the [illegible], and it is the [illegible] that the Russians are conducting a V-2 launching program at Peenemunde and have already fired at least three.

6. The V-2 missile is [illegible] long, [illegible] diameter, [illegible] tons weight, including 1,600 pounds of amatol, [illegible] tons of liquid oxygen fuel, and [illegible] tons of alcohol fuel. The maximum range is a little over 200 miles. Maximum altitude is [illegible] miles, maximum velocity is [illegible],500 m.p.h., terminal velocity is 2,000 m.p.h. Thrust [illegible] tons for [illegible] seconds, and 25 tons for 70 seconds.

[illegible]
Lt. Colonel, Air Corps
Chief, Special Weapons Section.

[redacted]

ENCLOSURE "C"

REVISED DRAFT TO LETTER FROM CHAIRMAN, NACA, NOVEMBER 5, 1945
SUPERSEDING ENCLOSURE "B" OF OCTOBER 25, 1945

To: The Secretary of War
The Secretary of the Navy

From: The National Advisory Committee for Aeronautics

Subject: Overall Program of Military Research

1. The National Advisory Committee for Aeronautics, at its annual meeting on October 25, discussed the problem of coordinating aerodynamic research, in particular the effective and economical utilization of present wind-tunnel equipment located throughout the country, and the further supplementation of this equipment as the programs may require. It became evident that a unitary program, with appropriate allocation of responsibilities, is essential if a situation is to be avoided in which judgment as to the support of programs becomes exercised on insufficient understanding of the over-all situation.

2. With this in mind the Committee was inclined to initiate action to resolve the matter in special fields of its interest. However, it was evident that this would solve only part of a large problem and, moreover, that this part could be solved most readily if it were approached as one aspect of a general resolution of the entire problem. This same situation obtains in many other fields of research.

3. The Secretaries of War and Navy have already referred the larger problem to the National Academy of Sciences, with the request that the Research Board for National Security direct its attention to the formulating of integrated programs of scientific research and development relative to the longer-term problems of national security.

4. Accordingly, the National Advisory Committee for Aeronautics recommends that the Secretary of War and the Secretary of the Navy ask that the Research Board for National Security, in connection with formulating programs for research and development, give early attention to the particular problem of programs involving wind-tunnel equipment, particularly wind tunnels in the supersonic field, in order that relative responsibilities and priorities may soon become generally understood.

5. The NACA will be glad to lean upon this determination in accordance with the terms of the Secretaries' letter to the National Academy, namely, that the recommendations of the RBNS shall be given the greatest weight and shall be followed unless there are controlling reasons to the contrary.

C O P Y

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Ordnance
LM [illegible], GC/[illegible]
5D - 1/2

W604

[redacted]

JGE [illegible]
[illegible]

SPOTU [illegible] [illegible] 1945

MEMORANDUM FOR Chief, Strategy [illegible] Policy Group, OPD, WDGS

ATTENTION: Colonel H. T. Almeet

SUBJECT: ASF Guided Missiles Program [illegible]

1. In accordance with a verbal request [illegible] [illegible], the following information concerning Ordnance Department Guided Missiles is furnished:

a. Guided Missiles already developed [illegible] [illegible] [illegible] [illegible]: None.

b. Future program for guided missiles: [illegible] research is necessary before tactically [illegible] [illegible] type can be produced. Present knowledge [illegible] [illegible] speeds is extremely limited. Fuels [illegible] [illegible] to handle and, in some cases, dangerous. [illegible] standpoint of logistics, must be developed. [illegible] missiles will travel control systems are needed [illegible] automatically determine the position of [illegible] compute and transmit to the missile the commands [illegible] at the target. For extremely long ranges present electronic [illegible] control [illegible] incapable of performing these functions. [illegible] that entirely new inventions [illegible] [illegible] developed. For the above reasons it is impossible to give [illegible] guided missiles will be available in three [illegible]. [illegible] of the future trends of the various types of guided missiles under development by the Ordnance Department follow:

(1) Ground-to-ground missile - [illegible] miles with one ton warhead [illegible] in range and azimuth should be available for [illegible] within three years. Ranges of approximately 1000 miles [illegible] accuracy should be available within five years.

(2) Ship-to-shore missile - At present in theoretical study stage. Same possibilities in the future as the ground-to-ground missile.

(3) Ground-to-air missile - A missile for use against an aerial target travelling at a speed of [illegible] miles per hour [illegible] altitude of [illegible],000 feet and horizontal range [illegible],000 yards is now being developed. It is anticipated that this development will be completed by [illegible] 1948. Development of guided missiles for use against aerial targets (aircraft or guided missiles) travelling at supersonic speeds will probably take an additional three years.

[redacted]

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W-610

[redacted]

50-2/2

SUBJECT: A F Guided Missiles Program [illegible] November [illegible]

[illegible]. It [illegible] development [illegible] models only. It is [illegible] after the [illegible].

FOR THE CHIEF OF [illegible]:

[illegible]

[redacted]

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SPSGE-2 16 November 1945

61-1/5

Memorandum for file (413.44 Radio Controlled Missiles)

Subject: Meeting at Ballistics Research Laboratory on ORDCIT Projects

1. A conference was held at the Ballistics Research Laboratory, Aberdeen Proving Ground, 9 November 1945, to discuss work on the Ordcit program in connection with the Wac Corporal and Corporals E & F. Those Present included the following:

Col. B. S. Mesick	O.D. at C.I.T.
Col. J. G. Bain	O.C.O.
Col. Eddy	AAF at C.I.T.
Col. J. D. O'Connell	SCEL
Lt.Col. J. J. Slattery	OCSigO
Lt.Col. H. E. Zahl	SCEL
Capt. P. R. Goudy	SCEL
Capt. G. D. Bagley	SCEL
Capt. G. H. Drewry, Jr.	O.D. at C.I.T.
Lt. C. C. Martin	O.C.O.
Dr. M. Golay	SCEL
Dr. L. A. DelSasso	B.R.L./A.P.G.
Dr. T. H. Johnson	B.R.L./A.P.G.
Dr. R. H. Kent	B.R.L./A.P.G.
Dr. F. J. Malina	C.I.T.
Mr. M. M. Summerfield	C.I.T.
Mr. E. Hubble	B.R.L./A.P.G.
Mr. F. W. Lehan	C.I.T.
Mr. H. J. Stewart	C.I.T.
Mr. D. Huffleit	B.R.L./A.P.G.
Mr. H. G. Williamson	A.P.G.
Mr. C. Mattox	SCEL
Mr. E. J. Fister	SCEL
Mr. J. Goodin	SCEL
Mr. N. A. Abbott	OCSigO

2. Col. Mesick opened the meeting, stating the purpose was to get the various associated parties interested in this program together to review the program on the WAC Corporal at the White Sands Proving Ground and to propose plans for the future. Dr. Malina, head of the Ordcit work, reviewed the Wac Corporal project. He pointed out that work started thereon about ten months ago for the purpose of developing a missile which would carry 25 pounds of meteorological equipment vertically to an altitude of 100,000 feet. Ten missiles were originally constructed to be fired for the purpose of determining if the technique of firing was satisfactory. It was not originally planned by CIT that these missiles would carry any meteorological or other types of measuring or indicating equipment. However, about March or April of 1945 a removable nose was designed to allow the Signal Corps to obtain experience with their available meteorological equipment. Incidentally, the original Wac Corporals were designed by using as many available components as possible.

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The tests at the White Sands Proving Ground have indicated to the Ordcit personnel that the missile is mechanically in good shape but that the nose-expelling mechanism is unsatisfactory and the means which were available for obtaining data on the missile were not suitable.

a. Two missiles were saved from those available for the October firing at White Sands and sufficient parts are available to construct three more. These five missiles will be fired in the spring of 1946. It was indicated that a new, lighter, rocket motor may be available in time to be installed in these five missiles, in which case the missile may be expected to go to an even greater height than the estimated 200,000 feet obtained at White Sands. It was indicated that work on a new nose-expelling device and nose design for these five missiles need not be frozen until 1 January 1946.

b. In reviewing the October shooting it was pointed out that the booster rocket was the Tiny Tim. The first four rounds were fired using booster only; then two rounds were fired with dummy charges; two more rounds using quarter charge; and then six full-charge missiles were shot. On the full-charge missiles a few modifications were made. On the final two rounds a mechanical timer for expelling the nose was used instead of the gyro device previously used but it did not work. It is believed that it was crushed in the acceleration at firing. One missile filled with lamp black and designated "Black Wac" had the nose expelled immediately after the start of the flight, and in the last shot, which was fired at night, either the nose fuse did not work or the nose failed to come off. Present information does not indicate which happened.

c. It was pointed out that in those cases where an additional battery was added to the missile the gyro firing mechanism worked all right despite the initial acceleration of 40 to 50 G. (This action was taken in only two of the missiles.)

d. All but one missile was recovered. The unrecovered missile had its center of gravity further forward than any of the other missiles and the opinion was held that this caused the missile to come straight down nose first and bury itself in the ground. It is believed that the frame in the missile on which the parachute pull is brought is insufficiently strong, since in those missiles which indicated that the parachute had been expelled this frame had been pulled apart.

3. In connection with the radar tracking of the missile, Dr. DelSasso stated that it had been the opinion of the BRL personnel prior to the flights that the missile could be tracked to 120,000 feet. However, in view of the fact that the missiles travelled straight up they exhibited a poor aspect for the radar. Further, since it was not known how the missile would fall, it was not practicable to assure the most favorable tracking positions. On some rounds the radar could not get on at all; in others it tracked part of the way, but on the last round good data was obtained. The phototheodolites were found suitable for a range of 8 to 10 miles. On the last missile tracked the radar carried to 45,000 yards, but generally the maximum was approximately 30,000 yards. Based on radar data the velocity was found to be approximately 3,000 feet/second at an altitude of 80,000 feet. Calculations based on these figures gave a maximum ordinate for the missile of approximately 230,000 feet. Theoretical calculations at CIT have given an estimated maximum altitude of 190,000 feet.

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a. The three radar sets SCR-584 used for the tracking were spaced at 120 angles from the launcher and initially about 5,000 yards away. Later, however, one set was moved in to a distance of only 1,200 yards from the launcher.

b. The average burning time of the missile was 45 seconds and the maximum velocity at the end of burning was approximately 3,100 feet/second occurring at an altitude of 80,000 feet. No modulation effects from the flame were noted in the radar sets.

4. Of the two missiles where the meteorological equipment was carried and expelled not SCR-658 data was obtained from the first missile. From the second missile erratic data appeared to be obtained as from a rapidly falling radiosonde. The operators were unable to obtain an accurate record of any kind and the radiosonde itself was never recovered.

5. It is proposed that the two remaining Wac Corporal missiles plus the three additional to be constructed from available parts will be fired in the spring or summer of 1946, probably in conjunction with Corporal E. In response to an inquiry by Dr. Malina as to whether or not the missiles were going too high, Dr. DelSasso indicated that with the beacon in the missiles the added hieght is of no importance in tracking, and Col. O'Connell indicated that no limitation in height is desired in view of the possibility of obtaining informative data on meteorological conditions. Col. O'Connell further indicated that the Signal Corps is intensely interested in the present program and is desirous of taking a greater part therein.

a. SCEL is making five beacons for use with Wac Corporal missiles, is modifying 15 AN/APW-1 equipments for use with the Corporal E, and is modifying one SCR-584 to track the beacons to be used with the WAC. The beacons will weigh about ten to eleven pounds including power supply and antenna. Antenna designs for both nose and fin mounting are being investigated.

6. Dr. Malina initiated a proposal to the effect that since there will be but five Wac Corporals available in the spring, with an additional five to be available at a future date, it might be desirable to eliminate any additional equipment from the missile and fire for trajectory only. If these five missiles were fired successfully then the meteorological equipment could be installed in the second five missiles which however would not be available for an additional one year period. Dr. DelSasso expressed the opinion that at least some of the missiles should be fired for trajectory only and suggested that the first two missiles be so fired. If these firings are successful then the next three missiles might be fired for a combination of trajectory and expulsion of meteorological equipment.

a. Capt. Goudy inquired as to the possibility of reducing the initial acceleration in order to prevent possible crushing of the meteorological equipment. Although tests have been conducted on the met equipments to accelerations of 150 G, this acceleration has been built up gradually whereas the 40 or 50 G obtained by the missile is almost instantaneous. The ORDCIT

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personnel pointed out that at a future date a liquid fuel launcher may by developed but at present it will not be practicable to use gradually increasing accelerations.

b. Captain Goudy pointed out that meteorological equipment must be designed to eliminate lag as the instruments rapidly descent in the rarified atmosphere. Furthermore, no equipment has yet been designed which is suitable for upper atmosphere studies. He suggested that the Signal Corps might want to design their own nose for the missile to carry the meteorological equipment. Such a procedure was agreeable to the Ordcit personnel provided the nose met certain minimum requirements to permit mounting on the missile.

c. In view of the unsatisfactory functioning of the fuse for blowing off the nose of the missile Ordcit is designing a time-firing mechanism rather than gyro. At the same time BRL is initiating work to design or obtain a new fuse for positive firing at the end of a predetermined period.

7. The question regarding the necessity or desirability of using a parachute with the Wad was raised. However, it was stated that a parachute was definitely required in view of the indeterminate nature of the region where the missile was to be used.

Example of Training Types Not interrupting development

a. Dr. Meline suggested that consideration might be given to having a firm fabricate a number of missiles for the Signal Corps without requiring any assistance from CIT. It was stated that drawings and procurement information are available for all necessary construction work and the Signal Corps would then be able to conduct as many experiments as desired with a "standard" missile. The launcher at White Sands Proving Ground could be made available to the Signal Corps for this purpose. It was estimated that the initial cost for such missiles would be about $5,000 each, diminishing as experience and quantity increase.

8. The Corporal E which will weigh between 10,000 and 12,000 pounds will have an automatic pilot with ground operated overriding control. It will be launched vertically, lake a V2, and has a range estimated at 60 to 80 miles. It is to be 30 inches in diameter and 40 feet long. It has four fins, aerodynamic control surfaces, and jet vanes. The rocket motor has a thrust of 30,000 pounds. The thrust at take-off is 1 G with about 3 G maximum and will probably operate at a Mach number of 2.5. It is not intended to guide this missile to impact but merely to guide it onto a predetermined (or program)course. It was stated that the Signal Corps is working on a long-range 27 cm set for tracking the corporal missiles.

9. Col. Mesick suggested to the Signal Corps representatives the desirability of having personnel stationed at White Sands Proving Ground for research on radar in connection with guided missiles. Col. O'Connell agreed that this was definitely a desirable proposal and the Signal Corps would cooperate to the fullest possible extent. It was pointed out that the SCEL is proposing to establish a laboratory for the study of reflections from miniature missiles as presently done at Ohio State University. This is a long-range program.

[redacted]

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a. The Signal Corps Laboratories are investigating the modifications of some standard radar sets for the purpose of tracking forthcoming flights of missiles in the event that the beacons therein faill to function.

b. Mr. Mattox suggested that the SCEL might construct a completely integrated SCR-584-Beacon-Plotting Board assembly for use in the spring firings of the Wac Corporal. Dr. DelSasso agreed that this would be desirable but indicated that careful discussions between BRL and SCEL would be required in view of the fact that the equipment which is modified for tracking the beacon will be the most important equipment present and will be the one required for plotting and controlling. SCEL will make a proposal on this matter to BRL within the next few weeks.

10. A new launching site is to be constructed for firing Corporal E and F missiles. BRL is to provide data for the construction of the radar control house to be used in connection with these missiles. BRL is to coordinate with SCEL on this matter. The corporal missiles are to be equipped for telemetering, and recording apparatus will be on the ground.

a. All personnel were notified that Col. Turner, the Commanding Officer at White Sands Proving Ground, will require information relative to all communication equipment 90 days ~~afk~~ before firings. He is going to have available about ten SCR-299 type radio sets in addition to wire lines between the firing point and the landing area. Radar equipment is included in this requirement.

11. For the Corporal E and F firings the CIT has taken responsibility for telemetering and autogryo requirements; the Signal Corps is to be responsible for beacons; and the BRL is in conjunction with SCEL to handle the radar control link.

12. In the long-range program now being initiated, the CIT intends to divorce itself from any production and apply itself solely to basic research. Application of the results of the research will be performed by such firms as General Electric Company, Bell Telephone Laboratories, and Radio Corporation of America.

E. A. ABBOTT
Radio Engineer
Radar & Countermeasures Branch

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Summary on Navy G.M. Program
AAF/MBA 45/14-4
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HEADQUARTERS, ARMY AIR FORCES
AC/AS-4
Inter-Desk Memorandum

AFTRA-3/FMB:a/4908

To: General Crawford

Date: 28 November 1945

Subject: Joint Agreement Between Navy Bureau of Aeronautics and Bureau of Ordnance on Guided Missiles Development.

1. For your information the following agreement between Bureau of Aeronautics and Bureau of Ordnance on Guided Missiles Development is quoted from BuOrd Memorandum for the Chairman of the Guided Missiles Committee dated 17 November 1945:

"10. ...(a) Responsibility for guided missiles shall rest with the Bureau of Ordnance, while responsibility for pilotless aircraft shall rest with the Bureau of Aeronautics.

(b) Classification of these devices, where any element of uncertainty exists, shall be resolved by the Chiefs of the two Bureaus.

(c) Where a certain component of one of these devices may more advantageously be developed by the Bureau not having responsibility for the entire device, responsibility for development of that component shall be assigned by agreement between the Chiefs of the two Bureaus.

"11. The Chiefs of the two Bureaus by that agreement have indicated a very cooperative spirit and to implement the above agreement have reconsidered the various current projects and assigned responsibility as outlined below:" (For a short description of each missile see Appendix A.)

"Guided Missiles - BuOrd Responsibility
- Bee Family
- MIT AA Missile
- Kingfisher
- Dove

"Guided Missiles - BuAer Responsibility
- Gargoyle
- Gorgon
- Bumbat
- Lark
- Loon
- Bat

"Completed or Inactive
- Pelican (BuOrd)
- Glomb (BuAer)
- Gorgon IIIc (BuAer)
- Little Joe (BuAer)

"Future projects will be the subject of future joint agreements."

V. A. STACE
Lt. Col., Air Corps
Actg Chief, Guided Missiles Br

1 Incl: Appendix "A"

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APPENDIX "A"

Bee Family	Payload (lbs)	Range (miles)	Use	Weight incl launch, boost (lbs)	Time Scale
SIZE 1					
Pre Bee	300 frag	15	Test AA	2,000	1946
Fight Bee	"	50	AA	2,800	1948
Esso Bee	"	50	Anti-missile	2,800	Very difficult
SIZE 2					
Can Bee 1	2,000 frag	50-150	B	7,000	1948
Will Bee 1	"	"	A/S	"	1949
Could Bee 1	"	300-500	B	3,500	?
Will Bee 2	Atomic	150	A/S	"	?
Esso Bee 2	"	50	A/M	"	?
Special Sizes					
Could Bee 2	Atomic	300-500	B	12,000	?
Glory Bee 1	"	1,000	"	25,000	?
Glory Bee 2	"	2,500	"	80,000	?
Glory Bee 3	"	4,000	"	?	?

Bumblebee - Shipboard ramp and booster used to launch into target tracking radar beam. Automatically confined to beam and ram jet propelled to aircraft target.

HIT AA Missile - No definite missile yet developed.

Kingfisher - Glide torpedo launched from parent aircraft and homing on signals from missile borne radar. Torpedo disengages from glider to enter water short distance from target.

Dove - Modified standard bomb dropped in high level or dive bombing on target having heat contrast with background. Heat sensitive detector guides Dove by manipulating spoilers.

Gargoyle - Launched from parent aircraft at 200 mph and powered to target by JATO unit. Guiding by radio control using visual observation by flare.

Gorgon - Ship launched from level catapult and propelled to area target by intermittent jet motor. Guided by radio control using ship's radar to track missile and target.

Buzzbat - The B-T's are propelled glide bombs similar to the BAT's. They are to be surface or ship launched, with ranges of 25 to 100 miles. Missile borne radar used to intelligence.

Lark - Ship launched into radar beam using catapult and booster, propelled to A/C target by liquid fuel rocket. Radio control keeps Lark in beam; predicted radar homing near end of course.

Loon - Launched from ramp or catapult on LST or CVE and propelled to target by intermittent jet motor. Guided by combination radio and preset control. Missile is a copy of German V-1.

[redacted]

[redacted]

__Bat__ - Glide bomb released from parent aircraft near ship or land target. Bat radar intelligence is locked on target before launching missile homes on its own reflected signals.

__Pelican__ - Glide bomb released from parent aircraft near target. Missile homes on radar signals reflected from target which is illuminated by transmitter in parent aircraft.

__Glomb__ - Conventional glider towed to target area with auto-tow device. When released, Glomb guided to target by radio control using television information transmitted by missile.

__Gorgon IIIc__ - No information available.

__Little Joe__ - Launched from modified 40 mm gun mount, propelled to A/C target by solid fuel rocket and booster. Guided by keeping missile in visual line of sight to target using radio control.

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HqATSC Form No. 16-514 Rev. 1 May 45

SAVE

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HEADQUARTERS
ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND

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TSESA-7/JL/mtc

WRIGHT FIELD, DAYTON, OHIO

6 December 1945

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL:
TSENG (TSESA-7)

SUBJECT: AAF Pilotless Aircraft Program

[redacted]
AUTH: C G ATSC
INITIALS SEP
DATE 6 Dec 1945

TO: Major General Leslie R. Groves,
Corps of Engineers,
Room 5120, NWD Building,
Washington 25, D. C.

Thru: Commanding General, Army Air Forces, Washington, D. C. Attention: AC/AS-4, Production Division.

1. The Army Air Forces has established a program to develop all types of Pilotless Aircraft, both offensive and defensive, for use as guided missiles. All offensive pilotless aircraft under consideration are being designed allowing sufficient space and weight for a 2000# warhead.

2. From statements made by some of the prominent figures who were connected with the development of the atomic bomb, it appears that within five years those foreign nations that are actively pursuing a similar development are likely to develop an atomic bomb at least comparable to that presently in the possession of this country. The nations with access to information on German guided missiles most probably will have progressed in this field as rapidly as we will have and will be quick to incorporate the atomic warhead once they have it developed. 75

3. Unless steps are taken at once to initiate a development program for the adaptation of atomic warheads to pilotless aircraft, particularly ground-to-ground type, there is a possibility that our present lead will be sacrificed. In order to adapt our development of pilotless aircraft to carry an atomic warhead, the Air Technical Service Command will require the following information:

a. Minimum space requirements, including probable dimensions.

b. Minimum weight and weight distribution.

c. Auxiliary equipment required for operation in a missile.

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d. Limiting operation conditions such as maximum and minimum temperatures, pressures, accelerations, anti-vibration requirements, etc.

e. Method of fusing and details of automatic operation necessary (if required).

f. Destructive radius against ground and air targets.

g. Anticipated improvements with an estimate of the increase in destructive radius, and reduction in space and weight requirements over the present atomic bomb.

h. Any known or possible countermeasures against which the vehicle should be designed.

4. The Air Technical Service Command desires to initiate a program for the development of a ground-to-ground pilotless aircraft carrying an atomic warhead. It is assumed that such a warhead should meet general requirements of the Navy, and the Army Ordnance Department as well as the Army Air Forces, and that it could be standardized to suit all present needs. As can be seen from paragraph 3 above, complete details of the atomic bomb will not be necessary. If the data listed above cannot be given at the present time, such additional information is requested as may guide the Army Air Forces in its program so that an atomic warhead can be adapted to the future pilotless aircraft.

FOR THE COMMANDING GENERAL:

L C Craigie

Copy to:
AC/AS-4, Production Division,
Washington, D. C. 2 5

ENGINEERING DIV

[redacted]

W-63350

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Subject: AAF Pilotless Aircraft Program.

1st Ind AFDRE-3

Hq AAF, Washington 25, D. C., 26 December 1945.

To: Commanding General, AAF - Air Technical Service Command, Wright Field, Dayton, Ohio. Attention: TSESA-7.

1. The development of atomic power will govern many aspects of the guided missiles program. Arrangements are being made to facilitate and exchange of information between the two projects.

2. As an interim measure, the questions outlined in the basic letter have been forwarded to the "Officer in Charge of the Atomic Bomb" through the appropriate channels.

3. The Engineering Division will be kept informed of all aspects of the Atomic Bomb Project likely to apply to guided missiles.

4. It is understood that General LeMay's Office contacted General [illegible] by telephone 19 December 1945, and requested that ATSC furnish names of technicians they desired to be cleared for essential information from the Atomic Project. It is believed highly desirable that the Pilotless Aircraft [illegible] be represented in this group as this information is of vital interest to that particular branch.

BY COMMAND OF GENERAL ARNOLD:

[illegible signature]

for ALDEN R. CRAWFORD [illegible]
Brig. General, U. S. A.
Chief, Research & Engineering Division
Office, AC/AS-4

[illegible] 18 Jan 46

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HEADQUARTERS USAF

ROUTING SLIP

TO:

1. OFFICE | DATE

ATTENTION Col Cooper

2. OFFICE 5D 975 | DATE

ATTENTION

3. OFFICE | DATE

ATTENTION

FOR: FOLLOWING ACTION(S) AS CHECKED

	COORDINATION		NOTE AND RETURN		INFORMATION
	NECESSARY ACTION		RECOMMENDATION		FILE
	SEE OR PHONE ME		APPROVAL		SIGNATURE

COMMENT

See my footnote - such theory as hesitated take off for aircraft must be our responsibility in this period design.

[illegible]

FROM:

OFFICE | ROOM NO.

INDIVIDUAL | PHONE

[illegible] AF [illegible]

1400

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ROUTING SLIP

TO:

1. OFFICE	~~Chief, Research & Engineering Division~~	11 Dec 45
ATTENTION		
2. OFFICE		DATE
ATTENTION	Gen. Crawford	
3. OFFICE	4E-1072	
ATTENTION		

FOR... FOLLOWING ACTION(S) AS CHECKED

	COORDINATION		NOTE AND RETURN		INFORMATION
	NECESSARY ACTION		RECOMMENDATION		FILE
	SEE OR PHONE ME		APPROVAL		SIGNATURE

COMMENT

Please return inclosures to this Office since they are the only ones for our files. Thank you.

Concur except that I dont think we will get far on his 10 C. recommendation

Should we change horses? why not let ASF continue the current work for us but not give them further projects?

FROM:

OFFICE: AFDMA-3	ROOM NO.: 5D 883
INDIVIDUAL: Colonel Stace	PHONE: 2100

1401

[redacted] [redacted]

AFDMA-3/Lt Col Stace/cr/2100

HEADQUARTERS, ARMY AIR FORCES
AC/AS-4
Inter-Desk Memorandum

To: Chief, Research and Engineering Division Date: 11 December 1945

Subject: Assignment of Guided Missiles Launching System and Warhead Development to Army Service Forces.

1. During the development of the JB-2 Jet Bomb, a number of questions came up concerning the correct Army development and manufacturing jurisdiction over various components.

2. Brig. General Phillips, then Chief of the Materiel Division (now Research and Engineering Division) decided that we should adhere rigidly to paragraph three of the memorandum of 2 October 1944, from the Chief of Staff, subject "Guided Missiles", (Tab A). Brig. General Phillips stated that he believed it would be to our advantage to stay "close to the line" until the AAF became separated from the Army. He believed that at that time we would be taking over the functions anyway that he then recommended relegating to the Army Service Forces.

3. Brig. General Phillips interpreted the phrase "should be called upon for assistance" to mean that the developing service should actually assign development responsibility and action to any other service having a "basic technical ability in research".

4. This interpretation resulted in a meeting called by Brig. General Phillips with the Air Ordnance Officer, the Air Chemical Officer and the Air Engineer on Non-Integral Launching Facilities. At this meeting, General Phillips explained his views regarding such non-integral launching facilities. These views are confirmed in the attached unsigned letter to ATSC, prepared on 16 April 1945, (Tab B). These views were concurred in by the Service Advisors. (Note: General Phillips had previously been given expressions of noncurrence in assigning the launching functions outside the AAF by Colonel Dent, Lt. Colonel Richardson, Lt. Colonel Gasser, Lt. Colonel Stace, and Major Powers, NDRC Office.) Major General Echols refused to sign the paper, however, and Major General Powers also refused to sign.

5. An expression of these views, however, was forwarded to the Army Service Forces. Tab C includes the original memorandum of 11 April 1945, from the Air Engineers to the Army Service Forces, their 1st Indorsement reply of 26 April 1945, our 2d Indorsement of 4 June 1945, the objection by this Office of 28 May 1945, to the policy approved by Brig. General Phillips, and the final ASF 3rd Indorsement of 8 June 1945.

6. The basic policy had also been forwarded to ATSC by an "interpretation" given to ATSC on 5 February 1945, (Tab D), and although they replied in substantial agreement by 1st Indorsement on 26 March 1945, (Also Tab D) they had objected verbally on practically every item of assignment to the Army Service Forces, stating that such assignment would only result in confusion and delay. As a result, the ATSC assigned all non-integral assisted take off, propulsion devices (for piloted or pilotless aircraft) with solid fuels to Ordnance (including the Monsanto project

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the Multiple-cartridge project), with liquid fuels to Chemical Warfare (the [illegible] project) and the actual ramp construction to the Engineers.

7. It is now completely apparent that Ordnance will be the sole basic development agency for guided missiles and guided missiles components in the Army Service Forces, and that the ASF have put their blessing on the Ordnance interpretation of paragraph three of the 2 October 1944, directive that the term "should be called upon for assistance" means technical guidance rather than the physical assignment of a development project. This has resulted in the following:

a. Assignment to Ordnance of normal Signal Corps electronic development responsibilities of guided missiles are involved. (Description in Tab E.)

b. Assignment to Ordnance of all jet propulsion responsibilities in the ASF (liquid and solid fuels) and in particular devices for assisted take-off of missiles and aircraft (Tab F).

c. Assignment to Ordnance of full responsibility within ASF for all research and development in launching systems - including a directive to develop launching systems to meet AAF requirements (Tab G).

8. This change in assignment within the ASF of development for the AAF was not coordinated with this Office.

9. It is increasingly evident that each component in a guided missile is far more dependent on each other component for its necessary characteristics than in piloted aircraft. It is the belief of this Office that it will be impossible to carry on a truly efficient guided missile development program unless the development of each missile is carried on as a completely integral project, and that component development (including warheads and fuzes) should not be delegated to the Army Service Forces unless the AAF is obviously incapable of doing an adequate job. Both the Ordnance and the Navy programs are being carried out on this integrated basis. It is outstandingly evident that the Ordnance is not coming to the AAF for development of such AAF specialties as airframes, stabilization systems, automatic pilots, navigation systems, remote control systems, etc.

10. It is recommended, therefore, that the following steps be taken:

a. That the Army Air Forces' interpretation of paragraph 3 of the 2 October 1944, directive be changed to the following:

> "The Army Air Forces will call upon any service having a basic technical ability for assistance in the development of guided missiles components. The Air Technical Service Command is charged with the responsibility of determining the extent of such assistance necessary to most efficiently promote the over-all missile development project. Procurement of guided missiles and guided missiles components will normally be made by the developing agency, unless other action is evidently more efficient."

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b. That this interpretation be carefully explained to the ATSC with particular reference to assisted take-off rockets, launching equipment of all types, warheads and fuzes.

c. That the final steps of Brig. General Phillips' program be taken now to transfer to the Army Air Forces the Army Service Forces' funds, projects, personnel, and facilities primarily concerned with development for the AAF guided missiles program. This will involve a similar procedure to that used in the late transfer from the Signal Corps to the Army Air Forces of development and procurement responsibility for equipment peculiar to the AAF.

d. That the Army Service Forces be informed of the future policy and told that in the event of required ASF development, AAF funds will be allocated to them.

11. If the establishment of the AAF as a force separate but parallel to the Army appears imminent, these recommended steps could be taken as part of the over-all change.

[illegible]

V. A. STACE
Lt. Colonel, Air Corps
Acting Chief, Guided Missiles Br

7 Incls:
Tabs A thru G

AFDMA-2 [illegible] Col Cooper
AFDMA-2B ________

Proceed along the lines we agreed upon in verbal discussion, giving to the "know-how" services for advice, assistance and development of an item they are not qualified to perform. Keep in mind however that the final accessory device must often be integrated with the whole and that in such cases where the AAF is responsible for the complete other item, that the accessory item must often be engineered for final design by the AAF, within such appropriate limitations as to safety etc., determined by the service of [illegible] technical agency. It is believed this does not violate any previous policy. Take up any controversial case with [illegible] then me. [illegible]

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... CONTINENTAL AIR FORCES
... FIELD
Camp Springs, Maryland

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[illegible] CG, [illegible], subject "Guided Missile Development and [illegible]."

[illegible] That, from time to time, training quantities [illegible] features current with development progress be [illegible] for training of the air forces. In the opinion [illegible], training in the technique of the use of [illegible] missiles must keep abreast with the development of the weapon, if the mission of the command is to succeed [illegible].

[illegible] COMMANDING GENERAL:

ST. CLAIR STREETT
Major General, USA
Deputy Commander

COPY

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WASHINGTON 25, D. C.

PHEubank/jw
RD - Ext. 3731

DREIC

4 JAN 19

471.94(C)( ) GNDEV-9/46860

SUBJECT: Defense Against V-2 (German A-4) and Similar Guided Missiles.

TO: Commanding General
Army Service Forces
Washington 25, D. C.
ATTENTION: Research and Development Division

1. Providing a defense against major caliber very high altitude, long range rockets of the V-2 (German A-4) type poses an extremely difficult problem. The importance of arriving at the most effective solution is apparent when consideration is given to the known fact that the Germans were making excellent progress on projects to increase greatly the range of the V-2. In the hands of an enemy, this, or a similar weapon, equipped with an atomic warhead would constitute a grave threat to the security of this nation.

2. To date, the only defense actually employed against the V-2 type of missile has been the bombing of launching sites and supply installations. The results obtained were negligible, and with increased ranges for such missiles this attempt at defense would become more difficult to execute and possibly of even less value.

3. Proposals have been made both here and in Great Britain for the employment of large concentrations of conventional AA guns as a defense against missiles of the V-2 type. Actual firing tests have not been conducted, and the effectiveness of this type of defense is very dubious.

4. This headquarters, by previous action, has requested the development of:

a. Equipment capable of assuming control of, or otherwise neutralizing enemy guided missiles.

b. Equipment capable of remotely detonating enemy guided missiles or bombs.

c. Equipment consisting of a suitable guided missile, early warning radar, fire direction and remote control material, capable of intercepting and destroying supersonic speed, very high altitude, long range, enemy guided missiles.

5. There is not unanimity of thought as to the method of defense

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S COPY FOR THE COMMANDING GENERAL, ARMY AIR FORCES. (ATTN: AC of AS, M & S).

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471.94(C)(6 - JAN 1942)GNDEV-9/46860 Continued

that offers the most promise of an effective solution to the problem. This lack of unanimity of thought is testified to by the divergence in means already employed or proposed as defensive measures. Recently an eminent scientist, Dr. W. A. McNair, of Bell Telephone Laboratories, stated in substance that since no overall, conclusive study had been made he would not presently support any single system or means, or combination thereof, as the best method of defense, and further that the best solution might well have not yet been proposed or discussed.

6. Basic development is proceeding on guided missiles, and thought, at least, is being given to other proposals for defensive measures. It appears timely and important, before developmental work proceeds much further, for all aspects of the problem of countering enemy guided missiles to be studied with a view to evaluating the equipment or combination of equipments either previously employed or proposed, or not heretofore employed or proposed, and to determining, as far as practicable, which one method or combinations thereof will probably be the most effective in accomplishing the mission stated.

7. The conduct of such a study should be in the hands of pre-eminently qualified personnel; and it may involve utilizing the services of other War Department agencies, the Navy Department, and civilian scientists. This headquarters will lend all possible assistance in the pursuit of this study.

8. It is requested that:

a. A study along the lines outlined above be initiated as a high priority project.

b. This headquarters be informed of the action taken and be kept advised as to progress.

FOR THE COMMANDING GENERAL:

[illegible]
[illegible], A.G.D.
[illegible] Adj. Gen.

COPIES FURNISHED: President, AGF Bd. # 1
Fort Bragg, N. C.

CG, Army Air Forces
(ACofAS, W & S)

CG, Army Air Forces
(Special Ass't for AA)

New Developments Division
(WDSS)

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HEADQUARTERS ARMY AIR FORCES

ROUTING AND RECORD SHEET

TALLY NO.	
FILE NO.	file

German activities in the Field of Guided Missiles

DATE 4 Jan 1946

[illegible], Requirements Division (Materiel Branch)

COMMENT NO. 1

AC/AS-3, Requirements Division (Policy & Tactical Employment Branch)

Col Cook/vml/72425

1. The attached account of German Guided Missiles has been extracted from the weekly compilation of Research Notes, 21 December 1945, MID.

2. This report is circulated for your information and consideration and because it is believed that it represents about the best concise readable report on German developments that has come through this office to date.

3. Special attention is invited to the provisions for anti-aircraft defense, [illegible], and the projected plans for long range guided missile development.

F. T. CULLEN
Colonel, Air Corps

1 Incl
Report

[illegible]
Colonel, [illegible]

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3-1109 A.F.

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[illegible] ACT[illegible]

1. [illegible] <u>[illegible] Activities in the Field of Guided Missiles</u>

a. The following article, extracted in toto, is the introduction to [illegible] Report [illegible] Technical Mission in Europe, dealing with German activities in the field of Guided Missiles.

b. Although the Germans recognized the potentialities of remotely controlled missiles during World War I and accepted them without equivocation as a military weapon over ten years ago, the science did not assume its [illegible] degree of [illegible] importance to them until the latter stages of the recent conflict. [illegible] the necessity of stopping the Allied bombers [illegible], it was realized that the answer lay in guided missiles.

c. Germany, however, [illegible] the remainder of other countries, had not [illegible] to lay the groundwork of fundamental research for [illegible] pro[illegible] a complete series of potentially satisfactory antiaircraft controlled missiles. However, the [illegible] did not manifest itself as usable "flak" [illegible] construction and experimental testing were neglected until [illegible]. It is obvious now that the foregoing resulted from underestimation of the damage the Allied air forces could inflict, from a misconstrued confidence in their standard [illegible] weapons which were even then obsolete, and [illegible] confidence in the damage, both physical and psychological, which their V-weapons were effecting.

d. It is interesting to note that it was the ground-to-ground self [illegible] missile, [illegible] the V-weapon, which was selected to receive the lion's share of the energy devoted to testing and developing of guided missiles. Even in minds trained to the utility of conventional weapons, the obvious strategical employment of this type could not be overlooked. However, in selecting what at that time must have appeared to them a fantastic innovation, they did not recognize the implications pointing to related weapons which were to become vitally important.

e. It must be borne in mind that the magnitude of the Germans' basic research program was tremendous and that it was equally thorough for all types of controlled missiles. Once they realized the defensive potentialities of various types of this new weapon, a program was inaugurated, which if given six more months uninterrupted time, might well have resulted in the achievement of what had become a basic policy: <u>to drive bombers from the sky at altitudes below fifty thousand feet</u>.

f. In justification of the above, the picture of the history and magnitude of German effort in this field is included. The idea of increasing the accuracy of a weapon by controlling it to its target was conceived during the First World War. This thought manifested itself in the form of an aerial bomb guided in range and azimuth by signals transmitted down a wire which unreeled as the missile fell. Projects related to the above lay dormant until World War II, when the modern controlled missile program made its

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appearance in the form of the FX high angle bomb and the Hs glide bomb series in the Mediterranean. However, the intervening time was not wasted, as it was during this period between wars that the experimental rocket groups were most active. One faction of these groups later formed the nucleus of the Peenemunde personnel.

g. The FX and Hs missiles were predicated on the assumption that the Luftwaffe would maintain air supremacy and while this condition existed they were used to good advantage. Contrary to popular idea, that the Allies succeeded in effectively jamming the radio control used in these missiles consequently arresting their use, the contributing evidence from enemy [illegible] and developmental personnel is definitely negative. It appears that a routine strike against an airport by Allied airmen had the good fortune of unknowingly destroying all enemy aircraft modified to carry the missiles, and that by the time new planes could be made available, the [illegible] had effectively put the Luftwaffe out of operation. Our radio jamming activities are said to have been effective on one channel of the frequency. The effort did not put an end to the use of Strassburg-Kiel radio control unit, but it did succeed in stimulating the enemy's thought and subsequent development activities relative to new control systems. Their first reaction was the return to the wire control method of transmitting intelligence. This was closely followed by programs designed to cover all eventualities.

h. With the increase in Allied air power, Axis interest began to focus on the development of controlled antiaircraft missiles. This interest grew rapidly and a highly competitive development program for AA missiles expanded with the steady increase of Allied aerial might until at one time in 1943 there were under development in Germany 48 different antiaircraft missiles. To counteract the increasing abuse Allied air power was delivering to German industry, it was necessary to streamline the program to insure greater emphasis and efficiency. Therefore, the 48 different antiaircraft development projects were surveyed and after an analysis as to completion of development and effectiveness of the missiles, all but 12 of the 48 were discontinued. The remaining 12 were to be carried through to full develop- for operational use.

i. During the period of growth of the Allied air power, the hereto- fore visualized need of long range remote controlled or self-controlled [illegible] for area bombing became an actual necessity. Resulting from the successive defeats, the Luftwaffe was suffering, it became less and less advisable to send bombing squadrons against the enemy; therefore, increased effort was placed on the development of supersonic missiles which were visualized as early as 1936 as potential weapons. These were hastily and prematurely thrown into the frey. In addition to the development of long range super- sonic weapons, there was simultaneously carried out through development to operational use, the V-1 weapon or "buzz-bomb". The V-1 was the first long range missile operationally used as a self-contained, non-piloted guided or controlled weapon. It is estimated that over 20,000 of these were used against the Allies.

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[illegible] being incorporated into the [illegible] built [illegible] at speeds both [illegible]

[illegible] missiles was being carried out [illegible] territory, from the border of [illegible] France to the Russian zone of [illegible] work was being done in Denmark. [illegible] that [illegible] of the total German effort [illegible] occupied territory, to which [illegible] results of the enemy's guided missile [illegible] and Holland.

[illegible] of the energy directed to [illegible] problems of guided missiles [illegible] Darmstadt, [illegible] establishments have [illegible] dreamed of in America. There exists [illegible] number of 4, i.e., four times [illegible] number of 10 was under construc- [illegible] was being carried out in all [illegible]

[illegible] a few isolated items relating [illegible] the German product was inferior to [illegible]. However, this is subject to being mis- [illegible] or exonerate our failures by so- [illegible] the field in a few weeks, returned to [illegible] to find the Germans have nothing [illegible] of the individual's refusal [illegible] innocent [illegible] should [illegible] ulterior motives.

[illegible] of the enemy's work, it is concluded that:

[illegible] short period of time, Germany would [illegible] bringing into the war an effective [illegible] bombers. She would have [illegible] superior assault weapons through [illegible] of the science of guided missiles;

[illegible] future warfare, the work of the [illegible] groups without question ranked [illegible] being done in Germany on any [illegible] results of this organiza- [illegible] covered by investigators, [illegible] groups' ultimate goal remains an [illegible] trend of their developments. Un- [illegible] to produce weapons from the A [illegible] would accurately hit any area on [illegible] earth. It is equally obvious that with [illegible] were not only working out in advance the [illegible] control problems of such weapons, but that

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in the present weapon they had a proven vehicle ready to receive whatever radically new explosive and propulsive substances they expected to become available. It is inconceivable that the V-2 was considered by the German scientists to be an end in itself, nor that, with all its complexities, it was developed at the cost of billions of dollars and manufactured in great quantity with highest priority merely to deposit 750 kilograms of ordinary explosive on British territory.

With the penetration to a practical degree of the impenetrable screen that has surrounded the investigation of German atomic disintegration research, some of the different [illegible] of their guided missile program may now be subject to an analysis from which reasonable answers can be derived. It is now obvious that the Germans realized and have accepted for years the fact that a guided missile is the natural vehicle with which to transport atomic explosive. At least, the reasoning behind the design specifications which provided for very small warheads and the inexplicable orders to terminate missile projects upon completion of development are no longer mysteries or absurdities.

(3) There existed in Germany no guided missile project which would warrant straight duplication with the expectation of using it as a practical weapon by the Allies. However, the knowledge to be gained from intensive study of their progress is infinite. Therefore, serious consideration should be given to the practicability of producing a limited number of representative German types to be used in a development and operational educational program conceived to bring the Allies abreast of the field.

(4) If in any country the development of the weapons with which to fight a future war is, as it has been in the past, dependent only on the impetus of the war for support, that country when attacked will not survive the first operation."

(Technical Report #237-45. "Survey of German Activities in the Field of Guided Missiles". U. S. Naval Technical Mission in Europe, August 1945--CONFIDENTIAL).

Comment: This article presents a clearer picture of German activities in the Guided Missiles field than any other which has yet appeared.

In addition to reviewing briefly but most accurately the progress made by the Germans, it also portrays very concisely the situation which almost

[redacted]

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certainly would have arisen if the Allied bombing program had not been successful and if the development of German guided missiles had been allowed to continue unhindered.

It is unfortunate that the classification of this report restricts the dissemination of the information which should certainly be extended to all Army personnel, the majority of whom are still oblivious to what might have and very nearly did happen in this field of warfare. Such further dissemination might also have the effect of stimulating a general interest in this class of weapon and of convincing the public that [illegible] in the interests of National Defense and is not, as so [illegible], a wasteful disposal of the taxpayers money by a [illegible] longhaired scientists. ([illegible])

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HEADQUARTERS ARMY GROUND FORCES
WASHINGTON 25, D.C.

9 January 1946

471.94(S)

SUBJECT: Evaluation of Radars for Use in Guided Missiles Countermeasures.

TO: President
Army Ground Forces Board No. 1
Fort Bragg, North Carolina
ATTENTION: Antiaircraft Service Test Section

1. Reference is made to:

a. Letter, Army Ground Forces to Antiaircraft Command, dated 6 October 1944, file 471.94/141/(S)(6 Oct 44) GNRQT-5/96415, subject: "Initiation of Army Ground Forces Guided Missile Program", wherein Antiaircraft Command was directed to establish a project covering, insofar as possible, all phases of a Guided Missiles Program for Army Ground Forces.

b. Letter, Army Ground Forces to Antiaircraft Command, dated 29 January 1945, file 471.94/102(S)(29 Jan 45)GNRQT-5/[illegible], subject: "RCM for Guided Missiles" which amplified the directive in subparagraph a, above, and expanded it to include countermeasures against enemy guided missiles.

c. Letter, Army Ground Forces to Army Service Forces, dated 20 September 1945, file 471.94/102(S)(20 Sep45)GNRQT-5/41274, subject: "RCM for Guided Missiles", requesting Army Service Forces to ship one each Radar Sets, AN/CPS-1 AN/CPS-4, AN/CPS-5, and AN/CPS-6 to the Antiaircraft Artillery Board, for tests to determine the capabilities of these sets to detect and determine the trajectory of long range guided missiles, as one phase of the problem of countering enemy guided missiles.

d. Teletype, Antiaircraft Service Test Section, Army Ground Forces Board No. 1 to Army Ground Forces, dated 23 November 1945, requesting a test directive for Radar Sets AN/CPS-1 and AN/CPS-5 which have arrived at Fort Bliss.

e. Letter, Army Ground Forces to the Coast Artillery Board, Field Artillery Board, Antiaircrafte Command, and others, dated 28 July 1945, file 319.1(ETO)(S)(28 Jul 45)GNRQT-5/[illegible], subject: "Detection and Fighting of the V-2 (German) Missile as Developed in the European Theater of Operations", which forwarded Copy #20 of the subject report for information.

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2. The Antiaircraft Command directed and the Antiaircraft Artillery Board established the project called for in subparagraphs 1 a and b, above. This project was subsequently assumed by the Antiaircraft Service Test Section, Army Ground Forces Board No. 1, when it was activated.

3. During the calendar year 1946, commencing about 1 April 1946, about seventy-five (75) missiles will be launched at the White Sands Proving Ground under direction of the Ordance Department. Types and approximate number of missiles to be launched are as follows: WAC Corporal (5 missiles), Corporal E (10 missiles), Corporal F (10 missiles), Sergeant (5 missiles), Captured V-2 Rockets (30 missiles), NIKE missiles without controls (15 missiles). In addition there is a possibility that other services will use the White Sands Proving Ground to some extent for testing other missiles, thus affording additional opportunity for observations. This 1946 series of firings afford an opportunity to add materially to the present knowldege of radar performance in this important field.

4. Plans of interested services, the Signal Corps, and Army Air Forces for testing radar equipment during these launchings are in the formative stages. The office of Chief Signal Officer has informally stated that the Signal Corps will actively participate in the tests. It is assured that the Army Air Forces will have equipment present for testing under their own direction. An invitation will be extended to the U. S. Navy to participate to the extent they desire. The Signal Corps will be the over-all coordinator of the tests of radar equipment. A Signal Corps officer will be furnished at White Sands Proving Ground with necessary assistants to coordinate the location and emplacement of equipment and its employment, and lend technical assistance.

5. It is desired that the Antiaircraft Service Test Section determine the suitability of existing standard Antiaircraft Artillery radar sets, and such other standard or experimental type radars as may be furnished, for employment as a means of supplying surveillance or fire control data in a counter-guided missiles role. Specifically, is each radar set, with modifications if necessary, suitable for supplying data as a basic for:

a. Long range early warning of the approach of enemy guided missiles for alerting such future defenses as may be devised, and for furnishing information to passive air defense agencies.

b. Fire control data for guided missiles defense employing missiles similar to the NIKE development.

c. Speedy location of launching sites of enemy missiles.

d. Tactical planning for early warning necessary for a coordinated defense.

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In addition, records of trajectory obtained will be desired by the Ordnance Department for study of the launched missiles flight characteristics and performance.

6. The following specific duties and responsibilities are assigned to the Antiaircraft Service Test Section:

a. Designate a competent officer as director and coordinator of the antiaircraft artillery effort.

b. Maintain liaison with the Director of White Sands Proving Ground, and the Signal Corps representative at White Sands Proving Ground, when the latter is assigned.

c. Plan, direct, coordinate and supervise, in cooperation with the Signal Corps, the antiaircraft artillery effort on this project to the end that factual, desired data is secured.

d. Furnish all possible material and personnel assistance to the Signal Corps to assure success of the project.

e. Receive, service and emplace for test such equipment as may be shipped for evaluation, including the AN/CPS-1 and AN/CPS-5 already received.

f. Prepare personnel and training estimates of the requirements for these tests, of personnel from sources in addition to Antiaircraft Service Test Section, and furnish to the Commandant, Antiaircraft Artillery School.

g. Submit to this headquarters, after coordination with Signal Corps representative, your plans for emplacing, employing and recording data of radar sets received for test.

h. Submit to this Headquarters , as circumstances dictate, interim reports of progress and conclusions reached.

7. The Commandant, Antiaircraft Artillery School, by separate correspondence, a copy of which will be furnished you, is being given the following responsibilities in connection with these tests:

a. Survey the officer and enlisted personnel of the 1st Guided Missile Battaltion, and such other personnel available to him as can be spared for these tests, and furnish this headquarters a summary to show the trained radar personnel, and their qualifications (MOS), that can be made available for these tests.

b. Furnish radar personnel to Director, Antiaircraft Service Test Section, as requested, providing such personnel can be spared without

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unduly impairing the normal functions of the Antiaircraft Artillery School.

d. Conduct the training necessary for radar personnel.

d. When reports submitted by the Antiaircraft Service Test Section become available, make recommendations to this headquarters as to the best tactical doctrine for employment of radar in defense against missiles of the V-2 type.

8. For the purpose of carrying out his responsibilities and duties in connection with this series of tests, the Director of the Antiaircraft Service Test Section is authorized to communicate directly with the Commandant, Antiaircraft Artillery School, the Signal Corps representative at White Sands Proving Ground, and the Director of White Sands Proving Ground.

9. Priority "A" is assigned to this project.

BY COMMAND OF GENERAL DEVERS:

[illegible]
Lt Col., A.G.D.
Asst Ground Adj [illegible]

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3

AAF Pilotless Aircraft Program.

TSEIG TSESA 10 Jan 46 1

1. The following is a brief summary of the AAF Pilotless Aircraft activities of the past and also the future program.

a. The AAF pilotless aircraft program was actively organized during 1941. Responsibility was delegated to the Equipment Laboratory. Initial designs used standard bombs as warheads in order to facilitate production.

b. Early in 1942 missiles designed to hit area targets were abandoned in favor of "pin point" missiles.

c. A program started in 1942 with N.D.R.C. developing controllable vertical bombs; The VB-1 (1000# Azon), VB-2 (2000# Azon) and the VB-3 (1000# Razon). All have been standardized. The VB-1 has been used successfully in combat. Thirteen VB-13, 12,000 lb. "Tarzon" have been built and are to be tested during February 1946.

d. In 1942 the A.T.S.C. completed tests using a B-17 "war weary" aircraft so that the airplane could be flown to the target and dived in through remote television control. These aircraft were used in close support operations. Actual control is given by 2 ground stations. During tests four out of five hit on a 7 ft. x 7 ft. target.

e. In 1944 and 1945 approximately 1400 JB-2's were constructed. 250 have been tested. The accuracy obtained was equivalent to that of the German V-1. Of 17 tests recently conducted using radar control eight were successfully controlled to hit within a two mile radius of the target at 85 miles.

f. Starting late in 1944, twenty-five air-to-air pilotless aircraft were procured from Hughes Aircraft. Ten have been tested, resulting in 4 rocket failures. Tests were fairly successful. Due to development of smaller seekers, a 60 per cent smaller missile can be constructed and the JB-3 project will probably be abandoned after all JB-3's have been expended.

g. In February 1945, the project work on pilotless aircraft was assigned to Aircraft Projects Section. Additional manufacturing facilities were becoming available and a comprehensive program for the development of all types of pilotless aircraft was initiated.

h. During early 1945, A.T.S.C. entered into a joint contract with Ordnance in a study by Bell Telephone Laboratories on a ground-to-air missile. The design submitted by Bell was unsatisfactory due to the short (12 miles) range of the missile.

i. In July 1945, the A.T.S.C. entered into a contract with Boeing Aircraft Company for three month's study (approximate cost $30,000). As a result a contract was initiated on 21 November 1945 for the initial steps in the design and development of a ground-to-air missile capable of attacking and destroying 700 mph aircraft flying at 50,000 to 60,000 ft. altitude, at 35 miles range.

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j. Since November 1945, additional military characteristics have been circularized the industry and educational institutions for the development of various types of ground-to-ground, air-to-ground, and ground-to-air missiles. Contracts will be initiated for these aircraft during February and March 1946.

k. In addition, A.T.S.C. is developing components that will be necessary for pilotless aircraft. During the war three heat seekers and three light seekers were used on glide bombs. Tests were satisfactory although considerable additional work was and is necessary to develop satisfactory control. Design study contracts exist with "Merill-Flood and Associates" and "Hillyer Engineering" to conduct work on a Stellar homing (navigation) control.

l. Carnegie Institute has a contract for magnetic homing controls.

m. Power Plant Laboratory has constructed a 20 in. ram jet based on the design of a 7 in. ram jet developed by M.I.T. These units have been installed on a P-61 airplane for tests. A.T.S.C. is procuring six 20 in. and two 30 in. "Marquardt" units for test on the P-80 aircraft.

n. A.T.S.C. is conducting research work on liquid rockets using ten types of fuels. A turbine pump has been developed for the 6000 lb. thrust acid-analine rocket and this pump is being modified for Nitromethane.

o. Two contracts exist with Bell Aircraft for supersonic piloted rocket propelled research aircraft. The XS-1, about to start initial tests is expected to have a high speed of 1298 mph for two minutes at 75,000 feet. The XS-2, in preliminary design stage expected to do 2080 mph for two minutes at 85,000 feet.

GEORGE E. PRICE
Colonel, Air Corps
Chief, Aircraft Projects Section
Service Engineering Subdivision
Engineering Division

EK/led
36351
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Copies to:
TSEAA-7
TSESE
TSESA

Missiles, Foreign
G. M. Br., AC/AS-4
12-1

4376

GUIDED MISSILES BRANCH

MEMO FOR GM BRANCH AND RECORD

Date: 14 January 1946

Subject: Enemy Guided Missiles Equipment

1. On 3 August 1945 the ATSC liaison officer at Aberdeen surveyed enemy guided missiles equipment under custody of Ordnance. Numerous items, those with wings which were unquestionably AAF material, were requested by T-2 of ATSC. In reply to this correspondence Ordnance stated that all of the material except certain specified items were sent to the Navy, that the remaining were sent to General Electric, Schenectady, Hermes Project, and that the matter apparently had been considered closed by the Navy Department.

2. On 11 January 1946 the undersigned visited Aberdeen and contacted Col. Jarrett for clarification of what actual pieces of enemy equipment were shipped to Navy, which to Schenectady, and why the AAF was not consulted prior to release of equipment to the Navy. Col. Jarrett showed a definite reluctance to answer any questions and referred the entire matter to Col. C. H. Corey, under the Chief of Ordnance, Washington, D. C. This officer was contacted in the Pentagon, whereupon he stated the matter in question had been handled by Col. J. C. Werner now out of the service, and that he himself could supply no details on the subject.

3. It was concluded by the undersigned:

(1) That any further effort to obtain information on enemy equipment through visit to Aberdeen (the receiving center in the U.S.) and any Ordnance personnel actually involved, would be futile. That correspondence already seven months old had failed and would continue to fail.

(2) That collection, shipping, and assignment of enemy guided missiles equipment should be above-board, and impartially and equitably done between Army Ordnance, AAF, and the Navy. That the existing Guided Missiles Committee of the Joint New Weapons Committee make a study of the existing problem and recommend to the Joint Chiefs of Staff the necessary action to straighten the situation out.

G. Gould
Maj, A.C.

Att:
Memo subj
Trip Rpt

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Missile Foreign
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25 Gen Crawford/RKH:ba/4908
(Written 23 Jan 1946)

AFDRE-3/N

Subject: Request for the Allocation of One German V-2 to the Army Air Forces

To: Office of the Chief of Ordnance
Army Service Forces
The Pentagon, Washington 25, D.C.

1. It is requested that one (1) complete and undamaged German V-2 from Army Ordnance's stock at White Sands Test Range, New Mexico, be allocated to the AAF and sent to Air Technical Service Command to be sectionalized and studied.

2. It was stated in a 2 October 1944 directive issued by the Deputy Chief of Staff, U. S. Army, known as the "McNarney directive", that the Army Air Forces would be responsible for the development of all guided missiles depending for sustenance primarily on the lift of aerodynamic forces. This places the V-2 under Army Ordnance. However, the Germans had planned on placing wings on V-2 type missiles thus securing the distance deemed necessary for their needs. If it is found true in the Ordnance Department's experiments with V-2 type missiles that this must be done to meet U. S. needs; then the weapons to be developed would, in accordance with the directive be a responsibility of the Army Air Forces. Without the research and technical information which could be obtained by ATSC if they had a V-2 at Wright Field, the carrying out of this program by the Army Air Forces would not progress as rapidly and a great deal of time and money would be lost in trying to obtain this information in any other way.

3. On 21 September 1945 in a directive from this Headquarters to ATSC, the following was stated: "It is directed, therefore, that missiles of both airplane type trajectories and trajectories of the A-9 and A-10 general type be developed as means of fulfilling the referenced military characteristics for ground-to-ground guided missiles." The A-9 and A-10 types mentioned are V-2 type missiles with wings and in compliance with this directive and a subsequent request for a proposal to aircraft manufacturers to develop this type, North American Aviation, Inc., has submitted a proposal for developing an A-9 type missile. Although this proposal has not been accepted as yet by ATSC, a proposal for a development of this type will be accepted and a contract let within two months with some manufacturer. With a V-2 missile at ATSC under careful study a great deal of valuable time would be saved in the development of this type missile.

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4. Furthermore, information gained by the various laboratories at ATSC on the propulsion, stabilization, guidance, etc. of the V-2 would be invaluable in the development of all guided missiles that fall under the purview of the AAF. The wealth of technical data that could be obtained from careful study of the V-2 by technically trained personnel at ATSC would afford a background which would enable the research and development program of the AAF to progress rapidly in a field which plays such an important part in the plans of the Armed Forces.

5. It is understood that Army Ordnance has one hundred (100) V-2 parts at White Sands, but due to shortages will only be able to assemble approximately twenty-five (25) missiles for actual firing. As Ordnance's purpose in firing these missiles is to train the personnel of the Guided Missiles Battalion in launching technique and gain some trajectory and ballistic data, it appears that the transfer of one of these missiles to ATSC would not hinder their program.

For the Commanding General, Army Air Forces:

ALDEN R. CRAWFORD
Brig General, U. S. A.
Chief, Research & Engineering Div.
Office, Asst Chief of Air Staff-4

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Brtm 16 Jan 46

SUBJECT: Military Characteristics of an Air Defense System

TO: Assistant Chief of Air Staff-4 Y020

1. The following military characteristics for an air defense system are proposed:

a. Type: Defense against air attacks by conventional types and pilotless types of aircraft, and/or guided missiles.

b. Mission: Determination through plotting or by other means of courses of enemy aircraft and missiles and of positions of enemy air fields and launching sites, continuous observation and display at control centers of positions of friendly and enemy aircraft and missiles, and continuous control of friendly aircraft and missiles employed against enemy aircraft and missiles in the air and against enemy ground and sea targets.

2. For simplication of statement of characteristics and development of equipment, the complete center shall be broken down into its major component parts. These component parts are Warning Systems, Operational Centers, Weapons and Special Devices. All component parts will be manned on a twenty-four hour basis to provide prompt defense against surprise attacks.

a. Warning Systems

(1) Types: Very Early Warning Circuits

(a) Mission: To detect the presence of aircraft, conventional and pilotless, and/or guided missiles, at long ranges and to present pertinent information instantaneously to the Master Control Center.

(b) Requirements: Shall be capable of detecting throughout 360° of azimuth the approximate number of aircraft, conventional and pilotless, and/or guided missiles, up to a maximum range of at least fifteen hundred (1500) miles, and at altitudes from sea level to at least fifty (50) miles, greater ranges and altitudes being desired. Accuracy shall be ten mils at fifteen hundred (1500) miles range. Locator systems, search radar and/or other locator equipment, will be capable of both automatic scanning and manual operation. Positive

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identification is desirable. Identification by velocity discrimination, beacon code, or a combination of the two is acceptable. Complete communications systems will be established between all Very Early Warning Circuits and the Master Control Center. All equipment will be as fully automatic as possible, in order that the human element may be discounted insofar as possible.

(c) Scanning: Will sweep at least twice a minute, continuous presentation being desirable.

(d) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interference.

(e) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(f) Safety: Consideration shall be given to incorporating maximum safety provisions.

(2) Type: Early Warning and Long Range Control Circuits

(a) Mission: To determine accurately the location of aircraft, conventional and pilotless, and/or guided missiles, at medium ranges and to present pertinent information immediately to the Master Control Center.

(b) Requirements: Shall be capable of defining throughout 360° of azimuth in groups and/or individually, enemy aircraft, friendly counterattacking surface to air weapons, conventional and pilotless, and/or guided missiles, as to mass, relative ranges and azimuths up to a maximum range of at least one thousand (1000) miles and at altitudes from sea level up to at least sixty (60) miles, great ranges and altitudes being desired. Accuracy shall be five mils at one thousand (1000) miles range. Locator systems, search radar and/or other locator equipment will be capable of both automatic scanning and manual operation. Positive identification is desirable. Identification by velocity discrimination, beacon code, or a combination of the two is acceptable. Complete communications systems will be established between all Early Warning Circuits and the Master Control Center. Pertinent information, as to mass, ranges, velocities and azimuths of aircraft, will be automatically transmitted to the Master Control Center from the locators. Data ascertained from these circuits will be used primarily in the launching and control of surface to air guided missiles.

(c) Scanning: Will sweep at least four times a minute, continuous presentation being desirable.

(d) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interference.

(e) Saturation: Provision will be made to insure the detection of a minimum of five hundred (500) aircraft, conventional and pilotless, and/or guided missiles by each station.

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(f) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(3) Type: Tracking and Short Range Control Circuits

(a) Mission: To track accurately groups and individual targets of conventional and pilotless aircraft, and/or guided missiles, in order that surface-to-air missiles can be accurately guided to a maximum number of kills.

(b) Requirements: Shall be capable of tracking accurately throughout 360° of azimuth targets, and our counterattacking surface-to-air missiles, in groups and/or up to a maximum range of at least eight hundred (800) miles and at altitudes from sea level up to at least one hundred (100) miles, greater ranges and altitudes being desired. Accuracy shall be three mils at eight hundred (800) miles range. Tracking systems, gun laying radar and/or other tracking equipment, will be capable of both automatic scanning and manual operation. Positive identification is desirable. Identification by velocity discrimination, beacon code, or a combination of the two is acceptable. Pertinent information as to mass, relative ranges and azimuths of group and individual targets will be automatically tied in with the control systems of surface-to-air weapons insofar as applicable. Maximum effort will be made to discount the human element in the transmittal of this information from the tracking systems to the systems used in controlling the various types of weapons. Data ascertained from the tracking circuits will be used primarily in automatic firing of antiaircraft batteries, and the directing of piloted aircraft.

(c) Scanning: Will sweep at least eight times a minute, continuous presentation being desirable.

(d) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interference.

(e) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(f) Safety: Consideration shall be given for incorporating maximum safety provisions.

b. Control Center

(1) Type: Master Control Center

(a) Mission: The rapid assembling of information from all of the warning circuits into the center where attacks can be promptly and efficiently evaluated, and prompt action can be initiated for the countering of attacks.

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(b) Requirements: This center will have consolidated presentation indicators, associated data relay equipment, evaluating devices, target designation equipment, and meteorological equipment. Automatic following units, discriminators as to velocities, altitudes, and azimuths, and computers for controlling counterattacking missiles will also be required for the controlling and/or alerting of surface-to-air weapons. Automatic display equipment on which a running score of target locations, hits, misses and targets remaining will be installed. Complete communications networks will be established between all warning circuits, the Master Control Center, and Operational Centers, or sites launching counterattacking weapons. It is desired that presentation equipment be three dimensional in aspect. All equipment will be as fully automatic as possible, in order that the human element may be eliminated insofar as practicable.

(c) Operational Procedure: Provision will be made for the carrying out of the following procedure. Once an attack is evaluated electrical circuits will be closed in the Master Control Center, by operational personnel, which will simultaneously accomplish the steps outlined below.

1. Data from the warning circuits, as to range, azimuth, and velocity of targets, will automatically be tied in by use of automatic following units and discriminators, to computors which compute collision courses to the selected targets. Collision course data will be automatically transmitted to the counterattacking missiles by radio transmitters or by other means. Should beam rider control or other methods for counterattacking guided missiles be more feasible, the Master Control Center will automatically present the Missile Control Circuits with pertinent data as to range, azimuth and velocity. Control of missiles will be then done by beam rider or other methods. A maximum amount of equipment will be retained in the Master Control Center. Launching sites will be capable of self operation if need be. Missiles will be launched from launching sites in the path of an attack upon command of the Master Control Center (Push-button type control at the Master Control Center being desired). Control will be applied after missiles are airborne.

2. Strategically located air bases will be alerted to the attack, at this time. These air bases will contain the best interceptor, fighter and/or bomber, types of aircraft possible. Air-to-air guided missiles will be utilized as part of the striking power of these aircraft. Tracking equipment will be established relative to the bases. It will be the responsibility of this equipment to furnish automatically to the bases relative ranges, altitudes and azimuths of the attacking aircraft. The operations centers of the air bases will then direct aircraft to the targets.

3. Antiaircraft batteries in the path of an attack will be alerted as to the predicted path of the attack. The tracking circuits for antiaircraft will then immediately start automatic scanning of the alerted area. Once the tracking circuits are on target the guns will be fired and corrected automatically by means of automatic tie-in equipment with the tracking circuits. Antiaircraft Operations Centers will monitor the firing of the individual batteries to insure a maximum number of kills.

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4. Air raid warnings will be set off in major cities and major military installations in the path of an attack. This will provide an element of time during which the passive side of the defense system can be carried out.

(d) Capabilities: It is desired that no limitations be imposed on the mass of attacks that this center may handle.

(e) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interference.

(f) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(g) Safety: Consideration shall be given for incorporating maximum safety provisions.

(2) Type: Piloted Aircraft Operations Center

(a) Mission: The rapid coordination of information, relative to piloted aircraft, from the Master Control Center for the concerned tracking equipment; to utilize data from these two sources to direct aircraft to the targets.

(b) Requirements: This center will have consolidated presentation indicators and associated data relay equipment, complete communications networks between the Master Control Center and the concerned tracking equipment, automatic display equipment, evaluating devices, target designation equipment, and meteorological equipment for providing pertinent data to individual aircraft. All data ascertained from the tracking equipment will be automatically transmitted to the aircraft operations center in order that the human element may be eliminated insofar as possible. All equipment will be as automatic as possible.

(c) Capabilities: It is desired that no limitations be imposed on the amount of pertinent information that this center may handle.

(d) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interference.

(e) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(f) Safety: Consideration shall be given for incorporating maximum safety provisions.

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(3) Type: Antiaircraft Operations Center

(a) Mission: The rapid coordination of information, relative to antiaircraft guns, from the Master Control Center for the concerned tracking equipment, to utilize rapidly data from these sources in monitoring individual battery firings so that a maximum number of kills will be obtained.

(b) Requirements: This center will have consolidated presentation indicators and associated data relay equipment, complete communications networks between the warning systems and the satellite centers, automatic display equipment, evaluating devices, target designation equipment, and meteorological equipment for providing pertinent data to individual firing batteries. All data ascertained from the tracking circuits will be automatically transmitted to the antiaircraft operations center and to the concerned individual antiaircraft batteries. All equipment will be as automatic as possible, in order that the human element may be eliminated insofar as possible.

(c) Capabilities: It is desired that no limitations be imposed on the amount of information that this center may handle.

(d) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interferences.

(e) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(f) Safety: Consideration shall be given for incorporating maximum safety provisions.

c. Weapons

(1) Type: Guided Missiles

(a) Mission: The destruction of all attacking enemy aircraft, conventional and pilotless, and/or guided missiles.

(b) Requirements: Guided missiles used will vary, just as present antiaircraft varies in size and range depending on the type or operational use of the target. Therefore, guided missiles firing batteries (mobile or fixed) will be located in strategic positions relative to the future approaches of global warfare. These batteries will include launching platforms (mobile or fixed) and methods of controlling the missile's path either through a system of transmitter controls as previously discussed, or by preset methods. All missiles will contain seeker-type warheads. Missiles used will correspond to those set forth in the Military Characteristics of Guided Missiles (Ground-to-Air Supersonic) dated 5 December 1946.

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(c) Saturation: It is desired that no limitations be imposed on the number of missiles that may be employed against groups of and/or individual targets.

(d) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interference.

(e) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(f) Safety: Consideration shall be given for incorporating maximum safety provisions.

(8) Type: Piloted Aircraft

(a) Mission: The destruction of all attacking enemy aircraft, conventional and pilotless, and/or guided missiles.

(b) Requirements: Piloted aircraft defense will involve the establishment of air bases at strategic locations relative to the probable approaches of future global attacks and the equipping of these bases with the necessary aircraft, aircraft ordnance and maintenance, aircraft protection, aircraft and target tracking systems and launching means to counter enemy air attacks, counter guided missiles, air-to-air, will be used in conjunction with all aircraft when practicable, as part of the striking power of the aircraft. Complete communications systems will be established between the Master Control Center, the Aircraft Operations Center, pertinent tracking circuits, and individual aircraft. Aircraft used will correspond to those set forth in the latest military characteristics for fighter and interceptor aircraft.

(c) Capabilities: It is desired that no limitations be imposed on the number of aircraft that may be employed against groups of and/or individual targets.

(d) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interference.

(e) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(f) Safety: Consideration shall be given for incorporating maximum safety provisions.

(5) Type: Antiaircraft Guns

(a) Mission: The destruction of all attacking enemy aircraft, conventional and pilotless, and/or guided missiles.

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(b) Requirements: Antiaircraft guns will be primarily charged with the destruction of those portions of enemy attacks that manage to elude the foregoing types of weapons. Antiaircraft guns will in particular be charged with interception and destruction of "sneak" low attacks, against which guided missiles will probably be ineffectual at most ranges and also against which piloted aircraft will be only partially effective. This type defense will involve the determination of the size and quantity of guns and ammunition. Complete automatic fire control systems will be incorporated with an automatic gun laying radar system, or other tracking means. Gun emplacements will incorporate insofar as practicable, with size and tactical use, a high degree of mobility. High rates of fire by all batteries is extremely desirable; all batteries will be self sustaining once their tracking system is put on target by the Antiaircraft Operations Center, and the concerned tracking circuits. Complete communications systems will be established between the Master Control Center, the Antiaircraft Operations Center and the individual firing batteries. Automatic display equipment on which a running score of target locations, kills, misses, and targets remaining is kept, will be installed in a group and/or in individual batteries. Antiaircraft guns used will correspond to these set forth in the latest military characteristics for antiaircraft guns.

(c) Capabilities: It is desired that no limitations be imposed on the number of guns that may be controlled against groups of and/or individual targets.

(d) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interference.

(e) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(f) Safety: Consideration shall be given for incorporating maximum safety provisions.

d. Special Devices

(1) Types: All countermeasure equipment pertinent to a defense of this nature.

(a) Mission: The counteracting of and/or the taking over control of attacking aircraft, conventional and pilotless, and/or guided missiles.

(b) Requirements: This will involve the employing of jamming stations, whose frequencies do not interfere with control systems or warning systems. It will also necessitate stations capable of taking over control of, changing the course of, and/or destroying enemy aircraft, conventional and pilotless, and/or guided missiles. The use of rays, atomic energy and other means for this purpose is highly desirable. These stations will be located so that they provide full coverage of all approaches to the United States. These stations will

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provide 360° horizontal and 180° vertical coverage. Pointing or directing of these stations will be done automatically, either by the Master Control Center or by ground operational personnel at the stations, upon notification from the Master Control Center.

(c) Capabilities: It is desired that no limitations be imposed on the number of stations that may be employed against groups of and/or individual targets.

(d) Jamming: Provision will be made to insure maximum freedom of equipment from natural, enemy or friendly interference.

(e) Weather: All equipment shall be suitable for use under the greatest variety of climatic conditions.

(f) Safety: Consideration shall be given for incorporating maximum safety provisions.

e. Passive Defense for an Air Defense System

(1) All known means of passive defense will be incorporated in the location of and construction of all centers, jamming stations, locator and tracking circuits, air bases missile launching sites, gun batteries and other exposed equipment insofar as practicable.

JAMES L. TRAVIS
Colonel, Air Corps
Acting Deputy Chief, Guided Missiles Division
Office of Assistant Chief of Air Staff-4

OFFICE SYMBOL		[redacted]	
GRADE AND SURNAME OF COORDINATING OFFICERS			

1250
[redacted]

AUTH CG, ATSC
INITIALS
DATE 24 Jan 1946

ARMY AIR FORCES
MATERIEL COMMAND
AIR TECHNICAL SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

TSESA-7/CWG/td
Date 24 January 1946

SUBJECT: Symposium on Guidance and Launching of
Guided Supersonic Missiles

OFFICE Aircraft Projects Section — Contract or Order N

SERIAL No. TSESA - 1240 — Expenditure Order N

A. PURPOSE:

1. To report on symposium held at Applied Physics Laboratory, John Hopkins University, Silver Spring, Maryland, on 3 and 4 January 1946.

B. FACTUAL DATA:

1. The symposium on guidance and launching of guided supersonic
missiles is one of a series of symposia being held by the Applied Physics
Laboratory on the various phases of guided missile development. The program
of this symposium is inclosed as attachment (A) and the roster of personnel
attending as attachment (B). The entire proceedings were recorded and will be
prepared and distributed as a printed report as soon as possible.

2. Probably the most emphasized point of the entire symposium was the
fact that a stable servo system, a stable automatic pilot, a stable guidance
system and a stable aerodynamic configuration can be and frequently are combined
with the result that the combination is dynamically unstable. The unanimous
opinion was that the development of at least the automatic pilot, the servo
system and the aerodynamic configuration must be developed simultaneously by
the same agency, if difficulty with dynamic stability is to be avoided.

3. Another point strongly stressed at the symposium was the increased
recognition of the importance of using flight simulators in the development of
guided missiles. Through the use of a flight simulator the majority of the
design parameters can be worked out prior to the initial flight test. In fact
considerably more data can be obtained on the dynamics of a guided missile from
a flight simulator than from flight tests. In working on the Navy "Bat" glide
bomb, the MIT servo laboratory developed one of the first flight simulators
and achieved such excellent results that it was unnecessary to change a single
parameter after flight test of the missile.

4. MIT is currently developing a new, improved flight simulator capable
of solving the stability problems on all guided missiles now foreseen. The
Radio Corporation of America has completed a flight simulator and the Applied
Physics Laboratory is working on one. The Office of Research and Inventions of
the Navy Department has recently employed Mr. Perry Crawford of the MIT

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Differential Analyzer Group to prepare specifications for a differential analyzer and flight simulator for use on Navy guided missiles. He is considering the possibility of constructing a large unit for the joint use of the Army and Navy.

5. Very interesting for the Pilotless Aircraft Branch was the extent to which the Boeing GAPA report on guidance has been accepted as the most authoritative work on the subject. The Applied Physics Laboratory personnel working on the "Bumblebee" project appear to be accepting the AAF guidance work to as great an extent as the AAF is accepting their ramjet developments.

6. Dr. W. Hausz of Electronics Laboratory of the General Electric Co. summarized the work being done on the "Hermes" project. Their conclusion to date is that the best way to obtain extreme ranges is through the use of free trajectory rockets guided only during acceleration and reaching such velocities and altitudes that they follow Keppler's laws for astronomical bodies. General Electric has also been making an analysis of the guidance possibilities and has prepared an outline of the possible methods. This outline is inclosed as attachment "C".

7. Among a number of technical devices and problems described during the symposium, the following were considered of the most interest:

a. The Germans had developed an electrolytic integrating accelerometer which would have .1 per cent accuracy on laboratory models and .2 per cent on production models. This device consisted of an electromagnetic accelerometer with the output current fed back into windings to oppose the motion, resulting in close coupled feedback so that the motion of the accelerometer never exceeded .0[illegible] to .00[illegible] inches. However, the current flowing through the coils was proportional to the acceleration experienced. This current was allowed to flow through an electrolytic cell, plating metal on the cathode. The quantity of metal plated was then an integrated measure of the accelerations applied since the start of the motion.

b. The Radio Corporation of America has built and flight tested a Shoran set with a computer which will enable it to fly a pilotless aircraft along a predetermined path.

c. Mention was made of the need for a dynamic pressure measuring device capable of varying the sensitivity of servo systems in guided missiles operating over wide ranges of speed and altitude.

8. The various aspects of the launching problem were discussed at length, with the conclusion that some type of external launching booster is usually essential. The use of a gun type launching ramp similar to the German V-1 ramp is quite efficient for getting velocity up to 500 ft. per second. However, its length and weight become prohibitive if the launching speed is increased much beyond 500 ft. per second. A ramp, to give a 500 ft. per second velocity to a 1000 lb. missile, can be expected to weigh between 10 and 15 tons

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and will require approximately [illegible] lbs. of powder for launching. This ramp will have the following lengths depending upon the accelerations to be exerted on the missile.

Acceleration	Length of Ramp
15 g	[illegible] ft.
25 g	[illegible] ft.
50 g	[illegible] ft.

7. The use of solid rocket boosters at the present appears to be the most promising for high launching velocities. The best present rocket designs give a ratio of approximately 1 lb. of [illegible] of powder. Using the best rockets now available, the following chart was prepared for launching a [illegible] missile:

Change in Velocity	Weight of Powder	Total Weight
[illegible]	[illegible]	[illegible]

[illegible] velocities in excess of [illegible] multiple stage [illegible] boost must be employed. [illegible] Furthermore, the weight of powder [illegible] appears to be the most efficient arrangement.

11. In connection with high thrust, [illegible] rockets the [illegible] Corporation [illegible] rocket being developed for the [illegible] project. [illegible] plastic base fuel in order to withstand the high accelerations expected, and [illegible] of this rocket giving 10,000 and 20,000 lbs. of thrust have been built and tested successfully.

C. CONCLUSIONS

1. The work done on guidance and control by Boeing Aircraft Co. on the GAPA project compares favorably with work done by other agencies.

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M.R. TSESA - 1240 [redacted]
24 Jan 1946

2. The use of flight simulators in the development of pilotless aircraft will greatly reduce the quantity of aircraft required to be expended in developing them.

3. The aerodynamics, the automatic pilot and the servo system should be developed simultaneously by the same agency.

4. For a supersonic ground-to-air pilotless aircraft, the most efficient launching system is a gun type launcher combined with rocket boosters.

D. RECOMMENDATIONS:

1. That the Engineering Division place high priority on the procurement of flight simulators for use in the pilotless aircraft development program.

2. That the Engineering Division consider the advisability of the joint development of a flight simulator for use by the Army and the Navy.

3. That the Engineering Division continue its present policy of allowing a prime contractor to simultaneously design and develop the aerodynamics, the servo system and the automatic pilot for new pilotless aircraft.

Prepared by
C. W. [illegible], Major A.C.

Approved
[illegible]
Chief, Pilotless Aircraft Br

Approved by
[illegible] PRICE, Col. A.C.
Chief, Aircraft Projs. Sect.

Distribution:
AC/AS-4 - CG, AAF (6)
TSEAC - Aircraft Laboratory
TSEPE-11 - Control Equipment Branch
TSEPR-7 - Research Branch
TSESA-7 - Pilotless Aircraft Branch
TSEWI - Engineering Division
TSIRE - Wright Field Reference Office
TSELT - Electronic Subdivision

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ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
MATERIEL COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

Auth: CG., ATSC
Initials ___
Date 1/25/46

Date 25 January 1946

SUBJECT: "Conference on German Research in Supersonic Flow".

OFFICE Aircraft Projects Section

SERIAL No. TSEPA-1741

A. PURPOSE:

1. To report on conference on German research in supersonic flow held by the U. S. Navy Bureau of Ordnance at the Aberdeen Proving Grounds, Aberdeen, Maryland, on 17 January 1946.

B. FACTUAL DATA:

1. A group of approximately 250 aerodynamics and guided missiles personnel, representing all service agencies, educational institutions and industrial firms connected with this work, were invited to attend this conference. A detailed report of the material presented will be prepared by the Bureau of Ordnance and be distributed to the personnel attending the conference. The agenda included the following general items: a lecture on "German Research Facilities" by Colonel Simon of the Army Ordnance Department; a visit to the supersonic wind tunnel, the ballistic firing range and the mobile facilities for obtaining field data on ballistics and bomb explosions; a lecture by Dr. Tsien of CIT on "The Evaluation of German Supersonic Aerodynamic Research Data"; and numerous discussions in small groups during the evening. Dr. Von Karman was scheduled to give the afternoon lecture but was unable to attend, Dr. Tsien delivering the lecture in his place.

2. Colonel Simon discussed the various German research installations, particularly those near Braunschweig. He emphasized the great care that had been taken in camouflaging the facilities. He also discussed the research organization of the German Army and commented that the research by the Luftwaffe was the most outstanding of the German work; however, it was usually of little value to the Luftwaffe since there was little or no coordination between the research personnel and the staff planners. The research organization was neither told what equipment was needed nor was it informed of the planned operations in order that it might determine what equipment would be needed. The separate research centers of the Wehrmacht and the Navy were well equipped but were staffed entirely by military and naval personnel. These facilities produced very little of value either to the armed services or as pure research.

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Memorandum Report No. TSESA-1241, "Conference on German Research in Supersonic Flow". 25 January 1946.

3. One interesting piece of equipment which the Germans had at Braunschweig was a centrifuge used to determine the ability of automatic aircraft weapons to function under high acceleration loads.

4. Colonel Simon also described a 5.5 centimeter aircraft rocket which was in production at the end of the war. Extensive studies were made by the Germans to determine the minimum amount of explosive necessary to knock down a B-17 or B-24; they arrived at the conclusions that 350 grams of powder exploding in the wing was sufficient. To allow a safe margin, 500 grams of powder was then used for the warhead of the new rocket. Extensive research was carried out on the solution of the aerodynamic and launching problems connected with this rocket. The maximum dispersion of the rockets was then measured, and it was found that if 12 rockets were launched at one millisecond intervals at least one hit was assured. The employment of this rocket proved so outstanding in operational tests that large quantities were being produced when the war ended.

5. After Colonel Simon's lecture, the group was taken to the supersonic wind tunnels. This facility was built at the original suggestion of Dr. Von Karman. It has provisions for three supersonic wind tunnels. The first tunnel was completed in December 1944, the second tunnel is now under construction and plans for the third have not yet been made. The present tunnel has three interchangeable throats: the subsonic throat is capable of giving Mach numbers up to .9; the second throat operates with a Mach number of 1.7; and the third with a Mach number of 1.3. The Mach number 1.3 throat has not yet been calibrated. It is planned eventually to fabricate additional throats for this tunnel to give Mach numbers of 3 and 4.5. The tunnel has a three component balance measuring lift, drag and pitching moment; and it is equipped with a two-mirror Schlieren apparatus. This tunnel can test models with one to two inch maximum diameters. The compressor room is equipped with three centrifigal compressors with compression ratios of 2.3 and each driven by a 3,000 hp electric motor, and two centrifigal compressors with compression ratios of 3.1 and each driven by a 2,000 hp electric motor. Two or more of these compressors are used in parallel to operate the present wind tunnel.

6. The new wind tunnel now under construction will have a flexible throat permitting operation at Mach numbers varying continuously up to 4.4. It will be equipped with a 6 component balance and will have provisions for spinning the model during the test.

7. The ballistic firing range is equipped to record the time and take a horizontal and vertical photograph of a projectile as it passes each of 25 stations along the range. Extensive work has been done on various shapes of projectiles including finned projectiles and hollow bullets. Results have checked the measurements made in the wind tunnel qualitatively but not quantitatively.

8. Dr. Tsien discussed the highly sweptback wing which played such an important role in recent German aerodynamic research. In the design

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Memorandum Report No. [illegible], "Conference on German Research in Supersonic Flow", [illegible] 1945.

of sweptback wings the center section must be considered as a straight wing for computing the drag coefficient, while the outer panels have drag coefficients based on the reduced effective Mach number. The portion of the wing which must be considered as part of the center section is dependent upon the angle of sweepback and the Mach number for which the wing is being designed. In general, however, the choice of wing plan forms for transonic and supersonic wings has not been solved.

[illegible] Mr. Tsien discussed the work done by the Germans on flow at extremely high Mach numbers. Aerodynamic flow can be split into the following categories:

Type of Flow	Mach No.
Subsonic	[illegible]
Transonic	.7 - 1.2
Supersonic	[illegible]
Hypersonic	[illegible]

[illegible] flow in the hypersonic condition is an entirely new regime. It can be assumed that effectively all of the energy of the air is in kinetic energy and that a decrease in pressure is obtained by further increase in velocity. This means that a flat plate would be the most effective airfoil. Analyses made by the Germans resulted in flat bottomed wings [illegible] with the upper surface curved or wedge shaped in a manner to give a minimum drag while including the required structure.

[illegible] Another problem to be considered in extremely high velocity [illegible] flight is that the mean free path of the air molecules is no longer small compared to the dimensions. Furthermore, the relaxation time [illegible] is no longer negligible compared to the time it takes for the air to pass over the wing. This will mean that the time is insufficient for the energy transfers to reach equilibrium and the standard aerodynamic equations will not be valid.

[illegible] The principal topics discussed in the periods after the conference were the effect of separation of the boundary layer in softening [illegible] and the extreme importance of turbulence in increasing the flame speed in rockets. The flame speed in laminar flow is between [illegible] and [illegible] meters per second whereas in strongly turbulent flow it is as high as [illegible] to [illegible] meters per second.

C. CONCLUSIONS:

[illegible] A considerable number of problems connected with the design of sweptback wings remain to be solved.

[illegible] A large amount of research is necessary before the design of aircraft with Mach numbers greater than four can be undertaken.

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Memorandum Report No. TSE[illegible]-1[illegible]1, "Conference on German Research in Supersonic Flow". [illegible] January 1946.

D. RECOMMENDATIONS:

1. That the Engineering Division in the future arrange similar conferences to encourage the interchange of technical ideas in such rapidly expanding fields of research.

Prepared by: C. [illegible] [illegible]Y, Major, Air Corps.

Approved: GEORGE [illegible] [illegible], Colonel, A.C.
Aircraft Projects Section

Approved:

JOHN [illegible] [illegible]LLY, Colonel, Air Corps

Chief, Pilotless Aircraft Branch

Dist:
Washington AC/AS-[illegible] CG, AAF (6)
Wright Field Reference Office TSRED
Airc. Lab. TSEAC
Pilotless Airc. Br. TSESA-7

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ARMY AIR FORCES
MATERIEL COMMAND
AIR TECHNICAL SERVICE COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

Auth: CG, ATSC
Initials: [illegible]
Date: 8 Jan 1946

TSESA-7/CRC/jd
Date 25 January 1946

SUBJECT: Visit of British Personnel to Wright Field.

OFFICE Aircraft Projects Section

SERIAL No. TSESA-1242

A. PURPOSE:

1. To report on visit to Wright Field by representatives of British Supply and Air Commission on 21 and 22 January 1946.

B. FACTUAL DATA:

1. A group of British engineers visiting various United States guided missiles development agencies was cleared by the Air Provost Marshal to visit Wright Field. This clearance covered the discussion and exchange of information on guided missiles work including new developments. However, discussions on research and development was limited to projects mutually developed or previously discussed. This group consisted of the following personnel:

Mr. J. H. Phillips, British Supply and Air Commission,
Washington, D.C.
Mr. R. J. Lees, Telecommunications Research Establishment,
Malvern, Worcester, England.
Mr. [illegible] Pollard, Ministry of Supply, London, England.

2. Mr. Lees and Mr. Pollard are specialists in radio control equipment; however, under the British breakdown, this category of equipment includes not only the radio equipment but also the gyro and servo units for the pilotless aircraft. While on Wright Field the above personnel visited the Pilotless Aircraft Branch, Aircraft Projects Section; the Electronics Subdivision; the Special Projects Laboratory of the Electronics Subdivision; and the Control Equipment Branch of the Equipment Laboratory. Principal personnel contacted were as follows:

Pilotless Aircraft Branch

Col. J. R. Kelly, Chief, Pilotless Aircraft Branch
Maj. Ezra Kotcher, Pilotless Aircraft Branch

Radio and Radar Subdivision

Col. [illegible] F. Heller
Maj. Gottschall

[redacted]

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[illegible] Jan 1946

Special Projects Laboratory

Capt. [illegible] Powers
Mr. [illegible]

Control Equipment Branch

Col. [illegible] Kime
Maj. A. [illegible]

3. [illegible] projects of the Engineering Division which were within the scope of the clearance were discussed with the British visitors. In exchange, a considerable amount of information on British projects was received. The British Air Ministry has recently completed a comprehensive analysis comparing the overall cost of ground-to-ground pilotless aircraft against conventional bombing, and concluded that conventional bombing was cheaper for targets within 1000 miles. This study, of course, was based on conditions of the recent war. As a result, their main effort has been towards the development of air-to-air and ground-to-air (anti-aircraft) pilotless aircraft; however, some thought has been given to the design of free trajectory rockets for long ground-to-ground use.

4. "Long Shot" is an air-to-air guided missile which was being developed for use against the [illegible] at the close of the recent war. It consists of a [illegible] diameter, body [illegible] long with four small flat plate wings and four control surfaces at the rear. It is capable of carrying a [illegible] lb. warhead and has an overall weight of [illegible] lbs. It is launched from a track beneath the wing of an airplane to a velocity of [illegible] ft. per second by a tandem booster consisting of [illegible] rockets [illegible] 1000 lb. of thrust for [illegible] seconds. Upon completion of burning, the attachment is separated by explosive bolts, and the booster falls free from the missile. No sustaining propulsion is used after separation. The missile is controlled only after separation by means of a [illegible], giving the missile an effective range of [illegible] ft. It is designed to [illegible].

5. Experimental models of "Long Shot" have been built and fired from a ground launcher. The first models were fired without separation of the booster and more recent models with separation. [illegible] flights of both types have been made. The alignment of the booster and the missile must be accurate. However, no particular difficulty has been encountered in this problem.

6. The beam follower receiver was first built and tried out with a [illegible] simulator and should soon be ready for flight testing. This [illegible]-tube receiver fits within a [illegible] diameter cylinder [illegible] long and includes within that space the electric servos. It is powered by a [illegible] volt battery similar to the one used in the American [illegible] and uses a small converter to give 210 volts DC plate supply. This radio control equipment is designed to withstand 30g launching accelerations.

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M. R. TSESA-12L2
25 Jan 1946

boosters, and models with radio control and power expect to be launched within six months. This missile is 9-1/2" in diameter and will be powered throughout its flight. Neither Mr. Pollard nor Mr. Lees were directly connected with this project.

Prepared by C. H. GUY, Major, AC

Approved by G. F. PRICE, Col., AC
Aircraft Projects Sec.

Concurrence:

Approved by

Distribution:

AC/AS-4 (5)	TSEPP-7	TSIRE
TSEAC	TSESA-7	TSELI
TSEPP-11	TSPNG	TSELP
	TSEPE	

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ATSC Form No. 44
6 Sep 44

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Dispatched 1-5-46

TSESA:GEP:as

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Guided Missiles

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
[illegible]N (TSESA)
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
G.E. PRICE
G. P. Smith
PROCUREMENT DIV.
READJUST DIV.
OTHER

Commanding General
Army Air Forces
Washington 25, D. C.

Att'n.: AC/AS-4

1. There are at present thirteen types of guided missiles which must be developed by the Armed Forces. They are:

a. Ground-to-Ground

(1) Subsonic (over 200 mile range) (400/700 mph)
(2) Supersonic (over 200 mile range) (1500 mph)
(3) Subsonic, 200 mile range (400 mph, JB-2)
(4) Supersonic projectile, 200 mile range (V-2) (3500 mph)
(5) Supersonic projectile, over 200 mile range (3500 mph)

b. Ground-to-Air

(6) Against high speed aircraft target.
(7) Against 3500 mph V-2 type target.

c. Air-to-Ground

(8) Vertical bombs, controlled.
(9) Subsonic (700 mph)
(10) Supersonic (1500 mph)

d. Air-to-Air - Offensive

(11) Subsonic (700 mph)
(12) Supersonic (1500 mph)

e. Air-to-Air - Defensive

(13) Subsonic (700 mph)

2. Each of these missiles contains five major components, each component being selected from a field of several models. The following is a partial breakdown of these components.

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Ltr. ATSC, [redacted] to CG, AAF, subject: Guided Missiles

	TYPE OF COMPONENT		NUMBER OF MODELS
a.	Power Plants		10
	Liquid Rockets	(3)	
	Ram Jets	(2)	
	Turbo Jets	(3)	
	Pulse Jets	(1)	
	Launching & Booster Rockets ..	(1)	
b.	Information Feeders (or "Controls")..		10
c.	Seekers		4
d.	Warheads		2
e.	Automatic pilots		3
	TOTAL		29

3. FACILITIES:

a. 15 major aircraft companies are available to build the missiles.

b. The component development load will have to be carried by not more than 36 radio and radar contractors plus 36 aircraft component manufacturers.

c. There are now available in this Country only eight wind tunnels (with over 3 sq.ft. of throat area) of sonic or greater speed. Four more will be available by the summer of 1946. These tunnels will have to carry the entire pilotless and conventional aircraft test load.

4. Considerable time and effort have been spent in attempting to allocate the responsibility for the various guided missiles. There have been endless jurisdictional arguments as to whether a given article is a Pilotless Aircraft or a Guided Missile; whether control fins were wings; whether the Army and Navy Air Forces had the exclusive rights to the use of wings; whether Ordnance could use fins which helped sustain flight in addition to exerting control forces; and whether an Ordnance missile could ever have a legitimate flight loading of 1g. The inevitable result has been unnecessary and ever increasing duplication of effort.

5. This plan, Plan A on the inclosed Chart, envisions an assignment of responsibility for each basic missile to one of the four Services: Army and Navy Air, Army and Navy Ordnance. The allocation of basic missiles has been influenced by what has in the past

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Ltr. ATSC, [redacted], AAF, subject: Guided Missiles

been considered normal cognizance. Regardless of whether or not the missiles in question have wings or oversized fins, the responsibility for "anti-aircraft," ground-to-air missiles has been assigned to Army and Navy Ordnance; the short range (up to 200 miles) V-2 type of projectile has been considered an artillery weapon and assigned to Army Ordnance; the long range (over 200 miles) V-2 type of projectile is considered a strategic bombing weapon and assigned to the AAF. The balance of the missiles have in general been divided between Army and Navy Air with Army Air being assigned the supersonic field and Navy Air the subsonic field. This was considered much more advantageous than having both Services covering both the supersonic and the subsonic fields. A missile developed by one Service would be furnished to another Service having an operational requirement for that missile.

6. This plan is believed to insure adequate coverage of the basic missile field. It assumes that in the development of any one guided missile the responsible Service will have two contracters working independently and will choose the better of the two missiles for production. However, if any additional competitive coverage of basic missiles should be considered desirable it should be remembered that each additional competing Service would require two contractors per missile; that there are thirteen basic missiles; and that there are four Services to consider. Thus any unnecessary empire building in the field of basic missiles starts the Armed Forces along the road that leads from 26 missile contracts to 104. This against the 15 major aircraft manufacturers available.

7. Little cognizance seems to have been taken of the fact that given the propulsion and control components; the fabrication of the missile airframe and the launching gear is relatively simple. The development of missile components is a problem of great magnitude. This plan covers the allocation of the components on a strict service cognizance basis. Developed components would, of course, be interchanged between Services. The allocation has in general followed the allocation of the relevant basic missiles, with some exceptions which are noted on the Chart. Controlled competition between Services is encouraged in building very important components, i.e., power plants, warheads and seekers. As in the case of the basic missiles, it must be assumed that the responsible Service will have two contractors developing a given component and will choose the better development for production. The Government must either develop these components for the basic missile contractors or limit to two the number of basic missile contractors developing any given component, except in the case of power plants, warheads and seekers where the limit would be four.

8. Even under this strict cognizance control of the 13 basic missiles and the 29 models of components, American industry will have its development abilities heavily overloaded. As shown in Plan A on the Chart, 54 component contractors will be required by the Services for adequate coverage of the 29 components which are needed. Plan B on the Chart, which is fairly representative of actual practice today,

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increases the component development load from 54 component contractors to 111 contractors, an increase of 106% which will seriously threaten to swamp industry.

9. If the missile components are being independently developed by the missile contractor, he will or should give himself the same double coverage noted before and will engage two subcontractors per component. In the early stages of the missile development he also must cover more than one model of component; for example, both a liquid rocket and a turbo jet power plant and both a heat seeker and a radar seeker. Fantastic increases in the load on the components industry will result unless the Government limits the number of basic missile contractors who are developing or controlling the development of any given component. If there is no limit the following can happen:

a. With basic missile cognizance strictly allocated it would mean an increase in components subcontractors from the required 54 to 218, an increase of 304%.

b. With basic missile cognizance overlapping as in Plan B on the Chart, the components subcontractors would increase from the required 54 to 292, an increase of 440%.

c. In the admittedly unlikely situation of each of the four Services building all of the basic missiles as in "No Plan" on the Chart, the components subcontractors could increase from the required 54 to 856, an increase of 1485%.

10. <u>RECOMMENDATIONS.</u>

a. That the Army Air Forces recommend to the joint Chiefs of Staff the following:

(1) That the responsibility for development and production of guided missiles be delegated as shown under Plan A on the inclosed chart (Exhibit A).

(2) That the responsibility for the development and production of guided missile components be delegated as shown under the same plan.

(3) That operational cognizance for guided missiles be that shown on the same chart under "Normal Cognizance."

(4) That the definitions of guided missiles contained in Exhibit B inclosed be approved.

(5) That the Service assigned responsibility for the development and production of a component be required to furnish that component to all guided missile contractors.

[redacted]

Ltr. ATSC, to CG, AAF, subject: Guided Missiles

(6) That all Services be directed to furnish to all other Services components, engineering information, and monthly progress reports as required by those other Services.

(7) That in the event of approval of this plan the four Services be directed to mutually agree on the physical and military characteristics of those common components listed in Chart A.

b. In any event, that the military characteristics listed in Exhibit G inclosed be withdrawn for the reasons shown in that Exhibit.

c. That the Army Air Forces Pilotless Aircraft Program be conducted according to Plan B if Plan A is not approved.

N. F. TWINING,
Lieut. General, USA,
Commanding.

7 Incls.
#1 - Exhib. A - Chart
#2 - Exhib. B - Definitions
#3 - Exhib. C - List of Mfgrs. of Basic Missiles
#4 - Exhib. D - List of Mfgrs. of Radio & Radar Equip.
#5 - Exhib. E - List of Mfgrs. of Components
#6 - Exhib. F - List of U.S. Wind Tunnels & their Capacity
#7 - Exhib. G - List of Mil. Charas. suggested to be withdrawn

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EXHIBIT B

DEFINITIONS

1. Ground-to-Ground - Long Range Pilotless Aircraft. Definition: A weapon of the subsonic or supersonic aircraft type to operate at ranges greater than 200 miles. Will operate in level flight (sustained by wings or rockets) for the greater part of its travel.

2. Ground-to-Ground - Long Range Projectile. Definition: Weapons of the V-2 type (with wings probably added) having ranges greater than 200 miles.

3. Ground-to-Ground - Short Range Projectile. Definition: A weapon of the V-2 type having a maximum range of 200 miles. Does not preclude the use of wings or stabilizing fins used for glide stabilizing purposes or fins used for control purposes.

4. Ground-to-Air. Definition: Missiles designed to intercept and destroy piloted and pilotless aircraft and projectiles.

5. Air-to-Ground. Definition: An aircraft launched missile; manually controlled or automatically target seeking. Missile speeds of about 700 MPH and 1500 MPH.

6. Air-to-Air - Offensive. Definition: Aircraft launched missiles designed to intercept and destroy 700 MPH aircraft at missile speeds of 900 and 1500 MPH.

7. Air-to-Air - Defensive. Definition: Aircraft launched missiles designed to intercept and destroy 700 MPH attacking aircraft and 1500 MPH "attacking" missiles. Will travel at supersonic speeds.

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EXHIBIT C

1. Companies available to design and fabricate basic missiles:

Major Companies

BELL	GOODYEAR	CHANCE-VOUGHT
BOEING	LOCKHEED	GRUMMAN
CONSOLIDATED	MARTIN	REPUBLIC
CURTISS	MCDONNELL	
DOUGLAS	NORTH AMERICAN	15 - TOTAL
FAIRCHILD	NORTHROP	

Secondary Companies

CULVER	INTERSTATE	PRATT, REED
EDO	RADIO-PLANE	TAYLORCRAFT
GLOBE	PIPER	WACO
HUGHES	NORTHWESTERN	WURLITZER
		12 - TOTAL

2. Companies available to design and fabricate power plants:

ROCKETS	TURBO JETS	RAM JETS
AEROJET	WESTINGHOUSE	WRIGHT AERO.
AM. CYANAMID & CHEM.	GENERAL ELECTRIC	CONTINENTAL
REACTION MFRS.	WRIGHT	
	LOCKHEED	9 - TOTAL

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MANUFACTURERS OF RADIO AND RADAR

Major Contractors who have both Engineering and Production facilities:

Western Electric, New York, N. Y.
Philco, Philadelphia, Pennsylvania.
RCA, Camden, New Jersey
General Electric, Syracuse, N.Y.
Bendix Aviation Radio Division, Baltimore, Maryland
Farnsworth Radio and Television Company, Fort Wayne, Indiana
Bell Telephone Laboratories

TOTAL - 7

Smaller Contractors who have both Engineering and Production facilities:

Emerson Radio Corporation, New York, N.Y.
Rada Radio Co., Long Island City, N.Y.
Fairchild Camera and Instrument Corporation, New York, N.Y.
Federal Telephone and Radio Corp., Newark, N.J.
Harvey Radio Company, Cambridge, Mass.
Holtzer-Cabot Division of First Industrial Corporation, Boston, Mass.
Hudson American Company, Brooklyn, N.Y.
Maguire Industries, Bridgeport, Conn.
Radio Receptor Company, New York, N.Y.
Stromberg-Carlson, Rochester, N.Y.
Templetone Radio Corporation, New London, Conn.
Westinghouse Electric and Manufacturing Company, Springfield, Mass.
Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.
Crosley Radio Corporation, Cincinnati, Ohio
Sparks-Withington Company, Jackson, Mich.
Belmont Radio Corporation, Chicago, Ill.
Delco Radio Division of General Motors, Kokomo, Indiana.
Doolittle Radio Corporation, Chicago, Ill.
Galvin Manufacturing Corporation, Chicago, Ill.
Hallycrafters, Chicago, Ill.
Magnavox, Fort Wayne, Indiana.
Noblitt Sparks Company, Columbus, Indiana.
Setchell-Carlson Company, St. Paul, Minn.
Sonora Radio and Television Corporation, Chicago, Ill.
Stewart-Warner Corporation, Chicago, Ill.
Wells-Gardner Company, Chicago, Ill.
Zenith Radio Corporation, Chicago, Ill.
Bendix Aviation Pacific Division, North Hollywood, California.
Gilfillan Corporation, Los Angeles, California.

TOTAL - 29

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EXHIBIT E

Manufacturers of complicated combination electrical, hydraulic, and mechanical devices, including instruments of the more complicated variety, compensating gun sights, etc.

Aero Equipment Company, Cleveland, Ohio
Air Research, Los Angeles, Calif.
American Bosch Company, Springfield 7, Mass.
Bausch and Lomb Optical Company, Rochester 2, N.Y.
Bowser, S.E., Company, Fort Wayne, Indiana
Cambridge Instrument Company
Cutler-Hammer, Inc., Milwaukee, Wisconsin.
Delco Productions Division, Dayton, Ohio
Eastman Kodak, Rochester, N.Y.
Emerson Electric Manufacturing Co., St. Louis 21, Mo.
Fairchild Camera and Instrument Company, New York, N.Y.
Ferrant Optical Company, New York
General Electric Co., Schenectady 5, N.Y. (Main Office)
Harvey Machine Co., Los Angeles, Calif.
Hobard Manufacturing Company
Jack & Heintz, Inc., Bedford, Ohio
Jack & Heintz, Inc., Cleveland, Ohio
Illsman Instrument Div., Elmhurst, L.I., N.Y.
L.A.B. Corporation, Summit, N.J.
P. R. Mallory and Co., Indianapolis, Ind.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
National Cash Register Co., Dayton, Ohio
Elmer Perkins Co., Glenborough, Connecticut
Pioneer Instrument Div., Bendix Aviation Corp., Teterboro, N.J.
Scintilla Magneto Co., Sidney, N.Y. (Slow)
A.O. Smith Company, Milwaukee, Wisconsin
Sparks-Withington Company, Jackson, Michigan
Sperry Gyroscope Company, Great Neck, L.I., N.Y.
Sperti, Inc., Cincinnati, Ohio
Standard Aircraft Products, Dayton, Ohio
Ternstedt Manufacturing Division
Thomas A. Edison, Inc.
Vickers, Inc., Detroit 27, Mich.
Victor Adding Machine Co., Evanston, Ill.
Westinghouse Electric Manufacturing Company, Newark, N.J.
Westinghouse Electric Manufacturing Co., Trafford, Pa.

TOTAL - 36

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EXHIBIT F

U. S. WIND TUNNELS

I. Presently operating: (Over 3 feet - 600 mph)

a. N.A.C.A. - L.M.A.L. Langley Field, Virginia

8 ft. circular, 14.4 ft. length

V = 750, M = 1.0, Power = 16,000 hp. Pressure atmospheric

Type of Tests - lift, drag, yaw, moment, pressure distribution

b. N.A.C.A. - A.A.L., Moffett Field

16 ft. circular, 24 ft. length

V = 680, M = .9, E = 27,000 hp., Pressure - Atmospheric

Type of Tests - lift, drag, yaw, moment, pressure distribution

Powered models

c. N.A.C.A. - L.M.A.L., Langley

High speed - 7 ft. x 10 ft. Rectangular - 15 ft. long

M = 1.0, Power = 10,000 hp. Pressure = atmospheric

Type of Tests - lift, drag, yaw, moment, pressure distribution

Powered models

Tip support, 1, 2, 3 strut systems

d. N.A.C.A. - L.M.A.L. (Langley) 4.5 ft. circular, 9 ft. length

1. Flutter tunnel V = 975, M = 1.0 Power = 1000 hp uses Ferron 12 instead of air-Type of Tests - lift, drag, moment and flutter

e. United Aircraft, East Hartford

18 ft. octagonal 36 ft. length

V at 8 ft. = 600 M = .8 Power = 7000 hp.

Type of Tests - lift, drag, yaw, moment, pressure distribution

Engine powered models [redacted]

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EXHIBIT F (Cont'd.)

f. Boeing Aircraft, Seattle

8 ft. x 12 ft. octagonal, 15 ft. length

V = 715, M = .95, Power = 18,000 hp.

Type of Tests - Powered Models, lift, drag, yaw, moment, pressure distribution.

g. Guggenheim Aeronautical Lab., C.I.T., Pasadena

8-1/2 ft. x 12 ft. rectangular, 18 ft. length

V = 760, M = 1, Power = 12,000 hp. Pressure = 1/10 to 4 atmospheric

Type of Tests - lift, drag, yaw, moment, pressure distribution, turbulence, wake

Powered Models.

II. Presently Operating: (Over 2 ft. - 600 mph)

a. N.A.C.A. - A.A.L., Moffett Field, California

1 ft. x 3-1/2 ft. rectangular, 10 ft. length

V = 730, M = 1.0, Power = 2000 hp.

Type of Tests - lift, drag, moment, pressure distribution

Tip supported models.

III. Operating in 1946:

a. U.S.A.A.F. - Wright

1. 10 ft. circular, 16 ft., 7 in. length

M = 1.0, Temperature = 165 to -30°F., Pressure = 1/8 to 2 atmospheric

Power = 40,000 hp. Type of Tests - pressure distribution and force measurements.

Powered Models

Jet Units

b. A.A.F. - Wright

2 ft. x 2 ft. rectangular

M = 2.5, Pressure = 1/10 to 1 atmospheric, Type of Tests - pressure distribution and force measurements

Powered Models

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EXHIBIT F (Concluded)

e. N.A.C.A. - A.A.L. Moffett Field (Not yet operating) under 2 ft. tunnels

2 1 ft. x 3 ft. rectangular supersonic

a) 1 ft. x 3 ft. rectangular - intermittent M = 3.4

b) Continuous 1 ft. x 3 ft. rectangular M = 2.3

Type of Tests - lift, drag, moment, pressure distribution

Models - tip supported.

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EXHIBIT C

Certain Pilotless Aircraft presently called for by AAF Military Characteristics (issued or planned for issue) have been disregarded by this plan and the requirements for them should be withdrawn. These pilotless aircraft are the following:

a. Air-to-Ground - Glide Type Missile. Far too vulnerable due to low speeds. Unnecessary in view of contemplated air-to-ground powered missiles.

b. Torpedo Carrying Guided Missiles. See retrievable guided missiles below.

c. Retrievable Guided Missiles - Bomber and Fighter Types. The guided missile program is too complicated at present without the addition of these luxury items. For bomber types, they violate the basic principle of Pilotless Aircraft, i.e., that the explosive payload is tremendously increased by virtue of the one-way fuel load. In addition, for any given state of aviation development the range of a pilotless aircraft per fixed explosive load will be 250 per cent of the same aircraft used as a retrievable. For Fighter types the same range limitations exist. Further, serious doubts exist as to the economic value of a television controlled fighter in comparison with Ground-to-Ground guided missiles.

d. Defense Measures Against all Guided Missiles (U.S. and Enemy) - The AAF and NAF should be concerned only with defense against Air-to-Air missiles. The defense against all other missiles is properly that of Army and Navy Ordnance.

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V-6292

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PROPOSED ALLOCATION OF BASIC MISSILES AND COMPONENTS

CONFIDENTIAL

20 January 1946

GENERAL NOTES

a. [illegible] of Symbols:
AA - Army Air Forces   NA - Naval Air
AO - Army Ordnance   NO - Naval Ordnance

b. In an effort to inject some standardization, power plants, automatic pilots and warheads have been divided into classes. These classes are indicated by Roman Numerals at the tops of the columns. Thus a Class I turbo jet would be of sufficient power to propel any missile shown as requiring a Class I power plant. Tentatively these classes are as follows:

Power Plants:
Class I 400 lbs.
Class II 4,000 lbs.
Class III [illegible],000 lbs.
Class IV 60,000 lbs.

The final physical characteristics of these power plants will have to be decided by the guided missiles design committee.

Auto Pilots:
Class I Light Weight [illegible]
Class II Conventional [illegible]
Class III Heavy Duty [illegible]

Warheads:
Class I 100 lbs.
Class II 2,000 lbs.

c. The numbers from 1 to 4 in the major component columns indicate first to fourth choice respectively. A notation such as [illegible] indicates, respectively, second choice for operating against land targets and first choice for operating against sea targets. [illegible] and [illegible] indicate, respectively, that the component would not be suitable for operation against land targets or that the component would not be suitable for operation against sea targets.

d. In certain instances in the itemized breakdown at the bottom of the components column a series of numbers will appear under the different component class headings, i.e.,

	LIQUID ROCKET I	II	IV
AAF	2	(2)	0

This indicates that the AAF would have two contractors developing liquid rockets. Each contractor would be developing one Class I and one Class II rocket. If there were no parenthesis around the two under column II, it would indicate four contractors, i.e., one Class I rocket being built by each of two contractors and one Class II rocket being built by each of two other contractors.

e. Under "Homing, Enemy Radio & Radar" the "x" indicates that this homing should be available for the initial phases of hostilities.

f. "Loran" and "Shoran" type of navigation control has not be considered due to ease of jamming.

g. The JB-2 which is built to operate in the ranges normally covered by V-2's has been retained due to being an "on-the-shelf" article.

BASIC MISSILES

Basic Missiles	Normal Cognizance	Number to be Developed: No Plan	Plan B	Plan A
GROUND/GROUND				
LR 500/700 MPH (above 200 mi. w/Tail Warning) ([illegible] range)	AA	[illegible]	2AA	2AA
LR 1500 MPH (Over 200 mi. range)	AA	[illegible]	3AA	3AA
SR 400 MPH vs. Land/Sea (JB-2)	AA	[illegible]	1AA	1AA
3500 MPH PROJECTILE (200 mi. range)	AO	[illegible]	2AO	2AO
4500 MPH PROJECTILE (above 200 mi. range)	AA	[illegible]	2AA	2AA
GROUND/AIR				
VS High Speed Aircraft Target	NO/AO	[illegible]	2AO 2NO	2NO
VS 3500 MPH (V-2) Target	AO	[illegible]	3AO	3AO
AIR/GROUND				
Vertical Bomb	NA/AA	[illegible]	1AA	1AA
700 MPH VS Land/Sea Targets	NA/AA	[illegible]	2AA 2NA	[illegible]
1[illegible] MPH VS Land/Sea Targets	NA/AA	[illegible]	2AA	2AA
AIR/AIR OFFENSIVE				
700 MPH	AA NA	[illegible]	2AA 2NA	2NA
1500 MPH	AA NA	[illegible]	2AA 2NA	2AA
AIR/AIR DEFENSIVE				
700 MPH	AA NA		2AA 2NA	2NA
NO PLAN:				
1. Missiles to Develop		104		
2. Missile Contractors Developing Components				
PLAN B:				
1. Missiles to Develop			56	
2. Missile Contractors Developing Components				
3. Component Contractors Developing for: (1) AA (2) AO (3) NA (4) NO				
TOTAL COMPONENTS				
PLAN A:				
1. Missile to Develop				26
2. Missile Contractors Developing Components				
3. Component Contractors Developing for: (1) AA (2) AO (3) NA (4) NO				
TOTAL COMPONENTS				

MAJOR COMPONENTS (Numbers [illegible] for various components): POWER PLANTS (Liquid Rocket, Ram Jet, Turbo Jet, Pulse Jet, Launching or Booster Rockets); NAVIGATION / INTERMEDIATE FLIGHT (Television & Manual, Manual Air/Gr. Short Range, Manual Override, [illegible]); HOMING (Radar, Heat, Light, Enemy Radio and Radar); WARHEADS (Warheads I, II); AUTOPILOTS (Automatic I, II, III). Numbers indicate totals for each component.

(A) Rockets - Cognizance has been given to the Army and Navy Ordnance to give them the entire liquid and solid rocket fields.
(B) Class I Ram Jets - AAF has been given cognizance due to control of three out of five basic missiles.
(C) Class I Turbo Jets Naval Air has been given cognizance instead of Naval Ordnance for the same reasons as above.
(D) Booster & Launching Rockets - Naval Ordnance has been given cognizance primarily due to its past experience with [illegible].
(E) Radar Map Trackers - Army Air has paramount interest. Naval Air involved only because of [illegible].
(F) Magnetic Pilot - Given to AAF due to control of four out of six basic missiles.
(G) Television - Given to Naval Air instead of Naval Ordnance due to allocation of air controlled television to Naval [illegible] given to Navy [illegible] greater value against sea targets.
(H) Manual Override - Naval Air due to control of mothered radar and television.
(I) Heat Seekers - Assigned to AAF due to its control of four out of seven basic missiles. Also of no value in use against sea targets.
(J) Class II Warheads - Naval Ordnance has no Class II warheads but is assigned the development [illegible] Class I warhead [illegible].
(K) Auto Pilots - Assigned to Army and Naval Air due to previous experience with auto pilots.

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Gen. Crawford/ee/71500 [redacted]

(1)

Subject: Bureau of Aeronautics Pilotless Aircraft Development Program. X380

1st Ind. AFDRE-1

Headquarters, Army Air Forces, Washington 25, D. C. 25 February 1946

To: Commanding General, Air Technical Service Command, Wright Field, Dayton, Ohio. VIA Bureau of Aeronautics General Representative, Central District, Wright Field, Dayton, Ohio. (Attn: TSEMO)

1. Reference is made to basic letter dated 4 February 1946, from the Chief of the Bureau of Aeronautics, which was dispatched first to this office.

2. An examination of the scope of the program outlined in the basic letter indicates that when this program is superimposed upon the programs of the Bureau of Ordnance, Ordnance Department and program of the AAF, there will be a serious possibility of duplication and an unnecessary overlap of projects unless all such projects are very closely coordinated. There are several Committees in existence at the present time which have been established for the purpose of obtaining the required coordination, but no such committees can eliminate the need for close and frequent liaison and exchange of plans at the working level. Not only is there the possibility of unnecessary duplication and overlap from a money standpoint but, of equal or even more importance, is the inefficient utilization of qualified personnel and facilities which will result from a duplicated program. In this connection, the following quotation from the Office of the Chief of Staff, dated 13 February 1946, is quoted for your information and appropriate action:

"In the meantime and until further instructions are issued, each of the Forces will be responsible that unnecessary duplication is avoided in research and development in the field of Guided Missiles. For this purpose, projects undertaken will be appropriately coordinated among the Forces themselves and with the Guided Missiles Committee of the Joint New Weapons Committee of the Joint Chiefs of Staff, upon which each of the responsible agencies has representation and which is the established joint agency of the War and Navy Departments to effect coordination in the field of Guided Missiles. Where studies by an agency establish that missiles will result which are practically equivalent to missiles under study or development by another agency, the question of the continuance of such studies into development of missiles will be referred to the Guided Missiles Committee for determination as to which agency is best equipped to proceed, and the study or development will be carried forward by that agency either without assistance or with the assistance of the other interested agencies as may be considered advisable to produce the best results."

3. In order that the Guided Missile program may be prosecuted with the greatest possible efficiency, it is directed that the Air Technical Service Command take such action as is necessary to insure:

a. An immediate and thereafter periodic review of all existing AAF guided missiles projects with a view of either AAF or other appropriate agency cancellations of all projects where an undesirable duplication or overlap of development appears to exist. It is obvious that with the very appreciable

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1st Ind. to CG, ATSC 25 Feb 1946

amount of money being spent on guided missiles development by the four Governmental agencies involved, that some undesirable duplication or overlap in the combined projects of the four agencies will exist. These instances must be reduced to the absolute minimum. This probability of undesirable duplication will be even greater during the Fiscal Year 1947, due to the greatly increased money contemplated for expenditure for guided missile development during that year.

b. An immediate review of the existing liaison arrangements for discovering and dealing with disclosed duplications and overlap of AAF, Ordnance Department and Navy programs.

c. The adequacy of Army Air Force contracts and projects, existing or contemplated, in order that necessary AAF development becomes established before the lack of such necessary AAF development results in an initiation of development projects by other Governmental agencies interested in the guided missiles field, which are properly of primary interest to the AAF.

d. The combining of two (2) or more projects into one joint financed and administered project, where two (2) or more Governmental agencies have a legitimate interest in the particular project.

e. An exchange of accomplished and planning data similar to that shown in the basic communication with all other interested government agencies, including the Guided Missiles Sub-Committee of the Joint Chiefs of Staff, Joint New Weapons Committee.

4. Your recommendations as to supplementary action, which might be appropriately undertaken by Headquarters, AAF, to avoid or eliminate possible interference or duplication of guided missiles effort, are requested.

By Command of General SPAATZ:

ALDEN R. CRAWFORD
Brigadier General, U.S.A.
Chief, Research & Engineering Division
Office, Asst Chief of Air Staff -

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HQ AAF

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[illegible]

March 1946

Fleet Admiral Chester W. Nimitz
Chief of Naval Operations
Navy Department
Room 2066, Navy Building
Washington, D.C.

Dear Admiral Nimitz:

Considerable attention is being given to the research and development activities of the War and Navy Departments in the field of Guided Missiles, and claim is being made of duplication and ineffectiveness in the use of funds. It would seem that in the main there should be little, if any, [illegible] since considerable [illegible] is being effected in this field by the Guided Missiles Committee under the Joint New Weapons Committee of the Joint Chiefs of Staff. However, I am having a review made of the assignments of responsibility for research and development of the various types of Guided Missiles in the War Department, and I am [illegible] instructions [illegible] effecting coordination to prevent unnecessary duplication. I am attaching the War Department directive on this subject for your information.

I believe it would be helpful if you might take similar action. Also it would be desirable to establish between the War and Navy Departments the respective fields of responsibility for research and development of Guided Missiles, and should it develop that equivalent missiles are being considered for development by both Departments to assign these for development to the Department which would be best fitted to undertake the work and carry it forward.

I suggest that the results of the investigation in our respective Departments be referred to the Guided Missiles Committee about 15 March 1946 [illegible] of any differences which may develop and the two Departments to [illegible] any action considered to be necessary in the assignment of research and development in the field of Guided Missiles to be certain that unnecessary duplication is avoided and effective performance is secured.

I would be very glad to have your thoughts on this subject and information on any action in this matter being taken in the Navy Department.

Sincerely,

/s/ DWIGHT D. EISENHOWER

"This letter merely pursues the same line
of thought that I suggested to you relative
to having the existing committee meet with
[illegible] responsibility. While you agreed
I [illegible] the Committee may not meet [illegible]
until next week."

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[redacted]

Gen. Crawford/66771560
Wtn 26 Feb 1946

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4 MAR 1946

Army Air Forces
2-27-46
Date Initials

MEMORANDUM FOR DEPUTY CHIEF OF STAFF:

SUBJECT: Policy on Research and Development of Guided Missiles

x360.2

1. The instructions of the Deputy Chief of Staff, dated October 2, 1944, subject: "Guided Missiles," assigned to the AAF the responsibility for development of all guided or homing missiles dropped or launched from aircraft, and all guided or homing missiles launched from the ground which depend for sustenance primarily in the lift of aerodynamic forces. Development responsibilities for guided or homing missiles depending primarily upon their momentum for sustenance in flight were, by the same instructions, assigned to the Army Service Forces. No division of guided missiles responsibilities between the Army and Navy was announced.

2. Guided missile development responsibilities of the War Department are performed by the Army Air Forces and the Ordnance Department. Similar responsibilities in the Navy are performed by the Bureau of Aeronautics and Bureau of Ordnance. Closer liaison and coordination of information between the four interested services has probably been had on the research and development of guided missiles than on any other subject. However, in view of the many unknowns, the extensive amount of basic research which must be performed, and the accumulative large amounts of money being expended by the four Services, a considerable duplication appears to be eventually inevitable, unless a more definite line of demarkation between the development responsibilities of the interested agencies is arrived at.

3. It is believed that no appreciable amount of undesirable duplication or overlap of research and development projects has occurred to date, but this condition cannot continue for long. Unnecessary or undesirable duplication should not be tolerated, not only from the standpoint of inefficient expenditure of money, but, of equal or greater importance, the great potential value of guided missiles does not permit an inefficient utilization of the limited facilities and personnel capable of contributing to the desired rapid development of these weapons.

4. Possible solutions for the problem of a more definite placement of guided missile developmental responsibilities would appear to be as outlined in the following alternatives. An attempt has been made to summarize the advantages for and against each of these proposals.

a. Re-emphasizing the necessity of the closest possible coordination between all interested agencies, without modification of the existing directive, pending progression of development of the entire field of guided missiles.

x321 AAF

1651 Research

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Memo for Deputy Chief of Staff

(1) Advantages

(a) No disruptions to the present programs of the four existing agencies, which programs are just now beginning to get under way.

(b) No required transfer of specialists between services to administer existing projects, which transfer would be required, if existing and planned projects were reassigned.

(c) Permits of a continued attack on the many problems involved in the field of guided missiles from the viewpoints and different approaches of several services.

(2) Disadvantages

(a) No amount of coordination, regardless of the intent of the coordinating agencies, can eliminate the considerable amount of inevitably undesirable and unnecessary duplication resulting from an approach by four agencies to a problem of the magnitude of the guided missile problem.

(b) Competition for the limited qualified facilities and talent will continue.

(c) Merely postpones the decision as to the more clearly established responsibilities of the interested agencies which will be eventually required.

b. No modification of the current directive on development responsibilities, except a specific placement of selected component parts developments entering into the completed guided missiles, with the Service possessing the most technical, background knowledge.

(1) Advantages

(a) An approach to the overall guided missile problem from several directions is insured.

(b) Most of the competition for facilities and qualified personnel will be eliminated.

(c) Most of the potential duplication will be eliminated.

(d) Insures a utilization of the experience, knowledge and facilities of the most qualified technical service.

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Memo for the Deputy Chief of Staff

(2) Disadvantages

(a) Requires some transfer of existing or planned projects.

(b) Some duplication will still be involved due to the necessity of final engineering and development when the basically engineered component is incorporated into the complete missile.

(c) Possibility of out-of-phase culmination of development of missiles and components.

(d) Probable dissatisfaction of development agencies with the characteristics of components developed by another service.

(e) Relaxation of the present competitive efforts in the field of component development.

c. Assignment of developmental responsibilities between the Service Forces and Air Forces, in accordance with an arbitrary decision as to the limiting ranges of Service Forces development of ground-to-ground missiles, and contemplated operational usage of antiaircraft types ground-to-air missiles.

(1) Advantages

(a) Insures an approach to guided missile development problems from several angles. The more varying the methods of approach, the sooner an acceptable solution will be realized.

(b) Does not require any immediate transfer of projects.

(2) Disadvantages

(a) Does not eliminate duplication of either component or complete missile development, inasmuch as basically the same development is required for a moderate extension of artillery ranges, if controllability in flight is to be had, as is required for longer tactical or strategic ranges. The same is true for antiaircraft and air-to-air missiles.

(b) Once initially established maximum ranges established for any service are realized, that service will attempt to extend such ranges into the sphere established for another service.

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(c) Competition for facilities and qualified developmental contractors is continued.

d. Assignment of the development of all guided missiles which are controllable in flight to the Army Air Forces.

(1) Advantages

(a) Eliminates the infringement of other services into the aerodynamic field. Since all missiles, if controllable in flight, must depend on aerodynamics forces for that control, it is in this field that the majority of the potential duplication and competition lies. Under this proposed solution, the Army Air Forces would rely upon the Army Service Forces for the development of those items, such as explosives and warheads, for which the Army Service Forces has the most technical, background knowledge.

(b) Places developmental responsibility with the service having the basic know-how in the development of aircraft, including the related fields of aerodynamics, high horse-power power plants, automatic flight control, and air-foil control surfaces.

(c) Permits of a gradual transition of the aircraft industry from piloted to pilotless aircraft or missiles, should pilotless aircraft progress to a point of replacement of the conventional military aircraft.

(d) Permits the aircraft industry to continue to look to one service for its contacts and contracts, with a resultant elimination of confusion and duplication of engineering and contract administration.

(e) Eliminates the current frantic inter-service competitive efforts, which competition, though healthful, will inevitably get out of control, and result, not only in a waste of money, but an unnecessary overloading of the qualified industry, with a strong possibility of delay in reaching the ultimate solution.

(f) Eliminates any possibility of omission or evasion of development responsibility, due to confusion of assignments between services.

OFFICE SYMBOL			
GRADE AND SURNAME OF COORDINATING OFFICERS	[redacted]		

W770

[redacted]

(2) Disadvantages

(a) Requires a reassignment of existing or planned projects, including a desirable temporary transfer of personnel currently administering that project.

(b) Introduces the Army Air Forces into the field of development of antiaircraft, and a supplementary extension of artillery ranges.

(c) Restricts the present highly competitive approaches of the different services to the development of a weapon of great potential value.

5. The establishment of a central War Department coordinating office, similar to that established in the Navy Department, for the specific approval of the proposed placement of guided missile development projects, has not been included among the above alternative solutions. This possible solution has intentionally not been included, as any augmentation of the current functions of the War Department Special Staff New Developments Division, to include this detailed supervision over the guided missile programs of the Air Forces and Service Forces would either, (1) create a bottleneck in authorization for placement of projects, (2) require a great expansion in the strength of the New Developments Division, which personnel could more advantageously be used in the direct administration of the guided missile programs, or (3) would require that Division to establish the rules under which each service would initiate projects falling within their scope. If such an office were established, the first two requirements are believed to be obviously undesirable, and the importance of the development of a weapon of the great potentialities of guided missiles, is believed, warrants a decision by the Joint Chiefs of Staff themselves as to the placement of both developmental and operational responsibilities.

6. An analysis of the advantages and disadvantages of each of the solutions outlined in paragraph 4 indicates the solution recommended in par. 4d will result in the least amount of developmental duplication or overlap. This solution will also result in the assignment of developmental responsibilities to the War Department agencies having the greatest amount of technical, background knowledge. Any missile traveling at any appreciable distance beyond the current ranges of artillery must be guided in flight, if a reasonable accuracy is to be obtained. This guidance in flight requires incorporation in the missile of such basically aerodynamic components as automatic pilots, magnetic and stellar controls, ram, turbo and pulse jet engines, and airfoil control surfaces. In all of these, as well as many other problems connected with the development of guided missiles, the Army Air Forces would appear to not only be the logical developmental agency, but, any infringement in such developmental fields by another service, will probably result in a serious duplication of effort in a field of restricted capacity. It should be emphasized that, in the solution recommended in par. 4d, the Air Forces would not attempt to

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W771 [redacted]

Gen. Crawford/ee/71500
Wtn - 26 February 1946

Memo for the Deputy Chief of Staff

duplicate the development of such items as explosives, warheads, and chemical fuels. The Air Forces would also rely on proper agencies of the Service Forces for the basic development of such items as radio and radar. The application of such basic developments to guided missiles would, however, appear to be properly chargeable to the Air Forces, similar to their current responsibility for the incorporation of basic radio and radar developments into conventional aircraft designs.

7. The wisdom of development of ground-to-air antiaircraft type guided missiles by the Air Forces also warrants some further explanation. The guided missiles antiaircraft weapon must rely on aerodynamic surfaces for the control necessary, if any reasonable accuracy is to be obtained, even more so than the longer range ground-to-ground missile. This is due to the more rapid correction of course required of antiaircraft missiles than the longer range ground-to-ground missile. In addition, the antiaircraft type of missile must, obviously, have many of the target seeking and maneuverability characteristics required by the air-to-air type guided missile. Any division of responsibility for development of these two similar weapons to different services appears highly undesirable.

8. Should the solution detailed in par. 4d not be favorably considered, the solution in par. 4b is considered the next most satisfactory substitute.

9. Insofar as the establishment of a more definite line of demarkation of guided missile developmental responsibilities between the War and Navy Departments is concerned, it is believed that it would be to the interest of the national economy, if the Navy were to limit its developmental responsibilities to an adaptation of War Department developed defensive and offensive missiles to shipboard or naval aircraft use. This suggestion will, in all probability, be considered by the Navy Department as untenable restriction of their prerogatives , without limitation of their responsibilities, and there is much logic to this probable attitude. An alternate solution to the problem of establishment of guided missile development responsibility between the War and Navy Departments can be had by continuation and augmentation of the current close liaison and an advance exchange of planning data.

Signed

[redacted]

MAR 1946

OFFICE SYMBOL	1. AFDRE-1	2. AFACD	3.	4. AFCSM	5.
GRADE AND SURNAME OF COORDINATING OFFICERS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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Guided Missiles Program [illegible]

AC/AS-4, Guided Missiles Division [illegible]
AC/AS-4, Research and Engineering Division, Guided Missiles Branch [illegible]
AC/AS-4, [illegible] Major Lancaster/[illegible]

1. Examination of trends in the guided missiles field in particular and warfare in general, [illegible] progress towards a state of [illegible] strategic as well as tactical [illegible] and [illegible] employment of guided missiles [illegible] aircraft. This conclusion is based on [illegible] of [illegible] missiles and on [illegible] of the potentialities of proposed missiles [illegible] development progress in the fields of electronics, propellants, nuclear energy, and engineering materials.

2. Major General A. [illegible] Special [illegible] guided [illegible]:

a. "The possibilities of development [illegible] the A-4 type rocket [illegible] increased range, increased [illegible] If [illegible] can be reduced [illegible] will be [illegible]. The German [illegible] further [illegible] they were [illegible] the trajectory [illegible] the Atlantic [illegible] value [illegible]."

b. "Whatever the [illegible] a possible weapon of war. [illegible] the U.S. [illegible] not [illegible] be prepared to counter [illegible] counter [illegible] can not be prepared without developing the weapon itself.

c. "The lesson of Operation [illegible] is that what Britain and the U.S. can do, other nations can do. No nation can afford to allow the development of long range rockets to [illegible] as a matter of routine. [illegible] of all the imaginative drive and brains that can be mustered. For the sake of [illegible] Britain and the U.S. must be masters of this weapon in the future."

3. This office [illegible] interested in the guided missiles field [illegible] and [illegible] representation on the Warheads and Fuzes Panel of the Guided Missiles Committee of the Joint Chiefs of Staff and on a similar body under [illegible] of the Aeronautical Board. This office also [illegible] Air Forces requirements for [illegible] for these missiles.

[redacted]

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6 MAR 1946

Guided Missiles Progress

AC/AS-3, Guided Missiles Division
AC/AS-4, Research & Engineering Division,
Guided Missiles Branch
AC/AS-4, Air Ordnance Officer

1 Cont'd.

Major Leonard/em/74958

In pursuit of these activities, it was inevitable that a broader, if less detailed, picture of all guided missile activity was impressed on those individuals involved.

4. It appeared to this office that there is considerable duplication of responsibility and overlapping of effort. The Army Air Forces, the Army Ground Forces and the Army Service Forces have each one or more guided missile or pilotless aircraft branches. At a lower level the Air Technical Service Command, the Ordnance Department and the Signal Corps are engaged in work on such missiles. At actual work levels are such programs as Aeronca[illegible], Ordcit and others under the direction of one or more of the commands or agencies noted above. In advisory capacities the Aeronautical Board and Joint Chiefs of Staff Committee on Guided Missiles are both functioning. In general a similar condition exists within the Navy Department between DCNO-Air, BuOrd and BuAer. Not previously mentioned but also concerned are guided missile divisions in [illegible] and the Manhattan District.

5. It is pointed out that while each of these bodies contribute to the whole program in proportion to its ability and importance, the net effort may fall short of the potential availability from a concerted effort. Rapid progress can only be insured by extraction of maximum results from available effort. The present number of policy making and administrative bodies with very good lines of cognizance precludes the possibility of drawing any single, clear cut picture of the overall effort. Producing contractors, research contractors and development contractors of one agency often work without the benefit of close liaison with parallel efforts under cognizance of another agency. At best it can be said that where such liaison exists it is by good luck rather than good management. It is probable that security requirements motivated the organization of the Manhattan District but the benefit of central direction has manifested itself in rapid progress and coordinated effort on the A-bomb project.

6. In view of the increasing importance of guided missiles, pilotless aircraft and associated material, it is felt that present organizations and the lines of cognizance, cutting both vertically and horizontally, through various components and through entire organizations and major commands should be thoroughly re-examined. Several alternatives suggest themselves:

a. A single government agency similar in scope to the Manhattan District with exclusive control of research, development, production and operational application.

b. A less inclusive organization be organized at the War Department level to include all War Department guided missiles activity.

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Guided Missiles Progress 6 MAR 1946

AC/AS-3, Guided Missiles Division
AC/AS-4, Research & Engineering Division,
Guided Missiles Branch 1 Contd.
AC/AS-4, Air Ordnance Officer Major Leonard/[illegible]/74328

c. A single command within the Air Forces with sole cognizance over all guided missile activity within the Air Forces.

9. It is believed that discussion of this subject may be timely at this point since as yet no definite plans or commitments are known to have been made as to the future place of this type weapon in our existing military establishment. Your comments are requested.

H. C. [illegible]
Brig. Gen., U.S.A.
Air [illegible]

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AFAAA 27 March 1946

MEMORANDUM FOR CHIEF, REQUIREMENTS DIVISION, AC/AS-?:

SUBJECT: Status of Air Defense

DISCUSSION

1. Reference memorandum above subject and R&R proposed for dispatch to AC/AS-5, the following comments are submitted.

2. The Simpson Board Report definitely charges the Army Air Forces with responsibility for air defense. This charge is from the War Department only. The Army has traditionally been charged with the defense of naval shore establishments. During World War II however, the Navy organized defense battalions to provide both seacoast artillery and antiaircraft artillery defense of landing operations. They also organized fighter aviation and fighter control and air warning units. It is believed that the Navy is inclined to retain all of above type of units, except those manning seacoast artillery, for the defense of their shore establishments.

3. Certain matters reference Air Forces responsibilities in connection with the development of tactics and technique, determination of military characteristics of armament and equipment, and construction of tables of organization and equipment applicable to antiaircraft artillery units are now in process of determination in connection with implementing the Simpson Board Report. These matters are between the Army Ground Forces and the Army Air Forces. It would appear that they should not be presented to the Joint Chiefs of Staff. When determined they presumably will result in an equal Air Force voice in determining all military characteristics of armament and equipment and the organization and tactics of Ground Force units to be used in air defense.

4. The matter of responsibility for development as distinct from that of laying down military characteristics is where the duplication exists. This is being fought out now in several ways - one is in implementing the Simpson Board reorganization of the Army; another is in a subcommittee of The Joint Chiefs of Staff's, joint new weapons and equipment committee.

5. It appears that the only matter that should be presented to The Joint Chiefs of Staff at present is this: "Is the Navy or the Air Force responsible for air defense of land naval installations including control and training of the antiaircraft artillery allotted to such defense." It is recommended that the R&R to AC/AS-5 be amended accordingly.

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Memo to Chief, Requirements Division, AC/AS-3 - 27 March 1945.

6. The weakness of this headquarters in proper planning for air defense is concurred in. This office concurs in the inadequacy of the number of officers presently assigned to the Fighter and Air Defense Section of the Requirements Division, AC/AS-3. It cannot concur in a central controlling agency in this headquarters to cope with all Army Air Force responsibilities in air defense. To be effective it would have to be in the nature of the directorates discarded years ago or any office of a Deputy Chief of Air Staff. The proper solution is believed to be education of the various staff sections of this headquarters as to their responsibilities in connection with air defense and their internal reorganization to insure a proper discharge of these responsibilities.

7. The first step is believed to be the adoption of general overall policies to govern air defense organization and planning by this headquarters. This office has recently recommended a list of such policies with the concurrence of your division. A copy of these policies is inclosed. The originals are in the hands of the Air Board.

RECOMMENDATIONS

It is recommended that every possible step be taken to secure an early approval (or modification) of these policies and their publication to the Air Staff and the Air Defense Command.

[illegible]
Major General, U. S. Army
Special Assistant for Antiaircraft

2 Incls
Added 1 Incl
Incl 2 - Statement of Policies

[illegible] concurred in this

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THIS PAGE IS DECLASSIFIED IAW EO 13526

W 774

Gen. Crawford/VSR/bja/2100
Written 1 April 1946.

[redacted]

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By Authority of
The Commanding General
Army Air Forces

Date Initials

AFDRD-3/R

25

APR 2 1946

SUBJECT: Guided Missiles in Arctic Warfare.

TO: Commanding General
Air Materiel Command
Wright Field, Dayton, Ohio

1. Recent evaluations of possibilities of involvement of the United States in war within the foreseeable future, and of the capabilities of potential enemies, have indicated increasing probability that the Army Air Forces may be called upon to carry on warfare in the Arctic regions during the period covered by the fruition of the current Army Air Force long term guided missiles program. It has also been apparent for some time that the most probable routes for guided missiles attack against the industrial centers of the United States, excluding attacks from vessels offshore, are through the Arctic regions.

2. This situation emphasizes the need for action to insure that the Army Air Force Guided Missiles research and development properly covers any new needs arising from Arctic warfare, and to build up in Air Materiel Command a reservoir of experience adequate to cope with additional problems in Arctic operations as they arise. The goal of such action must be to provide any equipment or techniques necessary to enable the Army Air Force to carry out its part in an Arctic war, both in the offensive and defensive phases.

3. It is recommended that the goals set forth may be best attained by a fourfold program:

a. Operation of existing guided missiles and components, such as the JB-2, VB-3, X-Band SCR-584 with plotting board, air defense systems, propulsion systems, gyros and servos, and ordnance items during the coming winter as part of the cold weather testing unit program.

b. Similar operation of guided missiles and equipment in the Arctic summer in order to cover problems peculiar to the muskeg areas.

c. Rotation of personnel through these Arctic testing operations to acquire experience.

d. Initiation or modification of development at the Air Materiel Command as dictated by the results of experiences and the goal in mind.

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19-(2 1/2 pp) 3Y W775

[redacted]

SUBJECT: Guided Missiles in Arctic Warfare.

4. It is directed therefore, that the Air Materiel Command take such action as is necessary to provide adequate guided missiles equipment and techniques for execution of the Army Air Force mission in Arctic warfare.

5. Recommendations for new or modified military characteristics will undoubtedly be forthcoming as the study of the problem progresses. It is desired that these recommendations be forwarded to AC/AS-4 for consideration as they become available. A general outline of the proposed procedure under this directive is desired in this office by 15 May 1946.

By Command of General SPAATZ:

ALDEN R. CRAWFORD
Brigadier General, U.S.A.
Chief, Research & Engineering Division
Office, AC/AS-4

Coordinated by
Gen Craig

[redacted]

OFFICE SYMBOL	1. AFDRE-3	2. AFDRE-1	3.	4.	5.
GRADE AND SURNAME OF COORDINATING OFFICERS	Col Cooper	Crawford			

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[redacted] Gen.Crawford/Mr. [illegible]
Written 28 March 1946.

4 April 46 HCS

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APR 4 1946

MEMORANDUM TO THE DIRECTOR, NEW DEVELOPMENTS DIVISION, W.D.G.S.

SUBJECT: Defense Against Guided Missiles.

x381

1. The attached correspondence covers the approval of the Signal Corps Technical Committee and Headquarters, Army Service Forces, of Item No. 1640, SCTC Meeting No. 400, 18 February 1946, for "Locator Equipment for Use Against Guided Missiles". This is one of a series of projects constituting the Signal Corps program to meet Army Ground Force requirements for defense against guided missiles.

2. The Army Air Forces has in progress an extensive program of development contemplated to meet the needs of the United States for defense against guided missiles.

3. The Army Air Force was assigned the responsibility for the air defense of the United States by directive of the Adjutant General, AG 320.2 (2-28-41) M-OPD-M, 17 March 1941, subject, "Defense Plans - Continental United States", amplified by letter AG 320.2 (3-24-41), 25 March 1941, subject, "Defense Plans - Continental United States". Further, the Army Air Forces have been assigned by WD Circular 429, dated 3 November 1944, responsibility for the research and development of radio and radar equipment peculiar to the Army Air Forces. In this connection, the responsibility for development of the SCR-270, SCR-271, and similar air defense equipment has been transferred from the Signal Corps to the Army Air Forces.

4. At the SCTC meeting of 13 August 1945, objection was made by the AAF to the establishment of this Signal Corps development program on the basis that such action overlapped AAF development functions and responsibilities and would lead to duplication of effort and expenditure. The objection was withdrawn however, upon representations that competition to a certain degree was healthy, that budgets at this time had not been seriously restricted, and the realization that the general problem had sufficient magnitude to warrant coordination of effort by both Army Air Forces and Signal Corps development agencies on the preliminary aspects. It was also represented that the Signal Corps program was directed at relatively short ranges (250 miles) compared to the longer range (up to at least 1,500 miles) Army Air Force development, and was therefore intended only for defense of the Army Ground Forces in the field.

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5. Item 1640, SCTC Meeting No. 400, 18 February 1946, among other modifications, extended the required range of the radar early warning equip-

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OFFICE SYMBOL	1.	2.	3.	4.	5.
GRADE AND SURNAME OF COORDINATING OFFICER					

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Subj: Defense Against Guided Missiles.

ment from 250 miles to 1,000 miles. This openly puts the development into the class of air defense equipment, and into an indisputable field of Army Air Force development responsibility. Additionally, the fact that 1,000 mile range is required for defense of the Army Ground Forces in the field is substantial proof that the operational requirement and the techniques involved are essentially the same as for the general problems of Air Defense, and separate development by Signal Corps of this type of equipment is forthright duplication. Further, the statement in the military characteristics that no identification of targets is required, indicates a lack of appreciation of the tactical problems involved. As long as the Army Air Force may have aircraft or missiles out in the field of view of the subject radar equipment, indiscriminate firing at anything that moves will be impossible.

6. The statements and discussions set forth in the preceding paragraphs, while specifically covering SCTC Item No. 1640, apply equally to the general program of some 30 projects on defense against guided missiles now existing in the Signal Corps Engineering Laboratories. They lead to one inevitable conclusion: the current Army Air Force developmental responsibility for air defense system must be specifically reaffirmed for the guidance of all concerned as specifically including defense against guided missiles. With this responsibility centralized in the Army Air Forces, apportionment to the development agencies of the Army Air Forces and the Army Service Forces of those phases of the overall task best suited to the basic technical abilities of each must be made. By this means, and only by this means, will the general problem of defense against guided missiles for the continental United States, for the Army Ground Forces in the field, and for overseas bases be adequately solved. The magnitude of this problem is certainly sufficient to warrant full use of all available experienced personnel and facilities.

7. The foregoing was brought to the attention of the Chairman of the SCTC subsequent to Meeting No. 400 of 18 February 1945. It was his opinion, concurred in by Headquarters, Army Service Force representatives present, that the matter should properly be brought before the Assistant Chief of Staff, G-4, for decision. It is the recommendation of the Army Air Forces, therefore, that for the guidance of all concerned, for the most effective and economical solution of the problem, and for the greatest benefit to the defense of the United States, that research and development of defense against guided missiles be specifically included in the air defense developmental responsibilities of the Army Air Forces.

For the Commanding General, ARMY AIR FORCES:

4 Incls.
1. Cy Item 1640, SCTC Meeting #400, w/1st & 2d Ind.
2. Cy Ltr, 17 Mar 41
3. Cy Ltr, 25 Mar 41
4. WD Circular 427, 3 Nov 44.

[redacted]

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AFDRE	AFACo			
Col Cooper				

[redacted]

6

ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

WASHINGTON D.C.
January [illegible], 1943

TECHNICAL INSTRUCTIONS

Serial No. TI-1138

Subject: Development and Design of Aerial Torpedoes.

To: Technical Executive,
Materiel Center, Wright Field,
Dayton, Ohio.

1. Problem Presented:

a. To design and develop an aerial torpedo in order that such missiles may be [illegible] for Army Air Forces use.

2. Authority:

a. By direction of Deputy Chief of Air Staff for Commanding General of Army Air Forces.

3. Factual Data:

a. The supply of aerial torpedoes for use by the Army Air Forces has been on a [illegible] with the Navy basis and until recently no specific allocations were directly made to the Army Air Forces. Furthermore, it is felt that the Navy has been very slow in designing, developing and manufacturing torpedoes suitable for release at high speeds, equivalent to characteristics of Army Air Forces airplanes. Therefore, in order to make available to the Army Air Forces quantities of torpedoes as needed by them and torpedoes having characteristics comparable to Army Air Forces, it has been decided to design and develop with our own activities such munition items.

4. Action Desired:

a. Initiate immediately a program for the design and development of aerial torpedoes which will have minimum characteristics as follows:

1. Suitable for release at air speeds of 350 miles per hour or higher and at altitudes of [illegible] feet at this speed.

[illegible] concerned
[illegible]

C [illegible] 356
Signature [illegible]

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[redacted] AIR FORCES

HEADQUARTERS OF THE MATERIEL COMMAND

~~WASHINGTON, D.C.~~ JHC:jjb:HRP
Wright Field, Dayton, Ohio.
11 October 1943

477/

16283

TECHNICAL INSTRUCTIONS

Serial No.: CTI-1471

cB

MX-446

[redacted]
AUTH: C. G., AAF
Materiel ~~Center~~ Command
DATE: 10/5/43
INITIALS: R.C.W.

Subject: Test of Glide Bombs.

To: Engineering Division

1. Problem Presented:

a. To conduct operational tests using the controllable glide bomb.

2. Factual Data:

a. ACAS/OCR feels that if the tactics listed below are applicable to the controllable bomb a simplified radio could be developed and placed in quantity production more easily and quickly than the present radio equipment.

b. Attached for information is a copy of an R&R received from ACAS/OCR covering the tests they desire.

3. Authority:

a. Commanding General, Army Air Forces. By letter dated 2 October 1943, same subject as above, from Chief, Development Engineering Branch, Materiel Division, Office AC/AS, M.M.&D.

4. Action Desired:

a. To conduct operational tests using the controllable glide bomb as follows:

(1) Release the controllable glide bomb at such an altitude and distance from the target so that it will pass directly over the target but at an altitude of 1000 ft. or more.

(2) When the controllable bomb is directly above the target at a proper distance as determined from the tests, it be placed in a vertical dive or spin with the idea being to lead the missile into the target from a vertical dive.

Classification cancelled
~~or changed to~~
AUTH: DB 356
Signature and Grade
Date 10/45

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MC-432-A-WF-4-24-43-30M

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

WASHINGTON, D. C.

JEO:jjb:H&P
Page 2
Wright Field, Dayton, Ohio
11 October 1943

TECHNICAL INSTRUCTIONS

Serial No.: CTI-1[illegible]

Subject: Test of Glide Bombs.

To: Engineering Division

[illegible]. When these tests have been completed, the Chief, Development Engineering Branch, Materiel Division, Office, AC/AS, M.M.&D., is to be advised of the results obtained together with appropriate comments and recommendations in order that they in turn may advise ACAS/OIA.

By Command of Major General [illegible]:

J. H. Olsen, 1st. Lt. AC

[illegible],
Colonel, Air Corps,
Deputy Chief of Staff.

Attach:
Cy R&R Hq 9/29/43

10-13-43 - Dist. by Eng. Div.
[illegible] - Eqp [illegible] Lab.

Cys. - General Carroll
Technical Staff
Aircraft Proj. Sec.
Aircr. Radio Lab. (3)
Aircraft Lab. (2)
Armament Lab. (2)

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AC-36 27-10 [redacted] NDRC

[redacted]: CG,AAF
Date: 10-23-43
Init: MCD

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

1-2 AC-36

JHO:jjb;HQP

Wright Field, Dayton, Ohio
28 October 1943

TECHNICAL INSTRUCTIONS

10-29-43 Dist by Engr Div.

Cys: Gen. Carroll
Tech Staff
Airc Prod. Sec.
Equip. Lab.
NDRC
Flt. Res. Lia. Br.
Flt. Data Unit
Airc (3)
Arm. (2) & ARL (3)

Orig: Prod. Div.
cy: ASC By Tech Exec.

Serial No.: CTI-1350, Addendum 1

Subject: High Angle Controllable Bomb in Azimuth.

To: Production Division

1. Problem Presented:

a. To procure 10,600 control and flare assemblies for the high angle controllable bomb.

2. Factual Data:

a. Necessary radio equipment for use in connection with these tail assemblies is being procured by the Signal Corps and information is available to the effect that the anticipated production schedule for the radio receiver is 50 sets per day, starting on or about 15 January 1944. Necessary action is being taken by the NDRC to turn over this development of the radio equipment to the Signal Corps. The transmitter, it is understood, is an Aircraft Radio Laboratory development and 100 units are on order.

b. Necessary contacts will be arranged with NDRC representative and release for this equipment will be made in order that procurement by the Army Air Forces will be established at the earliest practicable date.

3. Authority:

a. Commanding General, Army Air Forces. By letter dated 23 October 1943, subject as above, from Chief, Development Engineering Branch, Materiel Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance & Distribution.

4. Action Desired:

a. To procure 10,600 control and flare assemblies for the high angle controllable bomb. 10,000 of these assemblies for for Army use and the other 600 for the Navy. This equipment will be suitable for use with standard 1,000 lb. bomb.

b. The Chief, Development Engineering Branch, Materiel Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution, is to be advised as to when delivery may be anticipated in order that necessary shipping instructions for both the Army quantity and the Navy may be supplied.

By Command of Major General Branshaw:

T. A. SIMS
Colonel, Air Corps
Deputy Chief of Staff

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Dist:
ARL
Engr. Div.
ASC (2)

[redacted]

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/////////// JHO:mdh
Wright Field, Dayton, Ohio
20 January 1944

CTI-1560

Ground Skimming Bomb Project

SECRET
AUTH: C. G. AAF Materiel Center Command
DATE: 1/20/44
INITIALS: JHO

Engineering Division.

1. Problem Presented:

a. To expedite as soon as possible development work on the "Ground Skimming Bomb" project.

2. Factual Data:

a. The following comment concerning the subject project has been received from Chief, Development Engineering Branch, Materiel Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution:

"The prospective increase in range accuracy with the 'Ground Skimming Bomb' is highly desirable."

3. Authority:

a. Commanding General, Army Air Forces. By letter of 10 January 1944, subject as above, received from Chief, Development Engineering Branch, Materiel Division, Office, AC/AS, MM&D.

4. Action Desired:

a. That which is stated under paragraph 1, Problem Presented.

By Command of Major General BRANSHAW:

T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

Classification cancelled or changed to
AUTH:
Cd- 356
Signature and Grade
Date 10/1/45

COM. GEN.
TECH. EXC. JHO
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
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I. P. B.
A. S. C.
TECH. DATA
CIV. PERS.
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CENTRAL FILES

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////////////// JHD:mch:HQP
Wright Field, Dayton, Ohio
20 March 1944

CTI-1641/ed MX-453

Counter-measures Against Controllable Missiles

Engineering Division.

SECRET
ACT. C. G., A.
Materiel Command
DATE: 3-20-44
INITIALS: JHO

1. Problem Presented:

a. To initiate study and test to determine the best available counter-measures against controllable missiles.

2. Factual Data:

a. It is also understood that the Special Weapons Branch, Equipment Laboratory, Engineering Division is already investigating and testing two different methods accomplishing the above stated purposes. One is concerned with the establishing of a smoke screen at a rapid rate, and the other involves the use of very brilliant rocket flares.

3. Authority:

a. Commanding General, Materiel Command.

4. Action Desired:

a. That which is stated under paragraph 1, Problem Presented.

By Command of Major General BRANSHAW:

T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

Classification cancelled
~~or changed to~~
AUTH: CP 356
By ______ Signature and Grade
Date 10-1-45

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS

100

SECRET

AAFMC-100-WF-5-20-42-1 MB. CENTRAL FILES

100

1484

#1667

[redacted]
Command
6/19/44
WMB

WMB:cjt:HGP
Wright Field, Dayton, Ohio
17 June 1944

[redacted]

COM. GEN
TECH. EXC. W.W. [illegible]
ADM. EXC.
C.O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. ENG.
PROD. CONT.
I.P.S.
TECH DATA
CIV. PERS.
OTHERS

CTI-~~[illegible]~~ 1350, ADDENDUM NO. 5

Procurement of Azon Tails for 1000 lb. Bombs

Production Division

1. Problem Presented:

a. Assistant Chief of Air Staff, Materiel, Maintenance and Distribution has directed an additional procurement for 1944 delivery of 30,000 Azon tails for 1,000 lb. bombs plus accompanying standard spares.

2. Factual Data:

a. All of this additional procurement outlined above should be delivered in the year 1944 and monthly delivery rates should be established to meet this requirement. It is imperative that the present rate of production of approximately 3,000 per month be increased as soon as possible.

3. Authority:

a. Commanding General, Army Air Forces, by teletype MAL-51110 dated 15 June 1944, from, Chief, Materiel Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution.

4. Action Desired:

a. That the Production Division take the necessary action to make the procurement as outlined under Problem Presented. A report should be prepared and submitted to the Assistant Chief of Air Staff, Materiel, Maintenance and Distribution, through the Technical Executive Office, concerning the planned monthly Azon tail schedule for the balance of 1944, as soon as it is possible to determine this schedule.

CD-356
11-1-45

By Command of Major General MEYERS

Classification Cancelled
To "Restricted"
Auth

T. A. [illegible]
Colonel, Air Corps
Deputy Chief of Staff

cc: Engineering Division
Procurement Division
Air Service Command

[redacted]
CENTRAL FILES
RESTRICTED

101

AAFMC-199-WF-12-17-43-10M

1485

MX 446 / Central Files [redacted] 938

6-21-44 Dist by Engr. Div.
Orig: Equip (2)
Cys: Gen. Carroll
Tech Staff
Airc Proj. Sec.
Airc (3)
Arm. (3)
ARL (3)

ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND WMB;mjo;HQP

Wright Field, Dayton, Ohio

23828 TECHNICAL INSTRUCTIONS 19 June, 1944

C. 7y

Serial No.: CTI-1471, ADDENDUM NO. 4

[redacted]
AUTH: C. G., AAF Materiel Command
DATE: 19 June, 1944
INITIALS:

Subject: Simple Radio Controlled Glide Bomb

MX-446

To: Engineering Division

CENTRAL FILES
6-30-44

1. **Problem Presented:**

a. The Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution has directed that further experimental work on the controllable glide bomb as directed in CTI-1471, Addendum No. 2 paragraph 2 a. and 4 c. be discontinued in view of further developments in this field, particularly the GB-9 ground skimming bomb.

2. **Factual Data:**

a. The directive for this action as submitted through the Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution has been concurred in by the Air Communications Officer and the Office, Assistant Chief of Air Staff, Operations, Commitments and Requirements.

3. **Authority:**

a. Commanding General, Army Air Forces by letter dated 22 April, 1944, Subject: Simple Radio Controlled Glide Bomb - CTI-1471 from the Chief, Development Engineering Branch, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution.

4. **Action Desired:**

a. That the Engineering Division discontinue all experimental work on the controllable glide bomb as outlined in CTI-1471, Addendum No. 2, paragraph 2 a. and 4 c.

b. These Technical Instructions cancel and supersede those portions of CTI-1471, Addendum No. 2 mentioned above.

Classification cancelled or changed to ______
AUTH: CD 356
By ______
Signature and Grade
Date 10-1-45

By Command of Major General MEYERS:

T. A. Sims
T. A. SIMS
Colonel, Air Corps
Deputy Chief of Staff

cc: Production Division
Procurement Division
Air Service Command (3)

[redacted]

102

1486

1131

SECRET

Capt. [illegible] H. Ober
sep:HP [illegible]

ARMY AIR FORCES

HEADQUARTERS OF THE MATERIEL COMMAND

Wright Field, Dayton, Ohio
2[illegible] July 1944
UNSECRET
AUTH: [illegible], Mat. C[illegible]
Date: [illegible]
INIT: [illegible]

TECHNICAL INSTRUCTIONS

Serial No.: CTI-17[illegible]
E 1054

Subject: Aeropulse Jet Propulsion Power Plant

To: Engineering Division

1. Problem Presented.

a. To undertake a controlled missile project incorporating the Aeropulse jet propulsion power plant with a view toward establishing physical as well as performance requirements at the earliest possible [illegible]. As [illegible] as such requirements are established, the Bureau of Aeronautics is to be approached with a view toward [illegible] development and fabrication of an experimental quantity of the Aeropulse propulsion unit.

2. Factual Data:

a. The Bureau of Aeronautics is presently engaged in a development program at Aerojet Engineering Corporation [illegible] Hydropulse units for assisted take-off application [illegible] boats. Aerojet Engineering Corporation is also doing development work on Aeropulse jet propulsion units; however, because of high priority given to the Hydropulse by the Bureau, this project is progressing [illegible]. Due to the intense interest shown in the German flying bomb (robot airplane) it is believed that everything possible should be done to accelerate the development and testing of flying missiles similar or better than the German robot airplane. In connection with the above, mathematical calculations made by California Institute of Technology indicate that the Aeropulse unit possesses attractive performance features.

b. Pursuant to recent inquiry, the Bureau of Aeronautics has indicated that if a requirement of sufficient priority exists for the Aeropulse unit, the Bureau will be willing to retard on their priority requirements for the Hydropulse.

SECRET

103

1132

[redacted]

Capt. Jon H. Ober
sep;H.P 2-8139

ARMY AIR FORCES

HEADQUARTERS OF THE MATERIEL COMMAND   Wright Field, Dayton, Ohio
[illegible] July 1944

TECHNICAL INSTRUCTIONS

Serial No.: CTI-[illegible] (Continued)

Subject: Aeropulse Jet Propulsion Power Plant.

To: Engineering Division

[illegible]. Authority:

a. Commanding General, Army Air Forces. By secret letter, dated 11 July 1944, received from Chief, Development Engineering Branch, Materiel Division, AC/AS, M&S.

[illegible]. Action Desired:

a. That which is stated under paragraph 1, Problem Presented.

b. This project will have a 1B priority.

By Command of Brig. General WOLFE

T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff

Distribution:
Production Division

8-2-44 Dist. by Engr. Div.
Orig: Fighter Br.
Cy: Gen. Carroll
Tech Staff
Airo. Proj. Sec.
Equip. Lab. (2)
P. P. Lab.
NACA
Airo. Lab. (3)
Cy Prod. Div.) By Tech Exec.

[redacted]

~~SECRET~~

[illegible];mjo;HCP

[illegible]right Field, Dayton, Ohio

1[illegible] August, 1944

CTI-1350, ADDENDUM NO. 7

Additional Procurement of Azon Tails

Production Division

1. Problem Presented:

a. The Office, Assistant Chief of Air Staff, Materiel and Services has directed that an additional 60,000 Azon tails with standard spares for 1,000 pound bombs be procured for production in 1945.

2. Factual Data:

a. The continuance of the 10,000 per month rate of production of Azon tails which is to be reached in November and December of 1944 is also authorized for the above procurement of 60,000 Azon tails for 1945.

b. Reference is made to CTI-1350, Addendum No. 1 which directed the procurement of 10,600 Azon tails for 1,000 pound bombs and CTI-1350 Addendum No. 3 which directed procurement of an additional 10,000 Azon tails for 1,000 pound bombs and Addendum No. 5 which directed the procurement of an additional [illegible],000 Azon tails for 1,000 pound bombs.

c. These Technical Instructions confirm action taken by Production Division on teletype AF [illegible] 63049 dated 10 July which is the authority for these Technical Instructions and which was forwarded to Production Division on 11 July, 1944.

d. It is understood that the Azon tail production schedule planned for 1944 will be 5[illegible],600 (which was authorized by CTI-1350, Addenda 1, 3, and 5) and that the approximate schedule for the remaining months of 1944 will be August, 5,000; September 6,000; October 9,000; November, 10,000; and December 10,000; and it is further directed that the production schedule planned for the 60,000 tails authorized by these Technical Instructions will be 10,000 per month for the first six month.

COM GEN
TECHNICAL
Command
ADM EXC.
C.D.
BUD. OFF
EXP. ENG.
CONTRACT
PROD. DIV.
I.P.S.
TECH DATA
CIV. PERS.
OTHERS

15 Aug.

Classification Cancelled
"Restricted"
Auth. [illegible]
Initials [illegible]

CD-356

11-1-45

CENTRAL FILES

RESTRICTED

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[redacted]

MBW:rjo:RGP

Wright Field, Dayton, Ohio

14 August, 1944

GTT-1350, A[illegible] No. 7

Additional Procurement of Azon Tails

Production Division

3. Authority:

a. Commanding General, Army Air Forces by teletype MAR 68059 dated 10 July, 1944 from Chief, Production Branch, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Production Division take necessary action to procure an additional 60,000 Azon tails for 1000 pound bombs.

b. That the production of Azon tails be scheduled in accordance with paragraph 2 d. above and any [illegible] differences from this schedule are to be reported by teletype, through the Technical Executive Office, to the Office, Assistant Chief of Air Staff, Materiel and Services.

By command of Brigadier General [illegible]:

T. A. SIMS
Colonel, Air Corps
Deputy Chief of Staff

cc: Engineering Division
Inspection Division
Procurement Division
Air Service Command (3)

CD 356

[illegible] and Grade

11-2-45

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
[illegible] DIV
PROD. ENG.
PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS

[redacted]

AAFMC-120-WF-12-17-43-[illegible]

CENTRAL RESTRICTED

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[redacted]

CH. STAFF
DEP. CH. STAFF
TECH. EXEC.
ADJ. GEN.
EXEC. PROC.
AIR INSP.
INTELL.
COMPTROLLER
C.O.
BUD. OFF.
PERS. SEC.
ENG. DIV.
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS

TSCMP-4
Wright Field, Ohio
21 September 1944

CTI-1350, ADDENDUM NO. 9

Cancellation of Azon Tails

Procurement Division

1. **Problem Presented:**

a. To make immediate cancellation of all future production of the complete Azon Tail Assembly VB-1, excepting the radio equipment.

2. **Factual Data:**

a. Procurement has been directed for a total of one hundred ten thousand six hundred (110,600) Azon Tails in CTI-1350, Addenda 1, 3, 5 and 7. Of this quantity, approximately thirteen thousand eight hundred (13,800) will have been purchased before cancellation can be made.

3. **Authority:**

a. Commanding General, Army Air Forces by teletype WAR-33218, dated 19 September 1944, from Chief, Production Division, Office Assistant Chief of Air Staff, Materiel and Services.

4. **Action Desired:**

a. That the Procurement Division take immediate action to cancel production of Azon Tails as outlined in Problem Presented and advise the Office, Assistant Chief of Air Staff, MAS as soon as possible concerning the total number of Azon Tails produced so that appropriate cancellation of the Signal Corps Receiver may be made.

b. These Technical Instructions cancel CTI-1350, Addenda 3, 5 and 7.

CD-336
12-1-45

By Command of Lt. General KNUDSEN:

[redacted] T. A. SIMS
Colonel, Air Corps
Chief of Administration

CC: Engineering Div.
Maintenance Div.
Supply Div.
Liaison Office

CENTRAL FILES

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105

ATSC Form No. 43 (16 SEP 44)
MX-224
42-2pp

1228

COORDINATION
RECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
H T Brallard — SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
...NT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

X XXXXXXXXXXXXXXXXXX
AIR TECHNICAL SERVICE COMMAND

[redacted] Hqs:cjt:TSTEX
Wright Field, Dayton, Ohio
14 October 1944

CTI-1563, ADDENDUM NO. 2

Procurement of SRB (BAT) Units

Engineering Division

MX-224

1. Problem Presented:

a. To reduce the procurement of airplanes for the SRB (BAT) GB-7B Glide Bombs from 500 units to 100 in compliance with directive from the Office, Assistant Chief of Air Staff, Materiel and Services.

2. Factual Data:

a. Action has been taken by the Air Communication Officer to reduce the requirement of electronic equipment for GB-7B from 1000 for 1944 and 1945 to 100 for 1944 which are to be used experimentally.

b. The total procurement of air frames will be reduced from 500 to 100 to match the quantity of mark 31 (Navy) electronic equipment to be produced.

3. Authority:

a. Commanding General, Army Air Forces, by teletype TAR-45617, dated 12 October 1944, from Chief, Development Engineering Branch, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take necessary action to terminate all action for the procurement of 500 SRB-(BAT) GB-7B Glide Bomb equipment previously directed in CTI-1563 and Addenda 1 thereto.

13:08

b. That the Engineering Division take necessary action to procure 100 air frames for the SRB (BAT) GB7B Glide Bombs which are to be used experimentally.

~~CONFIDENTIAL~~

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4-61790

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ATSC Form No. 43 (16 SEP 44)

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MX-224
42

COORDINATION
D. FOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

XXXXXXXXXXXXXXXXXXXXX
AIR TECHNICAL SERVICE COMMAND

[redacted]

HFM::cjt:TSTEX
Wright Field, Dayton, Ohio
14 October 1944

CTI-1563, ADDENDUM NO. 2

Procurement of SRB (BAT) Units

Engineering Division

g. These Technical Instructions cancel and supersede basic CTI-1563 and Addendum No. 1 thereto.

By Command of Lt. General KNUDSEN:

T. A. SIMS
Colonel, Air Corps
Office, Chief of Administration

cc: Procurement Division (action copy)
Supply Division
Maintenance Division

[redacted]

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ATSC Form No. 43 (16 SEP 44)

1347

[redacted]

Capt. Jon H. Ober
eee/TSTWX (5-6147)

XXXXXX XXXXXXXXXXXXXX
AIR TECHNICAL SERVICE COMMAND
Wright Field, Dayton, Ohio
17 October 1944

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMIN. JAE.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

CTI-1796, Addendum No. 1.

Project Campbell.

Engineering Division.

Kingslow, ATSC 10/... JAE

MX-557

1. Problem Presented:

a. To supplement basic CTI.

2. Factual Data:

a. Arrangements have been made with O.S.S. to have future requisitions pertinent to subject, forwarded directly to Mr. Nicholas Post, Special Weapons Branch, Equipment Laboratory, Air Technical Service Command, Wright Field for forwarding through proper ATSC channels.

3. Authority:

a. Commanding General, Army Air Forces. By letter dated 27 September 1944, subject as above, from Chief, Development Engineering Branch, Materiel Division, AC/AS, MM&D.

4. Action Desired:

a. Necessary personnel are to be assigned and equipment furnished, to carry out the "Campbell" project. In regard to equipment, only items which are neither critical nor controlled shall be issued. Authority to issue critical and controlled equipment will only be granted upon specific request to Headquarters, AAF.

b. This project has a 1-A priority.

By command of Lt. General KNUDSEN:

Classification cancelled
~~or changed to~~
AUTH
By
Signature and Grade
Date

T. A. SIMS,
Colonel, A. C.,
Chief of Administration.

cc: Procurement Division
Supply Division
Maintenance Division

[redacted]

Y-61794 107

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[redacted]

Capt. Jon H. Ober
mas/TSE X (5-6147)

XXXXXXXXXXXXXXXXXX
AIR TECHNICAL SERVICE COMMAND
Wright Field, Dayton, Ohio
13 November 1944

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

TI-2043.

416

Guided Missiles - Ground to Air Remotely Controlled [illegible].

Engineering Division.

1. Problem Presented:

a. To develop a ground to air [illegible] missile.

2. Authority:

a. CG, AAF. By 2nd Indorsement dated [illegible] September 1944, with regard to the above subject, received from Chief, Development Engineering Branch, Materiel Division, AC/AS, [illegible].

3. Action Desired:

a. The missile called for will have the following characteristics:

(1) Nature of Missile - The missile will be launched from the ground or other suitable control.

(2) Type of Control - The missile will be controlled from the ground by means of radio, radar, or other suitable control. The missile shall incorporate devices which will enable it either to guide itself or be guided to within effective influence [illegible] range of the target.

(3) Launching - Missile to be [illegible] and launched from the ground.

(4) Speed and Altitude -

(a) Speed and rate of climb sufficient to intercept aircraft flying at speeds up to [illegible] mph.

(b) Maximum Altitude - at least [illegible],000 feet minimum, 60,000 feet desired.

(5) Explosive and Fusing - The explosive to be carried shall be sufficient to destroy a VHB from the [illegible] distance [illegible] ranged.

[redacted]

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ATSC Form No. 43 (16 SEP 44)

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IDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

AAXXX XXXXXXXXXXXXX
AIR TECHNICAL SERVICE COMMAND
Wright Field, Dayton, Ohio
13 November 1944

TI-2003, (continued).

Guided Missiles - Ground to Air Remotely Controlled Missile.

Engineering Division.

It shall use time, contact, proximity, and remote control fuses or any suitable combination of fuses.

By command of Lt. General KNUDSEN:

F. A. SIMS,
Colonel, Air Corps,
Chief of Administration.

cc: Procurement Division
Supply Division
Maintenance Division.

Copy of Ltr HAAF dtd 27 July subj "Mil Characteristics for Remotely Controlled Rocket &/or Pilotless aircraft w/1st Ind fr Materiel Command dtd 22 Aug &/2nd Ind fr HAAF dtd 21 Sept & incl thereto.
Total 18 pages

[redacted]

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ATSC Form No. 43 (16 SEP 44)
C.E.F MX 416
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[redacted]

Capt. Jon H. Ober
ees/TSTRX (5-6147)

XXXXXXXXXXXXXXXXXXX

AIR TECHNICAL SERVICE COMMAND

Wright Field, Dayton, Ohio
13 November 1944

Secretary, ATSC
11/13

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMIN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

TI-2003, Addendum No. 1.

Guided Missiles - Ground to Ground Remotely Controlled Missile.

Engineering Division. 416

1. Problem Presented:

a. To develop a ground to ground remotely controlled guided missile.

2. Authority:

a. CG, AAF. By 2nd Indorsement dated 21 September 1944, with regard to the above, subject, received from Chief, Development Engineering Branch, Materiel Division, AC/AS, M&S.

3. Action Desired:

a. The missile called for will have the following characteristics:

(1) Nature of Missile - The missile will be launched from the ground.
(2) Type of Control - Missile to be controlled by means of radio, radar or other suitable control. The missile shall incorporate devices which will enable it either to guide itself or to be guided to within effective range of the target.
(3) Launching - Launching and original aiming from the ground.
(4) Range and Speed -
(a) Range to be from 300 miles minimum to 500 miles desired.
(b) Speed to be from 400 mph minimum to 700 mph desired.
(5) Explosive and Fusing - The explosive to be carried shall weigh 2000 pounds and shall be fused with contact, inertia, time, remote fuses, or any combination of fuses.

By command of Lt. General KNUDSEN:

T. A. SIMS,
Colonel, Air Corps,
Chief of Administration.

cc: Procurement Division
Supply Division
Maintenance Division.

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ATSC Form No. 43 (16 SEP 44)

ORF MX 416

16 [redacted]

Capt. Jon H. Ober
eas/TSTPX (5-5147)

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMIN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

~~XXXXX XXX XXXXXXXXXX~~
AIR TECHNICAL SERVICE COMMAND
Wright Field, Dayton, Ohio
13 ~~November 1944~~

[redacted]

Director, ATSC

TI-2003, Addendum No. 2. 416

Guided Missiles - Air to Ground Remotely Controlled Missile.

Engineering Division.

1. Problem Presented:

a. To develop an air to ground remotely controlled missile.

2. Authority:

a. CG, AAF. By 2nd Indorsement dated 21 September 1944, with regard to the above subject, received from Chief, Development Engineering Branch, Materiel Division, AC/AS, Hqs.

3. Action Desired:

a. To develop an air to ground remotely controlled missile having the following characteristics:

Mission: To hit and destroy terrestrial pin point targets.

Characteristics:

Nature of Missile - Missile will be launched from an aircraft.

Type of Control - Missile to be aimed initially by aiming the aircraft. Missile to be controlled from the launching aircraft by means of radio, radar or other suitable control. Missile shall incorporate devices which will enable it either to guide itself, or be guided to within effective influence fuse range of the target.

Launching - Launching from aircraft in flight.

Speed and Altitude - Missile to have a speed of 500 mph at 40 to 50 thousand feet altitude and to be controllable in flight at this altitude.

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SECRET

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Y-57383-D

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ATSC Form No. 43 (16 SEP 44)

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

HEADQUARTERS [illegible]
AIR TECHNICAL SERVICE COMMAND
Wright Field, Dayton, Ohio
13 November 1944

TI-2003, Addendum No. 2 (continued).

Guided Missiles - Air to Ground Remotely Controlled Missile.

Engineering Division.

__Explosive and Fusing__ - Explosive load [illegible] equivalent of a 1,000 or 5,000 pound bomb or warhead. It shall use time, contact, proximity, and remote control fuses or any [illegible] combination of fuses.

By command of Lt. General [illegible]:

[illegible]
Colonel, Air Corps,
[illegible] Administration.

cc: Procurement Division
Supply Division
Maintenance Division

[redacted]

Y-57383-D.

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PENDAGA 22 SEP 44 3000M

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ATSC Form No. 43 (16 SEP 44)

162

C.R.F. Mx #16
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[redacted]

Capt. Jon H. O
ees/INTEX (5-52

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMIN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

~~XXXXXXXXXXXXXXXX~~
AIR TECHNICAL SERVICE COMMAND
Wright Field, Dayton, Ohio
13 November 1944

[redacted]
AUTH: C. G. AMC
Materiel Comd
DATE: 11/14/44
INITIALS: Eqe

TI-2003, Addendum No. 3.

Guided Missiles - Air to Air Remotely Controlled Missile.

Engineering Division.

416

1. Problem Presented:

a. To develop an air to air remotely controlled guided missile.

2. Factual Data:

a. CTI-1860 was established for the initial authority for this project, however, CTI-1860 was never actually published due to a change in numbering systems for all technical instructions. Accordingly, any document concerning this project using CTI-1860 as an authority will be considered legitimate.

3. Authority:

a. CG, AAF. By 2nd Indorsement dated 21 September 1944, with regard to the above subject, received from Chief, Development Engineering Branch, Materiel Division, AC/AS, WMS.

4. Action Desired:

a. The missile called for will have the following characteristics:

(1) Nature of Missile - The missile will be launched from an aircraft.
(2) Type of Control - Missile to be aimed initially by aiming the aircraft. Missile to be controlled from the launching aircraft by means of radio, radar, or other suitable control. The missile shall incorporate devices which will enable it either to guide itself, or be guided, to within effective influence fuse range of the target.
(3) Launching - Launching to be from aircraft in flight.
(4) Range and Altitude -

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1944 NOV 14

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ATSC Form No. 43 (16 SEP 44)

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[redacted]

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

~~XXXXXXXXXXXXXXXXXX~~
AIR TECHNICAL SERVICE COMMAND
Wright Field, Dayton, Ohio
13 November 1944

TI-2003, Addendum No. 3 (continued).

Guided Missiles - Air to Air Remotely Controlled Missile.

Engineering Division.

(a) Range to be from 5 miles minimum to 9 miles desired from point of launching. Speed at altitude indicated below to be 500 mph minimum to 700 mph desired.

(b) Maximum altitude - To be capable of maintaining an altitude of at least 40,000 feet minimum to 50,000 feet desired.

(5) Explosive and Fusing - The explosive to be carried shall weigh approximately 150 pounds and use proximity, contact, remote or time fuses, or any combination of fuses.

By command of Lt. General KNUDSEN:

T. A. SIMS,
Colonel, Air Corps,
Chief of Administration.

cc: Procurement Division
Supply Division
Maintenance Division.

[redacted]

Y-57383-C

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NDRC

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

E .cjt:TSTEX
Wright Field, Dayton, Ohio
17 November 1944

TECHNICAL INSTRUCTIONS

AC-36

Serial No.: TI-2003, ADDENDUM NO. 4

Subject: Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs

To: Procurement Division
Engineering Division
Supply Division

1. Problem Presented:

a. To transfer sufficient funds to the National Defense Research Committee to cover procurement of 1000 VB-3 "Razon" tails for 1000 lb. bombs.

b. The direct procurement of 2000 additional VB-3 "Razon" tails for 1000 lb. bombs to make a total procurement by the Army Air Forces of 3000 VB-3s.

2. Factual Data:

Gen. Carroll
Deputy Chief
Airc.Proj.Lab.
Equip.Lab.(5)
Airc.Lab.(2)
Arm.Lab.(4)
[illegible](1)
Engrg.Sec.(2)

a. The assignment of sufficient funds to the National Defense Research Committee to procure 1000 VB-3 tails is necessary since development is not entirely complete and it is necessary to make available at the earliest possible date, sufficient VB-3 tails for AAF Board test, test by the Navy of 300 VB-3s and the start of service tests in the theaters. A request to the N.D.R.C. for this procurement of 1000 VB-3s has been initiated by the Office, Assistant Chief of Air Staff, Materiel and Services to the War Department Liaison Officer for the N.D.R.C.

b. The following conditions are to apply to the direct procurement by this Command of the 2000 additional VB-3 "Razon" tails:

(1) The VB-3 "Razon" tails procured are to be for the same purpose as those developed by the N.D.R.C. Changes to design however, may be made at the discretion of the Air Technical Service Command.

(2) The procurement is to include the quantity of component spares considered necessary by the Air Technical Service Command.

(3) Deliveries are to start immediately after completion of deliveries to the N.D.R.C. and are to proceed at the same maximum rate as deliveries to the N.D.R.C. or at higher rates if considered feasible

[redacted]

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AC-[illegible]
31-43(P)
NDRC

[redacted]

HFS[illegible]:TSTEX
Wright Field, Dayton, Ohio
17 November 1944

Serial No.: TT-2003, ADDENDUM NO. 4

Subject: Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs

To: Procurement Division
Engineering Division
Supply Division

(4) The procurement will include all necessary items for the VB-3 except the radio receiver. The radio receiver will be procured by the Signal Corps and furnished as a G. F. E. item.

(5) Components and materials from the cancellation of the VB-1 Azon tail procurement are to be used to the greatest possible extent.

(6) All VB-3s obtained on direct procurement by the Air Technical Service Command are to be packed for overseas shipment.

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 11 November 1944, subject, same as above, from, Chief, Materiel Division, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Engineering Division cooperate with the N.D.R.C. on the development of VB-3 "Razon" tails and furnish to the Procurement Division all drawings and engineering data required by the Procurement Division for procurement of the 2000 additional VB-3 "Razon" tails. The Engineering Division will also furnish to the Supply Division any information necessary to enable the Supply Division to determine the testing equipment and tools necessary for the use of the VB-3 "Razon" tails and furnish to the Maintenance Division, engineering information necessary for preparation of appropriate technical instructions.

b. That the Procurement Division take the following action:

(1) The assignment of sufficient funds to the National Defense Committee to cover the procurement of 1000 VB-3 "Razon" tails.

(2) Upon receipt of the necessary drawings and engineering data from the Engineering Division, procure 2000 additional VB-3 "Razon" tails to make a total procurement for the Army Air Forces of [illegible]

[redacted] T-[illegible]-A-27

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AG-32
AS-3/3 PT
NDRC

152B

Serial No.: TT-2003, ADDENDUM NO. 4

Subject: Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs.

To: Procurement Division
Engineering Division
Supply Division

(3) Make the necessary arrangements for the radio receivers, which will be procured by the Signal Corps, to be delivered to the contractor as a G.F.E. item and incorporated in the "Razon" Tails.

(4) Determine, with the assistance of the Supply Division, the quantity of component spares considered necessary for the total procurement of VB-3 "Razon" tails and procure these spares.

(5) Arrange for the 2000 VB-3s procured by this Command to be packed for overseas shipment and delivered as directed by the Supply Division.

(6) Furnish to the Office, Assistant Chief of Air Staff, Materiel and Services, through the Office, Chief of Administration, the schedule for deliveries of the 3000 VB-3 "Razon" tails at the earliest possible date.

c. The Supply Division is to take the following action:

(1) Furnish to the Procurement Division, any assistance necessary for the procurement of the quantity of component spares necessary for utilisation with the VB-3 "Razon" tails.

(2) With the assistance of the Engineering Division and the Maintenance Division, determine the test equipment and tools considered necessary for the use of VB-3 "Razon" tails and initiate procurement action for this equipment and further furnish a statement to the Assistant Chief of Air Staff, Materiel and Services through this office, of the required equipment and the action being taken to procure this equipment.

d. That the Maintenance Division assist the Supply Division in the determination of the test equipment and tools considered necessary in the use of the VB-3 "Razon" tails and issue any necessary Technical Instructions.

By Command of Lt. General KNUDSEN:

T. A. Sims
T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Maintenance Division

[redacted]

Y-88187-A-27

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[redacted]

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Capt. Jon H. Ober
ees/TSTEX (5-6147)

[redacted]

AUTH: Director, ATSC
DATE: 4 December 1944
INITIAL: JHO

T E C H N I C A L   I N S T R U C T I O N S

Wright Field, Dayton, Ohio
4 December 1944

SERIAL NO: TI-2003, Addendum No. 6.

SUBJECT: Guided Missile - Air to Ground Remotely Controlled Missile.

TO: Engineering Division.

1. Problem Presented: 416

a. To develop an air to ground remotely controlled missile.

2. Authority:

a. CG, AAF. By 2nd Indorsement dated 21 September 1944, with regard to the above subject, received from Chief, Engineering Branch, Materiel Division, AC/AS, M&S.

3. Action Desired:

a. To develop an air to ground remotely controlled missile having the following characteristics:

(1) Mission - To hit and destroy terrestial pin-point targets.
(2) Type of Control - Missile is to be aimed initially by aiming the aircraft. Missile is to be controlled by means of radio, radar, and/or other suitable control.
(3) Launching - Launching from an aircraft in flight.
(4) Speed - Launching - 250mph, Striking - 500 mph.
(5) Range - Range is to at least five miles.
(6) Altitude - Altitude is to be 5000 feet.
(7) Explosive - Explosive load will not exceed the equivalent of 1000 pound bomb or warhead.
(8) Fusing - It shall use time, contact, proximity, or remotely controlled fuses or any suitable combination of fuses.

b. This project has a 2-A priority.

By command of Lt. General KNUDSEN:

Jon H. Ober Capt AC

T. A. SIMS,
Colonel, Air Corps,
Chief of Administration.

cc: Procurement Division
Supply Division
Maintenance Division.

Central Files

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Copy of Auth ltr under TI-2003 Add 2

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Capt. Jon H. Ober
ees/TSTEX (5-6147)

[redacted]
AUTH: Director, ATSC
DATE: 4 December 1944
INITIAL: [illegible]

T E C H N I C A L   I N S T R U C T I O N S

Wright Field, Dayton, Ohio
4 December 1944

416

SERIAL NO: TI-2003, Addendum No. 7.

SUBJECT: Guided Missiles - Medium Range Ground to Ground Remotely Controlled Missile.

TO: Engineering Division.

1. Problem Presented:

a. To develop a medium range ground to ground remotely controlled missile.

2. Authority:

a. CG, AAF. By 2nd Indorsement dated 21 September 1944, with regard to the above subject, received from Chief, Engineering Branch, Material Division, AC/AS, M&S.

3. Action Desired:

a. To develop a medium range ground to ground remotely controlled missile having the following characteristics:

(1) Nature - Missile to be launched from the ground.
(2) Type of Control - Missile controlled with preset controls, using some form of RF tracking, or remotely controlled.
(3) Launching - Sighted and launched from the ground.
(4) Range & Speed -
Range to be 50 miles minimum to 75 miles desired.
Speed to be 300 mph minimum.
(5) Explosive and Fusing - Explosive load to be 1000 lbs. Fuses to be remote, contact, inertia, or time or any combination of fuses.

b. This project has a 2-A priority.

By command of Lt. General KNUDSEN:

Jon H Ober Capt AC

T. A. SIMS,
Colonel, Air Corps,
Chief of Administration.

cc: Procurement Division
Supply Division
Maintenance Division.

Central Files

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Capt. Walter W. Burbank
jcs/TSTEX (5-6189)

[redacted]
AUTH: Director ATSC
DATE: 3 January 1945
INITIALS: [illegible]

Wright Field
Dayton, Ohio
5 January 1945

SERIAL NO: TI-2196, Addendum 1

SUBJECT: Project Campbell

TO: Engineering Division
Supply Division

MX-559

1. Problem Presented:

a. To completely equip a new B-17-G for operation with the Campbell Project, and upon completion of the installation in the new B-17-G, the present B-17-F, No. 3319 will be returned to Air Technical Service Command and the equipment installed in it will be returned to Supply.

2. Factual Data:

a. Authorization is granted by the Asst. Chief of Air Staff, Materiel and Services, for the release of equipment necessary for this installation. This will be essentially on a loan basis until such time as the equipment in use on the B-17-F can be returned to Supply. It is contemplated that this airplane, completely equipped for this project and for operation in the European Theater of operation, will be delivered to Bolling Field and turned over to Lt. Commander Shaheen, Chief of the Special Projects Office, Office of Strategic Services. The Asst. Chief of Air Staff, Materiel and Services, is to be notified when the installation is complete in order that delivery instructions can be supplied and arrangements made with the Office of Strategic Services for delivery of the aircraft.

Classification cancelled
~~or changed to~~
AUTH: CP 356
By ____________
Signature and Grade
Date 10 1945

b. The Air Technical Service Command is responsible for the complete development of Project Campbell and, therefore, has over-all responsibility on the test program. However, proper liaison will be maintained and the assistance of the Office of Strategic Services should be utilized wherever possible to carry out the test program.

c. The Office of Strategic Services will be responsible for making the installation in the remaining twenty (20) boats. The Air Technical Service Command will be responsible for the prototype installation and supplying the necessary technical data for the additional installations and also for supplying technical supervision for the remaining installations.

Central Files

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X-2231

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WMB:jcs:TSTEX
Wright Field
Dayton, Ohio
3 January 1945

[redacted]

SERIAL NO: TI-2196, Addendum 1

SUBJECT: Project Campbell

TO: Engineering Division
Supply Division

d. The Office of Strategic Services will be responsible for the operation and maintenance of the equipment to be used on this project. They now have personnel assigned for this project.

e. At present, the Office of Strategic Services is responsible for taking this project overseas and they have the necessary personnel assigned to accomplish this. Since plans for the use of subject equipment in the theater of operation have not been firmly established, no definite deadline date can be set for this project at the present time. The Asst. Chief of Air Staff will inform this Headquarters when plans for the use of this project have been firmly established.

f. The shipping instructions set forth in basic TI-2196 are amended to read as follows:

1. The following equipment is to be shipped to Major John G. Getz, Jr., AUS, Customs House, St. Petersburg, Florida:

(a) 11 ea. Television Transmitter Navy Model ATK, complete with filter unit and compass rupert back attachments.

(b) 2 ea. Television Receivers Navy Models ARK's. (Less Monitor BC-1214-A)

(c) 2 ea. Complete set of spare tubes for Transmitter ATK less Iconoscope, Type 1846.

(d) 2 ea. Complete set of spare tubes for Receiver ARK.

(e) 2 ea. Complete set of spare tubes for Monitor BC-1214-A.

(f) 6 ea. Iconoscopes, Type 1846

(g) 2 ea. Test Equipment AN/CR[illegible]-2
2 ea. Test Equipment AN/[illegible]-1
2 ea. Test Equipment AN/[illegible]-2
2 ea. Test Equipment IE-19 or IE-36
2 ea. Test Equipment IE-57

[redacted]

X-2231

1341

[illegible]B:jcs:TSTEX
Wright Field
Dayton, Ohio
3 January 1945

[redacted]

SERIAL NO: TI-2196, Addendum 1

SUBJECT: Project Campbell

TO: Engineering Division
Supply Division

(h) 21 ea. Radio Sets SCR-522

(i) 25 ea. Radio Receivers AN/CRW-5

(j) 2 ea. Radio Transmitters BC-186

(k) 2 ea. Complete set of tubes for AN/CRW-5
2 ea. Complete set of tubes for BC-186

(l) 11 ea. Radar Sets AN/APN-7

(m) 23 ea. Inverters MG-149-F

(n) 1 ea. Test Equipment AN/APM-10

2. The following equipment will be shipped as maintenance spares for the B-17-G:

(a) 1 ea. Gyro Antenna Type A-1

(b) 1 ea. SCR-717B, complete with "A" scope, replacement controls and junction boxes for "A" scope modifications.

3. The following equipment is to be held for installation in the B-17-G airplane.

(a) 2 ea. Radio Television Receivers ARK.

(b) 2 ea. Monitors BC-1214-A

(c) 3 ea. Gyro Antenna Type A-1 (1 ea. is already installed in B-17-F, Serial No. 42-3319)

(d) 2 ea. Radio Transmitters BC-186

(e) 2 ea. SCR-717-B complete with "A" scope, replacement controls and junction boxes for "A" scope modification. (1 ea. Set of the above already installed in B-17-F s/n 42-3391)

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TWB:jcs:TSTEX
Wright Field
Dayton, Ohio
3 January 1945

[redacted]

SERIAL NO: TI-2196, Addendum 1

SUBJECT: Project Campbell

TO: Engineering Division
Supply Division

(f) 1 ea. Complete set of Antennas for RC-186 (1 ea. AS-150) (1 ea. AS-89) (1 ea. AS-161)

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 23 December 1944, subject, New B-17-G Installation for Campbell, received from Chief, Engineering Branch, Materiel Division, Office, Asst. Chief of Air Staff, Materiel & Services; and, 1st. Indorsement dated 28 December 1944, subject Project Campbell, received from Chief, Engineering Branch, Office, Asst. Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Engineering Division take the following action:

1. Make the prototype installation in the B-17-G airplane.

2. Supervise the test of this equipment.

3. Prepare the necessary engineering specifications, drawings and data for submission to the Office of Strategic Services for installation of Campbell equipment in the remaining twenty (20) boats.

4. To provide technical supervision for the remaining installations.

b. That the Supply Division take action to obtain and ship the equipment as outlined above.

c. This project has a 1-A priority.

d. These Technical Instructions amend basic TI-2196

[redacted]

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1343

WWB:jcs:TSTEX
Wright Field
Dayton, Ohio
3 January 1945

[redacted]

SERIAL NO: TI-2196, Addendum 1

SUBJECT: Project Campbell

TO: Engineering Division
Supply Division

By command of Lt. General KNUDSEN:

T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Procurement Division
Maintenance Division

[redacted]

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Captain Jon H. Ober
ees/TSX EX (5-5147)

[redacted]

TECHNICAL INSTRUCTION

MX-108

AUTH: Director, ATSC
DATE: 10 Jan 45
INITIAL: JDD.

Wright Field, Dayton, Ohio
10 January 1945

SERIAL NO: TI-2003, Addendum No. 10.

SUBJECT: Guided Missiles - Radar Homing Bomb.

TO: Engineering Division.

1. Problem Presented:

a. To secure fifty (50) GB-7A air frames for use with the AC-771 radar receiver. These fifty (50) air frames are to be secured from conversion of GB-8 air frames now in stock.

2. Factual Data:

a. This TI supersedes and cancels CTI-1695. / +13.44 Rev 171

3. Authority:

a. CG, AAF. By message WAR 86955 dated 5 January 1945, with regards to the above subject, received from Chief, Engineering Branch, Materiel Division, AC/AS, M&S.

4. Action Desired:

a. That which is stated under paragraph 1, Problem Presented.

By command of Lt. General KNUDSEN:

[illegible]

T. A. SIMS,
Colonel, Air Corps,
Chief of Administration.

Classification cancelled or changed to [illegible]
Auth: CD-556
By: [illegible] Signature and Grade
Date: 11-1-45

cc: Procurement Division
Supply Division
Maintenance Division

Classification Cancelled
To "Restricted"
Auth. [illegible]
Initials [illegible]

[redacted]

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Central Files

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[redacted]

Major H.F. Mullins
ear:TSTEX:5-7126

ARMY AIR FORCES
Headquarters
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Wright Field, Ohio
2 March 1945

INITIALS
H.F.M.

Serial No: TI-2003, ADDENDUM NO. 22

Subject: Procurement of VB-1 Azon Assemblies

To: Procurement Division

1. Problem Presented:

a. To procure immediately 1000 additional VB-1 assemblies utilizing components and materials presently available.

b. To determine the practicability of procurement beyond the 1000 units referred to in paragraph 1.a. above, by utilizing existing components taking into account that it may be necessary to initiate replacement procurement of these components for VB-3 Razon.

2. Factual Data:

a. Procurement of radio receivers for the 1000 VB-1 Azon assemblies for which procurement is directed herein will be directed by the Office, Assistant Chief of Air Staff, Materiel and Services. These radio receivers for subject equipment will probably be AN/CRW-7.

b. Spare requirements should be taken into consideration in the studies directed herein.

c. The Office, Assistant Chief of Air Staff desires that procurement of additional components except radio receivers and tail assembly shells for VB-1's not be recommended at this time.

d. The production schedule on the procurement of 1000 units directed herein, and also on any production beyond the 1000 units which may be recommended in accordance with this directive, is to be forwarded to the Office, Assistant Chief of Air Staff, Materiel and Services.

e. Reference is made to CTI-1350, Addenda No. 1, 3, 5 and 7 which directed procurement of a total of 110,600 Azon tail assemblies VB-1, and to CTI-1350, Addendum No. 9 which directed immediate cancellation of all future production of Azon tail assemblies, VB-1, except radio equipment.

CD-356

Classification Cancelled
To "Restricted"
Auth
[redacted] Initials

Date 11-1-45

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[redacted]

Serial No.: TI-2003, ADDENDUM NO. 22

Subject: Procurement of VB-1 Azon Assemblies

To: Procurement Division

3. Authority:

a. Commanding General, Army Air Forces by teletype WAR-44504, dated 27 February 1945 from Chief Engineering Division, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take the necessary action to procure 1000 additional VB-1 assemblies utilizing components and materials presently available and determine the practicability of procuring beyond this 1000 units by utilizing existing components, taking into account that it may be necessary to initiate replacement procurement of these components for VB-3 Razon, and forward this information together with the production schedule for the 1000 units for which procurement is directed herein as well as the production schedule for any production recommended beyond this 1000, to the Office, Assistant Chief of Air Staff, Materiel and Services, through this office.

By Command of Lt. General KNUDSEN:

T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Engineering Division
Maintenance Division
Supply Division

[redacted]

X-53635

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[redacted]

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Major W. M. Barstow
jcs/TSTEX (5-4141)

[redacted]
AUTH: DIR., ATSC.
DATE: 10 April
INITIALS:

Wright Field
Dayton, Ohio
10 April 1945
PERMA...

SERIAL NO: TI-2003, Addendum No. 25 a8

SUBJECT: Procurement of Radio Set AN/APW-1A for JB-2 Buzz Bomb Control

TO: Procurement Division

1. Problem Presented:

a. To procure 10,000 each AN/APW-1A control equipment as soon as possible to meet the procurement of 10,000 jet bombs directed in TI-2003, Addendum No. 18.

2. Factual Data:

a. Reference is made to TI-2003, Addendum No. 18 and teletype WAR 58104, dated 24 March, which directed immediate placement of contracts for the 10,000 JB-2 articles and auxiliary equipment in addition to the 2,000 previously authorized.

b. The required production, which includes initial procurement of 2,000 AN/APW-1's is as follows:

1945			1946		
April	500	AN/APW-1	January	1000	AN/APW-1A
May	500	"	February	1000	"
June	500	"	March	1000	"
July	500	"	April	1000	"
August	500	AN/APW-1A	May	1000	"
September	500	"	June	1000	"
October	1000	"			
November	1000	"			
December	1000	"			

c. Action should be taken in making this procurement to avoid interference with critical artillery, ammunition and bomb programs of equal priority.

d. The next revision of the Army Supply Program, Section II, Airborne, will reflect an Army Air Forces requirement for 6,000 each during 1945 and 6,000 each during 1946 of the AN/APW-1A.

Classification cancelled or ~~changed to~~
AUTH:
Signature and Grade

[redacted]

X-94517-A- 118

MX-544

Orig ltr dtd 4-4 for file

471 [redacted]

SERIAL NO: TI-2003, Addendum No. 25

[redacted]: Procurement of Radio Set [illegible]/[illegible]W-1[illegible] for JB-2 Buzz Bomb Control

TO: Procurement Division

3. Authority:

a. Commanding General, Army Air Forces by letter dated 4 April 1945, subject, "[illegible]/[illegible]W-12 (Radio Set)," received from Asst Chief, Communications Equipment Section, Supply and Maintenance Branch, Asst Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take immediate action to procure 10,000 [illegible] radio sets as outlined above.

b. That the Engineering Division provide complete procurement data, as required by the Procurement Division.

c. A 3-C priority has been assigned to this project.

By command of Lt. General [illegible]:

[illegible]
Colonel, Air Corps
Chief of Administration

cc: Engineering Division (action copy)
Supply Division
Maintenance Division

[redacted]

X-94517-2-

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CONF[redacted]

446

Major W. M. Barstow
mej: TSTEX: 5-4141

ARMY AIR FORCES
Headquarters
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Wright Field,
Dayton, Ohio
25 Apr 1945

SERIAL NO: CTI-1802, Addendum No. 3

SUBJECT: Transfer of Procurement of Rocket Motors for JB-2 Guided Missiles To Ordnance.

TO: Procurement Division.

1. Problem Presented:

a. To cancel the instructions contained in CTI-1802, Addendum No. 2, and transfer procurement of the 10,000 Monsanto Type Assisted Take-Off Rocket Motors for the JB-2 Guided Missiles to Ordnance.

2. Factual Data:

a. Ordnance Committee action on propulsion unit, Jet, TIO, for Propelling Robot Bomb, JB-2 (U-161), is being taken to procure 22,500 units and 20,000 assemblies are being procured to load propellant powder so as to provide 1,000 launchings per month for five months. In addition, 2,500 propulsion units are required for necessary test work. Ordnance will also continue to procure propellant fuel, loaded warheads and necessary fuzes.

b. AC/AS, M&S, has advised that necessary steps will be taken to properly program all Ordnance items which are part of this development as soon as the actual schedule for airplanes and motors has been received from this Headquarters.

c. It is understood that the letter of intent written by this Command as a result of CTI-1802, will be cancelled and that the Ordnance Department will issue a separate contract for the 10,000 units against Ordnance funds.

3. Authority:

a. CG, AAF, by ltr dtd 11 Apr 45, subject, Robot Bomb, JB-2, from Deputy Asst. Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take the necessary action to cancel procurement of 10,000 Monsanto Type Assisted Take-Off Rocket Motors for JB-2 Guided Missiles and forward all pertinent data to the Air Ordnance Officer for transmission to Ordnance.

X-103064-B

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[redacted]

447

SERIAL NO: CTI1802, Addendum No. 3 (continued)

SUBJECT: Transfer of Procurement of Rocket Motors for JB-2 Guided Missiles To Ordnance.

TO: Procurement Division

b. These Technical Instructions cancel and supersede CTI-1802, Addendum No. 2.

By Command of Lt. General KNUDSEN:

Lt. John Bristow
for T. A. SIMS Major A.C.
Colonel, Air Corps
Chief of Administration
E H G.

cc: Supply Division
Maintenance Division
Engineering Division
Tech. Liaison Office
Aircraft Test Control
Air Communications Office

[redacted]

X-1C3064-B -

447

[redacted]

ARMY AIR FORCES
Headquarters
AIR TECHNICAL SERVICE COMMAND

Major W.L.Barstow
ear:TSTEX:5-4141

TECHNICAL INSTRUCTIONS

Wright Field, Ohio
8 May 1945

Serial No.: CTI-1802, Add. No. 4

Subject: Transfer of Procurement of Rocket Motors for JB-2 Guided Missiles to Ordnance

To: Procurement Division
Engineering Division

1. Problem Presented:

a. The Office, Assistant Chief of Air Staff, Materiel and Services has directed that the outstanding letter of contract for ten thousand (10,000) rocket motors for the JB-2 Guided Missiles should be formalized and then transferred, complete with all contractual instruments,to the Air Ordnance Officer for transmittal to Chief of Ordnance.

2. Factual Data:

a. Reference is made to CTI-1802, Add. No. 2, which directed procurement of ten thousand (10,000) rocket motors for JB-2, and to CTI-1802, Add. No. 3 which directed that procurement be cancelled and transferred to Ordnance.

b. It has been decided that the procedure outlined in Problem Presented above, whereby this Command completes the contract with Monsanto prior to transmission to Ordnance, could be more easily handled than the previous program outlined in CTI-1802, Add. No. 3 for cancelling the contract and forwarding complete data to Ordnance for necessary procurement action.

c. The Ordnance procurement allotment number that will apply is 505-2710 P120-084 212/51005 323-072.

d. This directive will confirm telephone conversation between Colonel Cunningham, Captain Turner and Lt. Swanson of this Headquarters, Major Erickson, Air Ordnance Office, Major Woods and Mr. Ballwen, Office, Chief of Ordnance.

3. Authority:

a. CG, AAF by teletype C119572, dated 1 May 1945 from Office, Assistant Chief of Air Staff, Materiel and Services.

Classification cancelled
or changed to: ______

AUTH:
By ______
Signature and Grade

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[redacted]

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UJG

RESTRICTED

Serial No.: CTI-1802, Add. No. 4

Subject: Transfer of Procurement of Rocket Motors for JB-2 Guided Missiles to Ordnance

To: Procurement Division
Engineering Division

4. Action Desired:

a. That the Procurement Division take the necessary action to complete procurement of ten thousand (10,000) Monsanto Type Assisted Take-Off Rocket Motors for JB-2 Guided Missiles and transfer the final contract, together with all contractual instruments, to the Air Ordnance Officer for transmittal to Chief of Ordnance.

b. These Technical Instructions cancel and supersede CTI-1802, Add. No. 3.

By Command of Major General [illegible]:

for T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Supply Division
Maintenance Division
Tech. Liaison Office
Aircraft Test Control
Air Communications Office

RESTRICTED

[redacted]

1866

ARMY AIR FORCES
Headquarters
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Major W.M.Marstow
ear:TSTEX:5.4141

ORIG FILE COPIES TO
RECORDS BR. AGO

Wright Field, Ohio
18 May 1945

Serial No.: TI-2003, ADDENDUM NO. 29

Subject: Procurement of VB-1 Azon Assemblies

To: Procurement Division

1. Problem Presented:

a. To procure an additional 2000 VB-1 Azon, 1000-pound bomb tail assemblies.

2. Factual Data:

a. Reference is made to TI-2003, Add. No. 22, which directed procurement of 1000 VB-1 assemblies, utilizing components and material presently available, and to determine the practicability of procurement beyond these 1000 units.

b. The above procurement was directed in order to provide increased VB-1 units for theater use as a stop-gap measure until VB-3 production has been increased to the requested 3500 per monthly rate.

c. These units should be equipped identically with those directed in TI-2003, Add. No. 22 and existing components should be utilized whenever practical. This directive also constitutes authority for procurement of 2000 AN/CRW-7 Radio Receivers.

Classification cancelled or changed to
Auth CD-356
By
Date 10/1/45

3. Authority:

a. CG, AAF by teletype WAR-82664, dated 15 May 1945, from Chief, Materiel Division, AC/AS, M&S.

4. Action Desired:

a. That the Procurement Division take the necessary action to procure 2000 additional VB-1 Azon, 1000-pound bomb tail assemblies, utilizing components and materials presently available whenever practical, and advise the Office, Assistant Chief of Air Staff, through this Office, by 21 May concerning the estimated delivery schedule of these additional 2000 units.

Classification Cancelled
"Rest"
Auth.

b. These Technical Instructions amend TI-2003, Add. No. 22.

c. This project has been assigned a 1-C priority.

By Command of Major General MEYERS:

RESTRICTED

for T. A. SIMS,
Colonel, Air Corps
Chief of Administration
X-13356O-

cc: Eng. Div.
Maint. Div.
Supply Div.
Tech. Liaison Off.
Proc. Test Control
Air Communications Off.

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483 ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTION

Major Jon H. Ober
aes/TSTEX (5-6147)
[redacted]
Auth: Dir, ATSC
Date: 5-21-45
Initial:

Wright Field, Dayton, Ohio
21 May 1945

SERIAL NO: TI-2224, Addendum No. 1.

SUBJECT: Development of a Television Set for High Altitude Reconnaissance Rocket.

TO: Engineering Division.

VALUE OF PAPER-CHECK ONE
PERMANENT ☒ TRANSITORY ☐

1. Problem Presented:

a. There is a requirement for a high altitude rocket television set which can be launched to great altitudes and transmit to a receiver the picture of an underlying cloud cover and of the earth's surface.

2. Factual Data:

a. In order to improve the knowledge of cloud forecasting, it is essential that data on prevailing cloud cover be obtained. The usual method of plotting the observations taken at isolated weather stations or from weather reconnaissance flights yields an incomplete picture of the cloud distribution.

b. It is contemplated that the rocket will be launched either from a submarine or an aircraft, and a television set will automatically transmit pictures of the cloud cover and the earth's surface to a receiving set located in the aircraft or submarine.

c. Various components of reconnaissance rockets are now in the process of development. The Allegheny Ballistics Laboratory, Cumberland, Maryland, is developing on an NDRC contract a rocket meterological sounding device (rocketsonde) capable of measuring temperature, pressure and humidity up to altitudes of at least 120,000 feet. The Camp Evans Signal Laboratory, Belmar, New Jersey, is developing the meterological element for a rocketsonde. Data on the development status of these two projects should be of assistance to ATSC in prosecuting the development of the television set for the high altitude rocket.

3. Authority:

a. CG, AAF, By letter dated 15 May 45, subject as above, received from Chief, Materiel Division, AC/AS, M&S.

BK

4. Action Desired:

a. That the Engineering Division develop a television transmitter suitable for the subject purpose, or to modify the AN/AXT-7 (MIMO) transmitter, in accordance with the attached military characteristics.

Classification cancelled
~~or changed to~~
AUTH:
By
Signature and Grade
Date

[redacted]

X-135339-A-

MK-544

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[redacted]

SERIAL NO: TI-2224, Addendum No. 1 (continued).

SUBJECT: Development of a Television Set for High Altitude Reconnaissance Rocket.

(1) The television system will be required to operate in daytime only.

b. This project carries a 1-C priority.

By command of Major General MEYERS:

T. .. SIMS,
Colonel, Air Corps,
Chief of Administration.

1 Incl:
Cy M/C for High Altitude Rocket Television Set for Cloud Reconnaissance.

cc: Procurement Division
Supply Division
Maintenance Division
Tech. Liaison Office
Aircraft Test Control
Air Communications Office.

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THIS PAGE IS DECLASSIFIED IAW EO 13526

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[redacted]

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Major Jon H. Ober
es/TSTEX (5-6147)

Wright Field,
Dayton, Ohio
19 July 1945

TECHNICAL INSTRUCTIONS

	INITIALS

SERIAL NO: TI-2003, Addendum No. 41.

SUBJECT: Necessary Improvement in Accuracy and Consistent Performance of the JB-2.

TO: Engineering Division

1. Problem Presented:

a. To expedite combat tests of the JB-2 for contemplated use in the Pacific Theater.

2. Factual Data:

a. It is evident, however, that the degree of accuracy and consistency of performance now being secured in the tests at Eglin Field, are not sufficiently satisfactory as yet to warrant such operational use.

b. It is presently indicated also that the fifty foot portable ramp, with rocket-assisted launching, will be the most practical [illegible] original employment in a theater of operations.

3. Authority:

a. CG, AAF. By ltr dated 29 June 45, subject as above, received from Chief, Material Division, AC/AS, M&S.

4. Action Desired:

a. That the Engineering Division expedite all tests of the JB-2 in order to secure improved accuracy and consistent performance of the JB-2 at the earliest possible date, in order to permit operational use. These tests are to be conducted with the major share of launchings from the fifty foot portable ramp, in order to simulate theater operational use.

b. This project carries a 1-C priority.

Classification cancelled or changed to ____
AUTH: ____
By ____
Signature and Grade
Date ____

By command of Major General KNERR:

Jon H. Ober Maj AC

T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Procurement Division
Supply Division
Maintenance Division
Tech. Liaison Office
Aircraft Test Control

[redacted] W-2577-A-

1524

ATSC Form No. 80-302 (2 NOV 44)
CONFIDENTIAL

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1 JAN 45-3400

Major W.M.Barstow
ear:TSTEX:5-4141

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Wright Field, Ohio
24 July 1945

TECHNICAL INSTRUCTIONS

Serial No.: TI-2003, ADDENDUM NO. 43

Subject: Modification of JB-2 Guided Missiles in Storage at the 829th Specialized Depot, Gadsden, Alabama

To: Procurement Division
Maintenance Division
Engineering Division
Supply Division

1. Problem Presented:

a. To completely modify for operational use all JB-2 Jet Bombs now in storage at the 829th Specialized Depot, Gadsden, Alabama, to include the AN/APW-1 radar control equipment and other necessary improvements to the engine, metering unit and auto pilot equipment in order to meet the following tentative planned shipping schedule for the JB-2 Bomb: 900 on 15 November 1945, 800 on 15 December, 600 on 15 January 1946, 500 on 15 February and 500 on the 15th of each following month.

MX-544

2. Factual Data:

a. Reference is made to TI-2003, Add. No. 32 which outlined the program for installation of AN/APW-1 radar control set in JB-2 in both production and storage, and letter dated 11 June 1945, from this Headquarters to AC/AS, M&S, subject: "Installation of AN/APW-1 in JB-2" which requested authority to delay installation of AN/APW-1 installation in storage JB-2 missiles until such time as complete operational modifications could be incorporated to the engine and the auto pilot in order to accomplish all the necessary work required on the JB-2 units with only one repackaging job.

b. It is understood that the present tentative delivery schedule of production JB-2 articles is as follows: 300 on 15 November, 350 on 15 December, 500 on 15 January and 500 each month thereafter so that the difference between the total delivery schedule outlined in Problem Presented above and the estimated production schedule will have to be met from storage modified JB-2 units. It is further understood that the Procurement Division has agreed to accomplish the necessary rework to the engine and auto pilot equipment at the contractor's plant in order to expedite the completion of the modification work required at Gadsden.

Classification cancelled
~~changed to~~
BY AUTH:
Signature and Grade

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[redacted]

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[redacted]

Serial No.: TI-2003, Add. No. 43

Subject: Modification of JB-2 Guided Missiles in Storage at the 829th Specialized Depot, Gadsden, Alabama

3. Authority:

a. CG, AAF by teletype WAR-35644, dated 20 July 1945, from Chief, Materiel Division, AC/AS, M&S.

4. Action Desired:

a. That the Supply Division take immediate action to modify all JB-2 jet bombs in storage at the 829th Specialized Depot, Gadsden, Alabama, complete for operational use including radar control and necessary revisions to engine and auto pilot equipment in order to meet the delivery schedule set forth above, taking into consideration estimated deliveries from the Procurement Division.

b. That the Procurement Division assist the Supply Division in this project by modifying at the contractor's plant the engines, automatic pilots and any other equipment necessary to make the JB-2 unit satisfactory for operational use in order to meet the delivery schedule outlined above.

c. That the Maintenance Division assist the Supply Division in this project and provide the necessary personnel in order to accomplish this job in the required time.

d. That the Engineering Division provide complete engineering and installation data for AN/APW-1 equipment in JB-2 guided missiles and provide any additional information or assistance required to completely modify these JB-2 bombs for operational use.

e. These Technical Instructions cancel and supersede TI-2003, Add. No. 32.

f. This project has been assigned a 1-C priority.

By Command of Major General KNERR:

Martin E. Eastman Major A-C
f/c K. H. BITTING
Colonel, Air Corps
Chief of Administration
E.H.E.

cc: Tech. Liaison Office
Flight Test

[redacted]

W-12180-

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ATSC Form No. 60-30 (NOV 44)

Capt F. [illegible]
TSTEX: [illegible]

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

[illegible] Field,
Dayton, Ohio.
22 August 1945

SERIAL NO: TI-2003, Addendum No. 46

SUBJECT: Procurement of VB-1 and VB-3 Assemblies.

TO: Procurement Division

1. Problem Presented:

a. To reduce the procurement of VB-1 [illegible] assemblies to a total of one thousand (1000) units.

b. To reduce the procurement of VB-3 Razon assemblies to a total of three thousand (3000) units.

2. Factual Data:

a. Associated equipment should be cut back in proportion to the reductions of VB-1 and VB-3 as outlined above.

3. Authority:

a. CG, AAF by teletype War #1369 dated 18 [illegible] 1945, from Chief, Materiel Division, Office, AC/AS, M&S.

4. Action Desired:

a. That the Procurement Division take the necessary action to reduce the procurement of VB-1 and VB-3 units as outlined under "Problem Presented" above.

b. These technical instructions amend TI-2003, Addenda No. 22, No. 29, and No. 31.

MX-225 MX-591 MX-225

c. This project is assigned a 1-C priority.

d. This is a post V-J Day project.

By Command of Major General KNERR:

J H Carey, Capt AC.
for K. H. BITTING
Colonel, Air Corps
Chief of Administration

cc: Engineering Div.
Maintenance Div.
Supply Div.
Tech Liaison Office
Flight Test Div.

Classification cancelled
~~or changed to~~
AUTH: CD-856
By [redacted]
Signature and Grade
Date 11-1-45

Classification Cancelled
To "Restricted"
Auth.
Initials

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SECRET

SECRET
AUTH: CG. ATSC
INITIALS
DATE 12 Sept. 1945

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Serial No.: TI-2196, Addendum No. 13

Major W. Burbank
jmy:TSTIX:5-6189

Wright Field, Ohio
12 September 1945

Subject: Project Javaman

To: Supply Division
Maintenance Division
Engineering Division

1. Problem Presented:

a. To cancel the Javaman Project in its entirety.

2. Factual Data:

a. Reference is made to TI-2196 and addenda thereto, which outline action to be taken in this Command in regard to the Javaman project.

b. By agreement with the Office of Strategic Services, the Javaman project has been cancelled.

c. In order to transfer all the equipment supplied to the OSS on this project, back to the Air Forces, Headquarters AAF has directed that the following action is to be taken:

(1) Transfer all ARB and JR boats from OSS to AAF. Specific action in regard to this transfer is outlined in TI-2155, Addendum No. 5. 1560 - Emergency Rescue Boats

(2) The nine (9) aircraft that were modified for operational use of this project are to have the Javaman equipment removed, essentially the group "B" parts only and the aircraft returned to storage. The one (1) B-17G that is assigned to Headquarters ATSC is to be delivered to Eglin Field for use on the Eglin Field project. The B-17F assigned to Headquarters ATSC on this project is to have all the Javaman equipment removed and the airplane processed for disposal. The nine (9) aircraft are covered on Project DCM-43B.

(3) All the equipment supplied to St. Petersburg for this project is to be returned to ATSC supply.

Classification cancelled
~~or changed to~~ [redacted]
AUTH: CD 356
By ______ Signature and Grade
Date 10-1-45

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[redacted]

Serial No.: TI-2196, Addendum No. 13 (Con't)

Subject: Project Javaman

d. Headquarters, AAF has sent a copy of the directive directing disposal of this project, to OSS, with a request that they cooperate with this Headquarters on the return of this equipment.

e. A project is being set up at Eglin Field to determine the tactical and operational suitability of the missile developed on this project for future reference.

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 31 August 1945, subject as above, from Chief, Production Division, Office, Assistant Chief of Air Staff-4.

4. Action Desired:

a. That the Maintenance Division take the following action:

(1) Remove the Javaman equipment and store the nine (9) B-17 aircraft as outlined above.

(2) Remove the Javaman equipment from the B-17F aircraft assigned to Headquarters, ATSC and process the aircraft for disposal.

b. That the Supply Division accept the transferred equipment from OSS.

c. That the Engineering Division take the necessary action to transfer the B-17G aircraft assigned to this Headquarters to Eglin Field for use on the Eglin Field project.

5. These Technical Instructions cancel and supersede TI-2196, and Addenda 1, 2, 4, 5, 8, 10 and 11 which are the only open TI's on this project.

By Command of Major General KNERR:

cc: Procurement Division
Tech. Liaison Office
Aircraft Test Control

for R. Wm. DAVIS Maj, AC
Major, Air Corps
Act'g Chief of Administration

Note: This TI is approved for post V-J Day compliance.

[redacted]

W-43780-A-

C.C.F. MX 4/6
1/2

ARMY AIR FORCES 170
HEADQUARTERS
. . R TECHNICAL SERVICE COMMANL

JOS/ISTEX/S-5144
[redacted]
AUTH: CG, ATSC
DATE: 12 Sept. 45
INITIALS: ZRO

TECHNICAL INSTRUCTIONS

Wright Field
Dayton, Ohio
12 Sep 1945

SERIAL NO: TI-2003, Addendum No. 50

SUBJECT: Countermeasures Against Guided Missiles

TO: Engineering Division

1. Problem Presented:

a. To outline program for guided missiles countermeasure development.

2. Factual Data:

a. It has become increasingly apparent that the future defense of the United States must include adequate measures for dealing with surprise saturation raids by guided missiles of the V-2 or similar type. At present, no effective countermeasure against such weapons exists. Probably the most nearly effective countermeasure was evolved by the British, who had worked out radar methods of tracking and were preparing to fire anti-aircraft guns at V-2's at the time that the launching sites were captured and firings against Britian ceased.

b. It is expected that a comprehensive study of this problem considering all aspects of active and passive air defense will indicate certain desirable modifications or developments of Army Service Forces equipment normally part of an air defense system. It is desired that it be clearly understood that this directive does not authorize the development in the Air Technical Service Command of anti-aircraft guns or any other devices normally the province of the Army Service Forces; that modification or development of such devices as your study indicates is warranted is to be conducted by the service having the basic technical ability in research; and that all guided missiles development is to be in strict accordance with the directive of the Deputy Chief of Staff, subject "Guided Missiles", dated 2 October 1944.

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 23 August 1945, subject as above, received from Chief, Materiel

[redacted]

W-37833-A-

416 - Countermeasures against Guided Missiles

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SERIAL NO: TI-2003, Addendum No. 50 (cont)

SUBJECT: Countermeasures Against Guided Missiles

Division, Office, Asst Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. Within the scope of development of guided missile countermeasure already under way, the Engineering Division will initiate development of the specific countermeasure against missiles of the V-2 type. This development is to encompass three phases:

(1) Development of new guided missiles, or other means, together with necessary auxiliary equipment and including guided missiles air defense control centers and systems, specifically intended to counter missiles approaching at extremely high speeds, from extremely high or low altitudes, and in large numbers. Military Characteristics to provide more specific guidance to this development will be prepared and forwarded in the near future.

(2) Adaptation, modification and improvement of existing Air Force equipment, weapons, and techniques, including radar warning, and modification of Air Force gun laying equipment.

(3) Referral to Army Service Forces of such projects as Army Air Forces research indicates is desirable.

b. This project has a 1-C priority.

c. This is a post VJ-Day project.

By command of Major General KNERR:

[illegible] Maj [illegible]

[illegible] HB. DAVIS
[illegible] Air [illegible]
[illegible] Chief of [illegible]

cc: Supply [illegible]
Procurement Division
Maintenance Division
Tech. Liaison Office
Flight Test Division

[redacted]

W-37833-A-

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CRF Mr. 416

1 JAN 45

Major Jon H. Ober
ced/TSTEX [redacted]

[redacted]

ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Auth: CG, ATSC
Date: 10/5/45
Init: gmo

TECHNICAL INSTRUCTIONS

Wright Field, Dayton, Ohio
5 October 1945

SERIAL NO: TI-2003, Addendum No. 51 A

SUBJECT: Guided Missiles of the German A-9 and A-10 Type

TO: Engineering Division

1. Problem Presented:

a. To develop missiles of both airplane type trajectories and trajectories of the A-9 and A-10 general type as a means of fulfilling the Military Characteristics for ground-to-ground guided missiles, as referenced below.

2. Factual Data:

a. Reference is made to letter, subject, "Military Characteristics for Ground-to-Ground Type Guided Missiles", dated 17 September 1945, from AC/AS-4 to the Air Technical Service Command (TSENG), transmitting Military Characteristics for four (4) types of ground-to-ground guided missiles.

b. The subject letter does not recommend or suggest the German A-9 or A-10 types of missiles as means for filling the requirements described by the referenced Military Characteristics. However, it should be understood that development of these types falls within the purview of the Army Air Forces. It should also be emphasized that long range missiles of these types were considered decidedly promising by the Germans and that the Army Air Forces Scientific Advisory Group also considers that this development field should be thoroughly explored and exploited. For information, there is attached an extract from "Where We Stand", the first report to General of the Army, H. H. Arnold, by the Scientific Advisory Group, AAF.

3. Authority:

a. CG, AAF. By letter dated 21 September 1945, subject as above, received from Deputy Asst Chief of Air Staff-4.

4. Action Desired:

a. That the Engineering Division accomplish that which is stated under Paragraph 1, Problem Presented, above.

b. This project carries a 2-0 priority.

416 - Guided Missile

W-49319-A-

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SERIAL NO: TI-2003, Addendum No. 51

SUBJECT: Guided Missiles of the German A-9 and A-10 Type

c. This TI is approved for post-VJ-Day compliance.

By command of Major General KNERR:

R. HB. DAVIS
Major, Air Corps
Acting Chief of Administration

1 Incl;
Extract frm
"Where We Stand"

cc: Procurement Division
Supply Division
Maintenance Division
Flight Test Division

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Auth: C. G. AMC
Initials: CMT
Date: 4 JUNE 1946

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C. G. A.M.C.
CMT
14 JUNE 1946

[redacted]

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App. E

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[redacted]

C.G. AMC
CMT
14 JUNE 1946

[redacted]

V-35349-5
App. E

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GUIDED MISSILES DOCTRINE

INDEX

SECTUIB I

HISTORICAL BACKGROUND

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GUIDED MISSILES TEXT

HISTORICAL BACKGROUND

A. General Chronology

ingenious

Guided missiles are the developments of many ingenuous applications of the Principle of Reaction. Sir Isaac Newton's Third Law of Motion explains this principle in the simplified translation, "For every action there is an equal and opposite reaction." Rockets and jet engines operate on this basis. Other means of locomotion depend on some kind of outside frictional contact on which to pull the vehicle along, but the reaction vehicle literally "pulls itself up by its own bootstraps." Self contained chemicals (exception where oxygen of air is used for fuel) release energy which acts against the main body of the vehicle. The vehicle reacts to the combustion by trying to move away from it. This reaction gives the vehicle the ability to travel in any direction -- if supplied with enough power -- and in the media of a liquid, gas, or a vacuum.

Recorded history indicates that the jet or reaction engine received the first attention about 150 B.C. when Hero of Alexandria built his Acolipile. We then take a long jump to the Thirteenth Century, shifting the scene of action to China where the rocket made its debut. Records indicate that the Chinese used "fire arrows" against their enemies, the Tartars, during the battle of Pien-King in 1232 A.D. Marco Polo and others brought the idea of gunpowder and its use in rockets back to Europe from China shortly after 1270. An Arabian treatise on War Engines, written in 1280, mentions rockets as "Chinese Arrows." By 1400 Europe had accepted rockets as standard weapons of war. A German military engineer in 1405 specified three types of rockets for combat purposes. Joanes de Fontana, an Italian military expert, designed a number of reaction combat vehicles including a rocket car. After this 200-year spurt, however, a study and development of rockets and jets took a slump toward the end of the Fifteenth Century. By 1500 the cannon had replaced the rocket as the long range weapon. Rockets continued in use as pyrotechnics, but further development appeared to be retarded by lack of understanding of reaction principles.

After a century lapse, interest in reaction engines was again revived. In 1629, an Italian engineer, Giovanni Branca, built a steam turbine, using the jet principle. Around 1680 either Newton or a Dutch Professor named Gravesande designed a jet-propelled steam wagon. Newton's pronouncement in 1687 of the Third Law of Motion apparently crystallized thought on reaction principles, and paved the way for future developments.

Jet propulsion was first applied to an aeronautical vehicle at Paris in 1783, when Abbe' Miollan and his partner cut holes around the center of a hot air balloon, covered the holes with controllable flaps, and proposed to obtain propulsion and directional control by allowing hot air to escape from the proper ports. Unfortunately, this experiment was never carried to completion because the balloon completely burned while it was being filled with hot air. In 1791 an Englishman, John Barber, secured a patent for a gas turbine.

Coming back to rockets and their use as weapons of war, in 1780 Prince Hyder Ali, of Mysore, with a rocket corps of 1200 men in his army, employed rockets against the British with considerable success for nineteen years. This situation caused General Desaguliers, Master of the Royal Military Laboratory in England to spend considerable effort to develop a rocket to counter the India rockets. Sir William Congreve picked up the torch from Desaguliers, and in 1801 began

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rocket experiments. His development of rockets affected the course of the Napoleonic Wars and the War of 1812. A British rocket attack set fire to Copenhagen and caused nearly complete destruction of the city in 1807. In 1809 rockets were used with success against the French Fleet. Rocket fires destroyed Danzig in 1813 and rocket barrages contributed greatly to the British victory at the decisive battle at Leipzig. In 1814 British rockets were used with success against United States troops in the battle of Washington, D. C. They were also employed unsuccessfully against us three weeks later at Baltimore, where Francis Scott Key wrote the "Star Spangled Banner" while being detained on board a British vessel in the harbor.

In his developments, Congreve had dropped paper "carcasses" in 1806 and changed over to iron containers. His culminating efforts resulted in 8, 12, 32, and 42 pound rockets with ranges from 2000 to 3000 yards. His types of rockets included:

Incendiary

Explosive Shell

Shrapnel

The 32 pound rocket was 4 inches in diameter, and $3\frac{1}{2}$ feet long. An iron plate with four holes or "nozzles" in it sealed the base. A semblance of stability was gained by attaching a fifteen foot stick to this base. A light launching rack gave an initial inclination of 55 to 65 degrees.

Congreve's developments resembled to a large extent the rockets used in the last war, and his assertions that small vessels could fire great numbers of rockets or large rockets without the difficulties of recoil may be considered a prophecy concerning the rocket ships of 1944 and other Navy developments yet to come.

Congreve's rockets were dangerous to handle, very inaccurate, and highly unstable in flight. Some of them actually boomeranged back to the firing positions. American genius added a step in development at this point, when William Hale, in 1846 designed a spin-stabilized rocket which eliminated the old 15 foot stick. Spin or rotation was effected by nozzle blast operating against curved vanes. Two thousand Hale rockets had been manufactured at the Washington arsenal by June 1847 and were on their way to the field for trial.

Ordnance Office, War Department, on December 2[illegible], 1846, ordered the organization of the First United States Battery of Rockets and Mountain Howitzers at Fort Monroe, Virginia. On October 26, 1847, Major G. H. Talcott reported that rockets were used during a landing near Vera Cruz, Mexico. Men of the rocket battery were reported wounded and missing in the storming of Chapultepec, near Mexico City. At the end of the Mexican war the following year, the rocket batteries were mustered out of the service. Rockets were not used again in battle until World War II, almost a century later. The forerunner of the modern two-stage rocket was designed by Colonel Boxer of the British Royal Laboratory and was used in England in the middle 1700's for carrying land lines to ships in distress just off-shore. At the time of this writing, it is interesting to note that Group Captain Boxer, RAF, a relative, is stationed at the British War Office in Washington, D. C., engaged in Guided Missiles Development.

It may be said that the current era of guided missile development began in the United States around 1914 when Dr. Robert H. Goddard started working with powder rockets. After five year's work he gave up the use of solid fuels in favor of liquid fuels for high altitude rocket development. He is credited with effecting the first successful liquid-fuel rocket take-off and ascent under its own power on March 16, 1926, at Auburn, Massachusetts. The fuels used were gasoline and liquid oxygen. The rocket ascended 184 feet in 2.5 seconds. On July 17, 1929, he sent a small camera and a barometer aloft in a liquid-fuel rocket and successfully recovered these instruments. New developments followed in rapid succession.

August 1929 - The Junkers Company at Dessau, Germany, started experiments in rocket assisted take-offs for aircraft.

September 30, 1929 - The first rocket plane made a flight of 1½ minutes with an altitude of 50 feet at Frankfort, Germany, with Fritz von Opel, automobile manufacturer at the controls.

March 14, 1931 - The first successful German liquid-fuel rocket rose 2000 feet near Dessau, Germany. Johannes Winkler was the builder.

June 4, 1931 - The first United States rocket glider was airborne for 30 minutes at Atlantic City, New Jersey, piloted by William C. Swan.

1931 - The first mail carrying rocket which used powder propulsion travelled between Schackel and Radegund in Aust

March 1934 - Major Alexander P. de Seversky, in a published article advocated the use of rockets for aircraft armament.

1936 - The smoked-filled powder rocket " ebelwerfer" was introduced to the German Army.

1937 - Air Commodore Frank Whittle, RAF, produced a successful jet engine.

August 27, 1940 - an Italian Caproni-Campini aircraft successfully completed the first flight of a propellerless, jet-powered aircraft at Forlanini Airport, Milan, Italy.

1940 - Army Air Forces started work on JATO (Jet-assisted-take-off).

May 1941 - The British JP Glouster "Squirt" was flight-tested.

June 1942 - First production of Bazookas for United States and other United Nations ground troops.

October 1, 1942 - First test flight of United States jet plane, the Bell Aircraft's "P-59."

January 6, 1944 - Joint public announcement by England and United States of jet aircraft (JP Glouster and P-59).

June 12, 1944 - The Germans fired the first V-1 against the United Nations.

September 8, 1944 - The Germans fired the first V-2 against England.

Many individuals, societies, and services have contributed to the development of reaction vehicles in the United States. Besides the regularly organized government agencies, the better known organizations have included:

- The Glendale Rocket Society
- The California Rocket Society
- The GALCIT Rocet Research Project
- The M.I.T. Rocket Research Society
- The Yale Rocket Club
- The Westchester Rocket Society
- The Amateur Research Society
- The United States Rocket Society
- The American Rocket Society

Other nations had their own rocket societies, such as the famed German Rocket Society (Verein fur Raumschiffahrt) (or VfR). The English Societies included:

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The British Interplanetary Society

The Manchester Astronautical Society

The Astronautical Development Society

The Paisley Rocketeers Society

The Combined British Astronautical Society

Holland, Australia, and Austria each had a rocket society.

Indications point to the fact that the United States, starting in 1914 with Dr. Goddard's research (later sponsored by the Smithsonian Institute) in this country, stepped ahead of the rest of the world on reaction motors until 1932 when Germany took the lead. In 1932, Walter Dornberger obtained support from the German Army to develop liquid-fuel rockets for war purposes. By 1933 German scientists had carried out tedious fundamental research on liquid rocket thrust motors. In the summer of 1934 a trail was made on the small rocket A-2 of 300 kg thrust and was successfully stabilized, reaching a height of 2000 meters. Thus, Germany had made her bid for rocket supremacy, the A-4 or V-2 rocket being the fourth model of this family.

The German catapulting step to rocket eminence was achieved when Peenemunde was conceived around 1936. It was recognized at that time that the development of rockets showed great promise in the field of aeronautics as well as in the army. Therefore, it was decided to build two large establishments for research and development of rockets and pilotless aircraft at Peenemunde. Work started immediately on high speed wind tunnels, large laboratories and other facilities. The aid of top flight scientists and engineers was secured to staff the institutions.

Although Germany gained the lead in the propulsion components, the United States was involved in the study of guidance and control problems of guided missiles. The term "guided missile" has been selected after a vast amount of discussion, treatises, and staff studies. Such titles as "pilotless aircraft" and "controlled air weapon" opposed the term "guided missile." At any rate, guided missiles have, beside the propulsion problem, the problems of aerodynamic flight stability, guidance, homing, and remote control. These features were introduced into the research field in the United States in 1917.

Robot missile development started in the Army Air Forces in 1917 with an aerial torpedo or controllable robot bomb which utilized a conventional torpedo as the fuselage and a bi-wing airfoil arrangement with a 38 hp engine. Control was effected by a system of gyroscopes and pneumatic valves. One flight of 16 miles was made. Later, radio remote control was introduced. By the latter improvement, a target 36 miles distant was hit twice, one 60 miles distant was hit 3 times, one 90 miles distant was hit once. This project was abandoned in 1924. In 1932 the project was opened again and later closed. Six years later, 1938, the project was again revived and, under various industrial contractors, progressed to successful radio remote control aircraft used as target drones, ground-to-ground and shore-to-ship weapons, and as radio systems in War-Wear, Hermit, etc. projects. Highlights of this type of development resulted in several remote-controlled B-17's taking off and landing after a course through the atom bomb cloud at Bikini, and in Operation Remote, a 2400-mile remotely-controlled flight of two pilotless B-17's from Hawaii to California. This work has all been sponsored and developed by the Air Materiel Command at Wright Field, Dayton, Ohio.

The Army Ordnance Department and the Navy Bureau of Ordnance have made great strides in developing short range solid fuel rockets, which have registered telling blows in combat. They have also achieved considerable success with liquid fuel test vehicles in the Army's WAC Rocket series and the Navy's Bumblebee Rocket series. The Army Signal Corps and Chemical Warfare Service have also made their contributions.

The Naval Air Arm contributed in the development of JATO, remote control aircraft, glide bombs, and all component developments of guided missiles.

B. Operational Uses of Guided Missiles by United States Army Air Forces

Prior to the end of World War II, the Army Air Forces had the following guided missile research and development projects, expected to be used in combat, placed with industrial and educational institutions:

JB's (Jet Bomb)

JB's 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Abusive Project

Javaman Project

GAPA Project

VB's (vertical control bombs)

VB's 1 through 12

GB's (glide control bombs)

GB's 1 through 5, 5C, 5D, 6, 7, 7B, 7C, 8 through 15, Spazon, Grand Slam

GT-1 (glide torpedo)

Hermit

XBQ (remote control expendable bombers)

XBQ's 1, 1A, 3, 4, 5, 6

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Total Army Air Forces guided missile projects in all agencies prior to the end of the war numbered 55. The following projects were actually used in combat operations:

GB-1

GB-4

Azusive

GT-1

VB-1 Azon

Numerous other guided missiles had completed the test and training stage and were ready for use when the war ended.

GB-1 - 2,000 lb. Preset Glide Bomb

Glide ratio of 6 - 1. Accuracy from 15,000 feet altitude was estimated at not better than one-eighth mile in azimuth and one-half mile in range. The GB-1 was intended for use in area bombing of targets heavily protected by anti-aircraft. The city of Cologne and the heavily concentrated manufacturing area near was one of the most heavily defended centers in Europe. Out bombers suffered heavy losses on all missions against this area when conventional bombing techniques were used. One hundred sixteen (116) GB-1's were dropped by 58 B-17's on 28 May 1944 from points over 20 miles away from the target. All aircraft were able to turn, after releasing their bombs, short of the heavy barrage of anti-aircraft fire. Of the bombs dropped, 44 fell in the target area, 37 fell nearby, and 28 spun in. Malfunctioning was blamed on the excessive number of times the bombs were loaded and unloaded before the actual mission.

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GB-4 - Television Glide Bomb

The following GB-4, 2,000 pound, television controlled glide bomb missions were flown in Europe:

13 August 1944 - Target, E-boat pens at LeHavre. Two (2) GB-4's were released, one landed one mile short, the other landed one mile east of target.

17 August 1944 - Target, sub pen at La Pallice, France, 2 GB-4's were released, first bomb television shutter failed to open, position of hit undetermined, second landed in city east of the pens.

26 August 1944 - RR bridge target, Ravenstein, Holland, one GB-4, bomber returned to home base due to bad weather over target. Bomb was not released.

10 September 1944 - Target electrical apparatus at Duren, Germany, one GB-4, fell three miles northeast of the target, due to bad weather.

13 September 1944 - Target, oil refinery at Salzbergen, Germany, one GB-4, scored a direct hit.

Although valuable information was gained in guided missile technique, the results were at first hand disappointing.

Remotely Controlled Aircraft

War Weary guided missile project (also known as Castor, Abusive, Aphrodite, Batty, and Willie) was an Army Air Forces project which utilized war weary aircraft (B-17) and similar types remotely controlled by a mother aircraft. Project originated 25 March 1944. The war weary aircraft were stripped of all excess weight, loaded with 18,500 pounds HE (torpex, TNT, Gelgas and white phosphorus) and flown into area targets by remote radio control from another aircraft.

Combat test results in the ETO were as follows:

Nine missions in January 1945 - (Range less than 400 miles)

Three shot down by flak before reaching target

Three lost from control by mother airplane

Two fell over or short of target (one made an undamaged landing and fell into enemy hands)

One hit target, Heligoland, with considerable devastation

Details of Missions

Missile	Dispatched	Distance	Target	Result
B-17F	11-9-44	320 miles	Sub pens, Heligoland.	Shot down by anti-aircraft fire, exploded 1000 feet off target.
B-17F	14-9-44	376 miles	Oil refinery, Henningstadt, Germany	Control pilot forced to dive plane visually because of irregular block picture, target overrun 1000 ft.
B-17G	14-9-44	376 miles	Oil refinery, Henningstadt	Lost by control plane, dived blind, probably into North Sea.
B-17F	15-10-44	320 miles	Barracks and shops, Heligoland	Shot down ½ mile off shore.
B-17G	15-10-44	320 miles	Barracks and shops, Heligoland.	Destroyed 2½ acres of buildings. (Unable to use television on these two missiles).
B-17F	31-10-44		Heligoland	Dispatched on compass for Berlin.
B-17F	31-10-44		Heligoland	Abandoned after heading into North Sea.
B-17G	5-12-44	336 miles	Herford, Germany	Shot down by anti-aircraft fire while turning on run.
B-17F	5-12-44	336 miles	Herford, Germany	Wing and Carburetor iced, perfect belly landing in Germany, did not explode, and was not destroyed.

Conclusion:

On the basis of these tests, it was reported that the control and idea were basically sound. Work then began on the Hermit project which was similar to War Weary, except the ground control stations took over control near the target, sighted and steered the war weary aircraft into pin-point accuracy. This version was conceived as a means of flying the explosive-loaded expendable aircraft into Jap stronghold caves.

GT-1 - Glide Torpedo

GT-1 glider borne pattern torpedo used preset GB-1 airframe with 6-1 gliding ratio. GT-1 kit contains special paravane that frees the torpedo from the wings by actuating other devices, including explosive pins, when it contacts the water.

Eighteen B-25 crews and planes departed for the Pacific Theater in April 1945. Operational use was made of the crews sent to the 7th Air Force in the campaign against the Japanese mainland, specifically, Nagasaki and Sasebo Harbor, in July 1945.

Two GT-1 (glide torpedo) missions were accomplished during July 1945 in the Pacific Theater by the 41st Bombardment Group (M).

a. The first combat mission was directed against Nagasaki Harbor employing nine (9) B-25's carrying GT-'s. Four (4) of the glide torpedos were seen to explode in the water; one (1) overshot the harbor and hit the side of the mountain; and the remaining four (4) were unobserved. All glide torpedos were launched successfully and were seen to proceed satisfactorily on their flight. Heavy flak did not permit observation of the torpedo patterns in the water.

b. The second mission of thirteen (13) B-25's launched 13 GB-1's against Sasebo Harbor. One was hit by flak in mid air and exploded. Another spun in during flight due to a flak damaged wing occuring before the drop. It exploded upon ground impact. The other eleven (11) were seen to explode in the harbor against or near three carriers and one cargo vessel. All glide torpedos were released from 7300 to 7900 feet and all flew perfectly. One carrier was set afire and was photographed a few minutes later emitting a large column of smoke. Again, flak did not permit observation of the torpedo patterns in the water; however, the lead B-25's carried GT-1's set for a figure eight pattern.

VB-1 Azon 100 lb. High Angle Azimuth Controlled Bomb

Remote radio control for azimuth only.

a. Mediterranean Theater -

(1) The first Azon group in Italy, after a slow start, had spectacular success in blocking the Brenner Pass. In April 1944, personnel of the Air Materiel Command led an Azon party to Italy. Azon missions were carried out in which the first bombs were dropped singly, with good results, but higher headquarters insisted that trains of Azon be dropped. It was found that the dispersion between bombs was greater than that between standard 1000 pound bombs, therefore only one bomb had a possibility of hitting directly while the others of the train would be missed. This gave the impression in the theater that Azon was not too practical for bridge type of bombing desired there. Many tests were carried out by tying the bombs together; these were unsuccessful. Azon bombing was carried on from Corsica with only a fair amound of success.

b. European Theater -

(1) 8th Air Force - The first of May 1944 a second Azon squadron was

taken to England. In this theater the bombs were dropped singly as they were supposed to be dropped. The technique was to use a 6 ship formation carrying 5 Azons and 1 standard bomb in the formation, thus 5 Azons were separately controlled into a single target at one time. This proved to be fairly successful from all standpoints, flak was exceptionally heavy over the targets and several ships sustained severe damage because of the 30 second additional straight and level bomb run. The second section of 6 ships usually caught the worst flak. One bridge and one canal lock were definitely destroyed, and the approaches to several bridges were damaged. Reconnaissance photographs show that standard bombs had thoroughly covered the target with little damage. Only 6 missions were accomplished. These early operations were made difficult, however, by the practice of assigning a number of targets to each airplane for each mission, and the consequent confusion in recognizing the targets in sufficient time. Later operations in England were hampered by the extremely limited number of days with weather good enough for Azon bombing, and the placing of most bridges in the "taboo" class during August. Azon was used from the B-17, B-24 and B-26.

(2) 9th Air Force - Sixteen airplanes and 16 technicians arrived at the 9th Air Force as an Azon detachment. Flying-personnel from a 9th Air Force Squadron were used on the project. One mission was carried out with only minor success and one airplane was shot down enroute to the target. (Planes flew at 13,000 feet.) Upon the completion of this mission Bomber Command called off the Azon bombing as being too costly.

(1) On 18th February 1944, 500 Azon tail units and 10 Azon equipped

heavy bombers, B-24J's, were requested by the Tenth Air Force. These were received and a statistical summary follows of Azon results between 27 December 1944 and 5 March 1945 against bridge targets:

Missions in Which Used - 23

Targets Attacked - 38

Bridge Targets Attacked - 36

Azon Bombs Dropped - 482

Azon Bombs Dropped on Bridges - 413

Bridge Hits by Azon Bombs - 87

Bridges Knocked Out or Rendered Unserviceable - 23

Damaged but Serviceable - 3

Average Size of Bridges Bombed - 190' x [illegible]'

Average Altitude of Drop - 9250'

Average Range Error - 201'

Average Deflection Error - 131'

Advantages of Azon:

a. Azon bombing has been proven to be the most accurate method of high-altitude bombing used in the Burma-India theater, affording bombardiers an opportunity of converting near misses into hits, and reducing the number of aircraft required per target.

b. It has permitted the successful bombing of bridges, which, because of surrounding topography, were not available for low level attack.

c. It has also proven safer than low level attacks. The big, slow-moving B-24 at low level is too good a target for ground fire.

Existing Air Force guided missiles which are considered to have progressed to a state warranting immediate use and the quantities of such missiles which were available on VJ-Day are as follows:

VB-1	Azon	12,000
VB-3	Razon	3,000
VB-6	Heat Seeking	Service Test Quantities
Glide Bombs		1,800
JB-2 Buzz Bombs		950

Numerous others were in the test stage, as Tarzon, JB-3, VB-2, VB-10, ROC, etc.

C. <u>Operational Uses of Guided Missiles by United States Navy Air Arm</u>

The Navy had numerous guided missile contracts and one missile actually entered the combat phase in the Pacific area. Data on this missile, the "BAT", follows:

Fifty-four (54) SWOD Mark 9 units reached the forward area. They were expended as follows:

5 Hits (one unconfirmed)
7 Near Misses (less than 75 feet)
2 Misses (between 75 and 500 feet)
4 Destroyed by Enemy Action
5 Lost by Equipment Failures
7 Lost by Operator or Pilot Error
10 Jettisoned
2 Accidentally Lost
4 Expended for Spare Parts
8 Surveyed (end of war)

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D. <u>Operational Use of Solid Fuel Short Range Rockets by United States Aircraft</u>

Early in the history of guided missile development, the Army Air Forces recognized the need for a weapon that could fire a heavy projectile from an airplane against ground or air targets. Heavy caliber guns, though used, were somewhat impractical because of their weight and recoil, characteristics not inherent to rocket launchers. Heavy caliber guns up to 75 mm were used in both the European and Pacific theaters. These were highly inaccurate due to fast closing speed, poor sighting mechanisms, thus were considerably off in range. The 105 mm gun was also developed and inserted in aircraft for use but did not reach the combat zone.

Rocket-firing aircraft, however, by the end of the war, were operating with considerable success against both ground and air targets. The Naval air arm also employed rockets successfully against surface craft and submarines. It is interesting to note that the fire power of a rocket-equipped plane is the equivalent of a salvo from a naval destroyer.

In December 1940 N.D.R.C. set up a rocket laboratory at Indianhead, Maryland, where work was carried on jointly for the Army and Navy. At the end of July 1941, the manufacture of 500 each of plane-to-plane and plane-to-ground rockets began. Although rockets were already in combat use by the British, Germans, and Russians, the United States had made considerable advancements by April of 1942. It was not until March 1944, however, that the AAF first used air-launched rockets in combat. The 14th Air Force in China with 39 P-40 rocket mission sorties seriously damaged or destroyed river boats, factory buildings, barracks, locomotives and launches.

Although starting operational use late, the United States made rapid progress. At the end of the war, our solid-propellant rockets were probably superior to those of any other nation. Accordingly, our developments and operational uses are worthy of study.

A compilation of air launched combat rocket operations was not available at the time of preparation of this history. Until Statistical Analysis has made a thorough study of the matter, it is exceedingly difficult, if not impossible, to obtain accurate figures. The following table, which by no means covers the total rockets launched, will offer some general idea as to the quantities launched:

AAF ROCKET EXPENDITURES BETWEEN SEPTEMBER 1944 AND MARCH 1945

	ETO			MTO			CBI			POA		
1944	4.5"	5"	5"HVAR	4.5"	5"	5"HVAR	4.5"	5"	5"HVAR	4.5"	5"	HVAR
Sep			118	11			107			577		
Oct	17	10		1053			451			268		
Nov		171	54	2438			18			126		
Dec			1150	5255			33					
1945												
Jan		1155		2764			127					
Feb		1332	2202	2880			31					
Mar			4567	5631			326					

Although a vast number of 4.5", 5", and 5"HVAR were used in combat by both the Army and Navy, another rocket worthy of special mention is the 12" aircraft rocket (Tiny Tim). This 11.75" 1100-lb. rocket was developed under Section L of O.S.R.D. at California Institute of Technology. Two types of these were developed, one for use against ground targets and one possessing a long underwater trajectory for use against ships, designed to perform the functions of an aircraft torpedo. This rocket was a potent weapon. A P-47 aircraft carried two, one slung under each wing. The Navy in particular used these rockets in Pacific combat. The story of the aircraft carrier, Franklin, is well known. This carrier was loaded with Tiny Tims when it blew up, thus preventing the extensive use of the 12" rockets as planned.

E. <u>Operational Use of Solid Fuel Short Range Rockets by United States Ground Forces and Navy</u>

Infantry-type Rockets:

One of the most successful applications of the rocket principle is the "Bazooka," familiar to all ground forces. In this weapon, full advantage is taken of the recoilless light launcher inherent to rockets. The portability and cheapness of rocket launchers suggested the use of heavier rockets as infantry weapons, especially in airborne operations and in difficult terrain. However, the inaccuracy and revealing blast at the launcher position is a handicap.

The Bazooka has proved effective as a neutralization weapon against Japanese positions. Other rockets have proved of value for area fire. It is the consensus of opinion that rockets, both ground and air, are not sufficiently accurate for pinpoint attack of positions. However, there are certain cases where short range rockets may be useful. Terrain features such as reverse slopes may offer possibilities for effective use of rockets fired from air or ground.

The German panzerfaust (equivalent of the American Bazooka) was used against our tanks during the Italian Campaign and proved a real menace to our fast moving armor.

Field Artillery Rockets:

An early development was a field artillery type rocket [illegible] which was fin stabilized, highly inaccurate with a short range (4100 yards). The next development was the M16 rocket with launcher T66. This rocket is spin stabilized, has

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greater accuracy and 1100 yards greater range. The T66 launcher mounts 24 tubes on a split-trail towed carriage and weighs about 1240 pounds.

Several field artillery rocket battalions were organized and trained with this equipment. Two of these battalions went to the Pacific theater but did not operate in combat.

A rocket battalion can fire an 864-round volley, the equivalent of 72 battalions of 105 mm Howitzers firing a one-volley TOT.

Another advantage is economy in materials and manpower. Rockets and launchers can be made quickly and easily with simple tools and unskilled workers and comparatively small demands for strategic materials.

Due to the inaccuracy of free flight rockets, they may remain a supplementary weapon with important but limited tactical uses.

Tank-Mounted Launchers:

Tanks are occasionally called upon to perform a secondary mission as field artillery. The flat trajectory and small capacity of tank shells make them relatively ineffective in this role. With use, the high-velocity tank guns quickly lose velocity and penetrating power. Consequently, a tank-mounted rocket launcher was developed, but such a launcher has the disadvantages of any auxiliary weapon.

The T34 is a 60-tube launcher which is mounted on a medium tank and can be jettisoned quickly before or after firing so the tank can proceed on its normal mission. The tubes may be fired singly or at one-half second intervals.

The T34 on its tank mount is a very conspicuous piece of equipment but has some important advantages: (a) It can occupy positions which could not be reached

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by trucks. (b) The crew has the protection of the tank. (c) The weight of metal it can deliver in 30 seconds is very large. (d) It is controlled in elevation and azimuth with the same controls used for the 75 mm gun in the turret. (e) The tank radio provides communication and simplified the coordinated firing of all launchers.

Anti-aircraft:

The United States has shown little interest in anti-aircraft rockets because present solid fuel short range rockets lack the essential accuracy and high muzzle velocity.

Navy Rocket Craft:

In an amphibious assault landing, there is a short but critical phase when the fire of supporting cruisers and destroyers is masked by the leading wave of landing craft. The Navy recognized this problem, and rockets offered a solution. Because of the lack of recoil and their light weight, numerous launchers could be mounted on light craft whose shallow draft permitted them to approach close to shore. Rocket craft have a tremendous volume of fire and their comparative inaccuracy is no handicap since the mission is to saturate an area with fire. First used in Sicily and Anzio, rocket naval craft became a separate class, these vessels playing an increasingly important role in the amphibious operations in the Pacific.

F. Brief History of German Guided Missile Developments

As in the United States, rocket experiments began to pay dividends in Germany about 1930. During that year a group of young students from the Technical College in Berlin who were influenced by "Paths to Inter-Planetary Navigation" by Professor Oberth commenced experimental rocket test at Reinickendorf, north of Berlin. Werner von Braun was the acting head of this outfit.

In 1933 the work of the student group has become so expensive that they went to the Army for support. Von Braun was able to sell to the Army the idea that development of rockets was well underway and that they would have a practical military value. The Army then took this young student group into the Ordnance Branch, where rocket research was under the leadership of General (then Captain) Walter Dornberger.

In about three years, three rockets were built in succession, A, A-1, A-2. These were still comparatively small; the last and largest type weighed about 1760 pounds, having a thrust of 1.5 tons. All three of the rockets were purely experimental. Two of the rockets were fired into the North Sea to study the principles of stabilization.

In 1936 the powder rocket Nebelwerfer, used as a smoke-filled weapon, was introduced to the Army.

During the year 1936 it was decided to construct a special experimental site for liquid fuel-rockets at Peenemunde. The Plan was laid out on a very large scale and the group acquired an initial allocation of approximately 100 million marks. Construction started in 1936, by summer of 1937 it had progressed to a point where the rocket group was able to move in. The station at Peenemunde was divided into two departments, one called Block East and the other Block West. Block East was under control of the Army, and Block West was under the German Air Force.

In November 1937 the first steering devices arrived from the Kreiselgerate firm. The first firing test of the A-3 with the steering device was planned to be launched from the island, Greifswald Oie. The small island was selected because the rocket was to be launched vertically and the experimenters were not sure in which direction the rocket would descend. This test was complete failure; the rocket, instead of traveling at the height of 17 kilometers, reached about 400 meters.

During the following year new designs in both propulsion unit and steering devices were developed. These were placed in the A-3 rocket, and firing tests were conducted during the winter of 1938-1939. These tests were successful except that the range of 270 milometers - the minimum requested by the Army - was not achieved.

Then the A-4 (or V-2) was designed to give the range the Army desired. In the spring of 1939 parts of the A-4 (V-2) rocket were being produced at the workshops in Peenemunde; it was not, however, until 1942 that the 25-ton-thrust combustion chamber was developed.

From 1942 until the Germans fired their first A-4 (V-2) against England on 8 September 1944, tests were made to improve accuracy and performance. Special precautions were made to decrease the number of air bursts due to heating caused by skin friction. Even after the first use of the A-4 (V-2) in combat against England, the control systems were changed from time to time, indicating that research work was continuing until the defeat of Germany.

About 5400 V-2's were manufactured by the Germans. 1800 were expended experimentally. Two thousand (2000) were launched against London, 1600against Antwerp. One thousand fifty (1050) actually hit London, roughly 50%. Of those which did not hit London, about 30% exploded in flight, while the remainder were inaccurate and usually fell far short of the city. Each V-2 carried 1650 lbs. of explosive. A total of about 867 tons of V-2 explosive hit London.

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Operational accuracy of the V-2 was a 50% circle of radius about 6 miles at 200 miles range. Production cost of the V-2 is estimated at 60 man-months and the cost of launching as 2-man-months, other incidentals make a total cost of 65 man-months for the V-2

Fuel Weight	8.5 tons
Warhead Weight	.95 tons
Carcass Weight	2.75 tons
Total Starting Weight	12.2 tons

The effect of the V-2 continuous all-weather bombardment of London on morale will always be remembered as a factor in favor of the long-range guided missile. The main attraction of the long-range guided missile rocket is the currently virtual impossibility of taking effective countermeasures against it, at any rate once the missile has been launched.

Development of V-1

In 1935 a German inventor, Paul Schmidt, developed for the German Air Ministry an intermittent jet motor. This motor became the well-known German V-1 buzz bomb. In 1939 Argus Motor Company, with the assistance of Schmidt, commenced development which ended in 1941 as the first successful V-1 motor. Fieseler Aircraft Company was selected to design the airframe.

The first reconnaissance photograph of V-1 was taken by the British at Peenemunde in April 1943, and Peenemunde was made uninhabitable by bombing in August 1943. The first operational use was on 12 June 1944. During 80days bombardment which followed, approximately 8070 V-1 bombs were launched. Of these, some 2,300 (29%) got through into the London region. 25% or 2000 bombs launched were inaccurate; many dived into the sea-- others strayed as far as Norfolk and Northampton.

46% were brought down; 1900 by fighter planes, 279 by barrage balloons, 1560 by anti-aircraft guns.

The other principal target for the V-1's was Antwerp. Between late October 1944 and the end of March 1945, nearly 5000 V-1's were launched against that great city, but only 2800 appeared as threats to the vital port area. Of those 2800, about 1800 were shot down by the defenses -- an AAA Task Force known as the Antwerp X Command. Only 211 bombs actually struck within the vital area.

The German guided missile program was by no means limited to the V-1 and V-2, though these were the highlights of the actual operational weapons. Numerous other German guided missiles reached combat use or the final test stage. A table follows which in general covers the more important German missile weapons.

G. Summary of Developments of Guided Missiles in England, France, Russia and Japan

Rocket and guided missile development was carried out to a minor degree during the war by Great Britian, France, and Russia. Most work in England and Russia consisted of design and improvement of barrage rockets for artillery work. England developed and used semi-effectively an anti-aircraft rocket. The British and Russian barrage artillery rockets, about 5" in diameter similar to those used extensively by the Americans, were employed in combat with fair results.

Since the end of the war, guided missile development in England has been primarily a study of German progress and technique and plans of departure from where the Germans left off into a vast field almost comparable to that in the United States.

France on a smaller scale than England and with fewer funds is following the program of reviewing German developments before expanding into actual development.

Russia is undoubtedly abreast of the German guided missile ability and is now with assistance from many German rocket engineers pursuing a field of development on the level of that in the United States. Recent news items of spook rockets over Sweden and Europe indicate some success of the Russians, the extent and degree of this success is a primary interest but still is nebulous as far as facts are concerned.

Japan achieved operational success of a guided missile during the War with the Baka. The Baka bomb is a rocket-propelled, piloted glider bomb designed for use against shipping targets, and carried under the fuselage of a parent aircraft from which it is launched. The aircraft most generally employed was the Betty. When launchedfrom a height of 27,000' which is maximum service ceiling for Betty, Baka had a macimum horizontal range of 55 miles. The bomb is designed in the form of a midwing monoplane having a single tail plane with twin fins and rudders. The fuselage consists basically of three sections: the warhead, which contains 1,135 pounds of high explosive, the pilot's cockpit, and the tail section. Japan borrowed plans of the V-1 from Germany, however, no efforts were expended in reproduction, Japan did, however, develop an air-to-air guided missile from their own ingenuity. This weapon was called the "Igo." It did not reach combat.

H. Post-War Guided Missile Development

During the war all available AAF effort was devoted to projects having direct application to the defeat of the enemy. Some thinking about post-war possibilities began in March 1945, but it was not until the surrender of Japan in August 1945, that a large proportion of development effort was diverted to post-war activities.

Following some preliminary discussions of long term guided missile projects, Bell Telephone Laboratories proposed a contract for such a project to the Ordnance Department. This was made a joint AAF-Ordnance project, for an anti-aircraft guided missile, and a study contract was let in February 1945. At the same time (March 1945) the general division of the post-war program into the following categories was planned and preparation of military characteristics to cover these categories was begun:

a. Surface-to-air

b. Surface-to-surface

c. Air-to-air

d. Air-to-surface

e. Retrievable guided missiles

f. Defense against guided missiles

Subsequently a study contract for an anti-aircraft missile was let to Boeing Aircraft in June 1945. This was the forerunner of a series of study contracts which were let with most of the major aircraft companies shortly after VJ-Day. The study phases of these contracts are being brought to fruition during the spring of 1947, so that by 15 February 1947 evaluation of these studies will be underway and will lead to selection of those contracts which are to continue to the construction of a prototype.

Of the projects current at the end of the war, the following is the present status:

a. JB-2 (Buzz Bomb) - Design completed, quantity production begun, missile now classed as obsolete.

b. Razon - 1000 pound bomb guided in range and azimuth. Design completed and service tested. Ready for operational use.

c. Felix - Heat seeking bomb-design completed and service tested.

d. Roc - Television bomb-design completed; missile unsatisfactory, project stopped.

e. Tarzon - Guided 11,000 pound bomb development continued and nearing completion. Trial bombs have been dropped.

f. Tiamat JB-3 - Air-to- air missile. Missile unsatisfactory and project closed. Now Project Tiamat II begun.

g. Hermit - Ground control of missiles for attack of cave defenses. Project continued; military characteristics have been written calling for greatly improved accuracy. New missils will probably be developed for this need.

Since the 7 October 1946 directive of the Chief of Staff assigned to the Army Air Forces responsibility for research and development of missiles to meet all War Department needs, the requirements of the Army Ground Forces have been included in the Army Air Forces development program. The War Department guided missile program now being prepared by the Army Air Forces Technical Committee will include these requirements.

1. Development of Research Potential

German Forethought at Peenemunde:

In January 1930, when Dr. Walter Dornberger was assigned to the German War Department as a rocket expert, the only factory associated with rocket manufacture was located at Wessermunde where black powder rockets for sea rescue work were produced. By 1932 he was able to obtain the necessary approval to develop liquid fuel rockets for war purposes. He secured the services of the promising young Werner Von Braun who, in addition to his army service, was allowed to continue his studies at the Technische Hochscule. Other scientists such as Drs. Risdel and Rodulf joined the group.

A small test field was set aside on the provingground at Kummersdorf. This field served for the testing of the A-2 and propulsion units with thrusts of 1000 and 1500 kg. The field was too small for further testing and attempts to interest industry in further development were proving futile. It looked as though rocket progress in Germany had come to a standstill. Captain Dornberger, in desperation, appealed to Generals Fritsch and Kesselring for backing. That his arguments were convincing is evidenced by the fact that Peenemunde was started in 1936. This amazing project, the "Oakridge" of guided missiles, cost some $100,000,000.00. It formed a focal point for a concentration of the most up-to-date scientific facilities and the best scientific and engineering talent in Germany's guided missile field. That this project was worth the expense and effort can be vindicated by the fact that the Germans, by VE-Day, were at least ten development years ahead of the rest of the world in the province of rockets.

Astounding Success of Manhattan Project:

While Germany centered her "Task Force Research" methods on guided missiles at Peenemunde, the United States, with the aid of other of the United Nations, was focusing on development of the Atomic Bomb with the Manhattan Task Force of Researchers. The United States had become the sanctuary for many of the world's greatest nuclear physicists fleeing from Facism and Nazism. The possible harnassing of atomic power for the use of man had intrigued the imagination of people in all walks of life from school children to scientists. Scientists felt that "chain reaction" was just around the corner but the money to construct the necessary facilities, produce the necessary compounds, employ the necessary skilled personnel and labor and to furnish the necessary management amounted to an astronomical figure and was therefore impossible to get, according to any of the old accepted standard curves for normal development. The urge to defeat the scourge of Totalitarianism set the imagination of science and the Nation's leaders to surmounting the impossible and the stage was set for Manhattan Project. The Task Force of Science stormed the battlements of the Unknown while compatriots in the military task forces engaged the Axis.

During the 1930's, popular imagination fed on the fantastic possibilities of atomic power. Scientific speculation was rampant after the fall of 1938 when two German scientists, Otto Hahn and Fritz Strassman, at the Kaiser Wilhelm Institute in Berlin found barium in the residue material formed after bombarding uranium with neutrons from an outside source. Atomic fission had been witnessed.

In the autumn of 1939 the first government committee on uranium was created. The Uranium Committee was reconstituted under the NDRC (National Defense Research Committee) in June 1940.

In March 1940 Plutonium was discovered at the Radiation Laboratory, Berkeley, California.

In December 1941, Dr. Arthur H. Compton was placed in charge of the uranium project under the OSRD (Office of Scientific Research and Development) and the chain reactor program was concentrated at the University of Chicago.

Dr. Vannevar Bush, Director, OSRD, early in 1942, recommended to the President that a special Army Engineer organization take over full responsibility for the development of the atomic bomb. Manhattan Engineer District

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was formed that summer and in September Major General L. B. Groves assumed command.

"On December 2, 1942, man first initiated a self-sustaining nuclear chain reaction, and controlled it." This was accomplished at the "Chicago Pile," Stagg Field, Chicago, Illinois.

Manhattan Project erected whole cities, radically different manufacturing plants and all attendant facilities spreading over miles of countryside in many parts of the United States. The booming project, with its fabulous experimentation, was driven by a force of two billion American dollars into the greatest single objective enterprise in the history of the world. It paid off at 3:30 A.M., July 16, 1945 when the first bomb went off near Alamogordo, New Mexico. Task Force Research had done in a short space of time what normally might have taken a century of the world's effort.

Design for Tomorrow:

The threat of war compels scientific advancement. Science leads the way for engineering supremacy, and by continued progress in this field we escape slavery and gain the privilege to continue our way of life. Weak peoples present a constant temptation to aggressor nations, constituting one of the most serious threats of war. Some weak nations can never be expected to reach the point where they can protect themselves against aggression, so some form of United Nations guardianship must guarantee their security. The best intentions of a United Nations group are impotent against a single powerful aggressor nation, with a totalitarian form of government whose scientific and engineering achievements have outdistanced the other nations of the world. A modern power does not declare war when it is felt that the chances of success are small. Our leaders in this country since the time of our first president have advocated preparadness as the best means of avoiding armed conflict. Had the geographical location of the United States been close to the leading aggressor nation of the last two World Wars, these wars might not have occurred. Military aircraft and guided missiles may furnish that factor of proximity in the future, providing our scientific and engineering progress is kept out in front.

Almost all military developments have applications to facilities for peacetime pursuits so that defective effort is not lost to the world's peacetime economic life. We must keep in mind that the United States exists for "life, liberty, and the pursuit for happiness." We are not bound together for the purpose of making war. It is well, however, to remember that era of chaos in the early history of the Western United States, when vigilantes were a necessary evil. The rights of man could not be enjoyed until law and order were definitely established. This condition existed only after the establishment of an adequate police force.

The police force of the world must be equipped with the most modern weapons to be effective. The G-man with a horse pistol is no match for a gangster with a tommy gun and hand grenades.

All nations have seen the possibilities of task force research demonstrated by Manhatten and Peenemunde projects. It is inconceivable that other nations will not follow the pattern already established. Therefore, we in the United States must continuously strive to stay at the forefront of the effort to make Mother Nature give up her secrets in the shortest possible time. We shall work in anticipation of the day when all peoples of the earth shall live together amicably and perhaps unite against a common enemy in the form of an uninvited visitor from outer space or some unforeseeable disruption of the good order and balance of the solar system.

While the United States exploited task force research methods to the fullest extent in the field of nuclear chain reaction, a relatively small emphasis was placed on research and development of guided missiles during the years of World War II. We have not taken full advantage of sound advice in some instances. To quote from Dr. Theodore von Karman in his report "Toward New Horizons", Vol. II-I "Where We Stand," "I myself tried to persuade... after my return from a trip to Europe in 1937, to install a supersonic tunnel at ....decided in 1942 to build a tunnel at ...." Had supersonic wind tunnel development in the United States actively started in 1937, our guided missile development could now be progressing at a much more rapid rate. From this point forward we must not miss any opportunities to improve our capacity to accelerate new developments. As we get further and further away from World War II, peacetime interests will gradually draw public attention away from defense requirements. It will be increasingly difficult to obtain public funds for research and development of combat weapons. Public support must be sought. Well planned and efficient programs have some chance of continued existence. Applications to peacetime projects, when feasible, of new principles discovered in military developments keep up public interest. Alert intelligence in foreign countries will keep our leaders and consequently the public awake to the status of our own defense.

"All things come to him who waits" but can we, as a nation, afford to sit back and let other nations take the lead in the development program? To accelerate the rate of new developments, we must secure the aid of science to work in conjunction with research engineers on planned projects. Dr. L. H. Hafstad, Director of Research at the Applied Physics Laboratory of John Hopkins University, in his "Introduction to Guided Missiles Problems" refers to such integrations as "Research Associations" or Task Force Research" organizations. In his chart, based on a similar study by Sir C. F. Goodeve, U. K., Figure I, he indicates the work of the scientists on the "Universities" curve and the work of the engineers on the "Industries" curve. Task Force Research is indicated on the "Research Associations" curve. It is evident that the purpose of the Research Association is to fill in the time gap between the University and Industry curves. The low point of gap is where the guided missiles problems fall, according to Dr. Hafstad who indicates this fact to be the conclusion of the Dewey Committee. It is pointed out by Dr. Hafstad that the reason for the success of the OSRD (Office of Scientific Research and Development) during the war was that "each of its divisions was essentially a Research Association."

Dr. Hafstad has pointed out in his lectures to the War and Navy Departments that the greatest success in contracting for civilian research teams has been found in contracts with big companies like the Bell Telephone Laboratores and General Electric Corporation, or with university-small company combinations. Big companies employ both scientists and engineers, and these two fields are also covered by university-small company combines. Contracts with other agencies result in sub-contracts back to existing contractors, e. g., small companies sub-contract back to universities or big companies to obtain the services of scientists.

Chronology of United States Government Effort in Establishing Civilian Research Agencies:

The Army Air Forces, in addition to facilities for research and development in its own agencies, has access by request to the facilities of the various technical services of the Army, the Navy Department, the Department of Commerce, N.A.C.A., and other civilian Government agencies, as well as by

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contract to the many educational and scientific institutions throughout the United States. Prior to 1940, the N.A.C.A. carried out nearly all the AAF-sponsored research being done by such agencies. The National Research Council and its parent body, the National Academy of Sciences, had given a measure of cooperation by scientific agencies in the first World War, but the effectiveness of these bodies gradually tapered off until when war was again imminent in 1940, President Roosevelt found it necessary to create a new organization for the purpose; the National Defense Research Committee. The remarkable work of this Committee and unlimited presidential support soon made available to the War Department most of the available university and scientific talent.

This contact has been continued, to the benefit of both the War Department and the institutions, within the limits of available budgets. The civilian Government agency facilities are still available upon request, although readjustment toward peacetime activities has reduced the priority of such work.

A list of Civilian Government research agencies and institutions, together with a brief historical statement, follows:

a. The Smithsonian Institution was created by act of Congress 10 August 1846 under the terms of the will of James Smithson for the "increase and diffusion of knowledge among men." This organization sponsored the work done by Dr. Goddarel in firing the first liquid-fuel rocket in 1926. No guided missile work is being done at present by this Institution, although its Astrophysical Observatory is equipped to do considerable research, and its International Exchange Service is the United States agency for exchange of scientific information with foreign governments.

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b. The National Academy of Sciences was established on 3 March 1863 by President Lincoln to "investigate, report, examine, experiment, and report upon any subject of science or art ....."

c. The National Bureau of Standards of the Department of Commerce was established 3 March 1901, and is the principal Government agency for fundamental research in physics, chemistry, and engineering. It has custody of the national standards of physical measurement. Bureau of Standards present work in the guided missile field covers radio propagation studies at V-2 altitudes, electronic control systems, proximity fuses, interior ballistics, materials, and instruments.

d. The Bureau of Mines of the Department of the Interior was organized July 1, 1910 for the more efficient conservation and utilization of American mineral resources and for the promotion of safety in the mineral industry. This organization is currently investigating, at Army Air Forces request, the future availability of petroleum resources for aircraft fuels.

e. The National Advisory Committee for Aeronautics was established on 3 March 1915 to "supervise and direct the scientific study of the problems of flight, with a view to their practical solution--direct and conduct research and experiment in aeronautics." NACA is carrying out an extensive program of basic research applicable to guided missiles, in subsonic and supersonic aerodynamics, fuels, propulsion, and instrumentation.

f. The National Research Council was organized in 1916 by the National Academy of Sciences at the request of President Wilson. Neither N.R.C. nor N.A.S. is carrying out guided missile work at present, with the one exception of a guided missile manpower survey currently being sponsored by the National Research Council.

g. The National Defense Research Committee was formed in 1940 to provide adequate research facilities for national defense. Much guided missile work was carried out by NDRC during World War II; Azon, Razon, Bat, and ROC were NDRC development projects. Radar navigation devices, countermeasures, fuels, explosives, propulsion devices such as the multiple cartridge ramp, rockets, materials, and other guided missile components, were developed by NDRC. This body is now liquidating, having transferred most of its continuing projects to the armed services.

h. The Office of Scientific Research and Development, organized in 1941, was made the parent body of NDRC and the Committee on Medical Research. OSRD activities were of apolicy-determining nature.

During World War II, the research potential of the United States was so applied to war effort that most of the universities and scientific institutions were operating under the sponsorship of NDRC while most of the industrial research operated under direct contract with the armed services. In August 1945, NDRC began action to demobilize; the services, chiefly the Army Air Forces and the Office of Naval Research, acted immediately to take over those NDRC research projects worthy of continuing development. In the organization and direction of the Army Air Forces post war guided missile program, it soon became apparent that this program could not properly be carried out without a great deal of preliminary study and basic research for which the universities of the United States were best fitted. As a result, several of the larger educational and scientific institutions were approached with direct contracts when various guided missile projects were initiated. Others entered the program by sub-contract, while still further university participation has taken place by direct contract with the Air Materiel Command for components, instruments, and services.

A list of educational institutions engaged in research under sponsorship of army agencies, together with a brief summary of their work, follows:

a. <u>California Institute of Technology:</u>

(1) Subsonic and supersonic aerodynamics, propulsion research on JATO, liquid and solid fuel rockets, ram jets, fuels, materials.

(2) Complete guided missiles for artillery, sounding, and strategic purposes; fuels; propulsion and launching devices, etc.

(3) Theoretical aerodynamics and hydrodynamics.

(4) Stabilization studies of roll, pitch, and yaw for ground-to-ground missiles.

(5) Control systems for corporal missiles.

(6) Testing of TG-180 (General Electric) jet engine with aim of improving performance for use in guided missiles.

(7) Calculations of performance of modified JB-2.

(8) Theoretical work on combustion maintenance problems.

(9) Gas turbines - theoretical calculations and tests on optimum bucket angles.

(10) High temperature materials for rockets and thermal jets.

(11) Investigation of rocket motor components; fuels systems, injectors, cooling, mixture ratios, materials, optimum dimensions.

(12) Basic research in solid propellants.

(13) Basic research in liquid propellants.

(14) Launching devices for Ordcit missiles.

(15) Telemetering for Corporal missiles.

(16) Instrumentation for upper atmosphere research.

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(17) Fundamental research in ram jets.

(18) Continuing research in liquid rockets.

b. Cornell University:

(1) Theoretical studies of ram jet trajectories for long ranges.

(2) Investigation of more accurate radar timing circuits for guided missile navigation.

(3) Research on radar display in three dimensions.

c. University of Michigan:

(1) Anti-V-2 Missile.

(2) Telementering for V-2 upper atmosphere work.

d. Pennsylvania State College:

(1) Ceramic research for aircraft power plants.

(2) Research on radio wave propagation between 10 kc and 500 kc for guided missile navigation.

e. New York State College:

(1) Ceramic research at temperatures of 4000° C and higher.

f. Ohio State University:

(1) Ceramic research for gas turbines and turbo jet components.

(2) Liquid hydrogen as aircraft fuel.

(3) Study of infra-red attenuation due to atmospheric water vapor.

(4) Study of mono-molecular films for infra-red detectors.

g. University of Illinois:

(1) Ceramic coatings on metals.

(2) More accurate timing for radar to be used for guided missile navigation.

h. Battelle Memorial Institute:

(1) Ceramic liners for rocket chambers and nozzles.

(2) Basic studies of combustion, covering airstream velocity, turbulence, atomization, droplet size, etc.

i. Columbia University:

(1) Accoustical methods of locating guided missile impacts.

j. Massachusetts Institute of Technology:

(1) Stable platform for steller navigation systems and computer for guided missile navigation.

(2) Continuous comsic ray research to determine basic structure of matter.

k. University of Florida:

(1) Research on radio wave propagation in 10 to 500 kc range for application to guided missile navigation.

l. Carnegie Institute of Technology:

(1) Study of advantages of AN/APW-6 blind bombing over radar bombing.

m. University of Chicago:

(1) Cosmic ray research at various altitudes and latitudes.

n. National Geographic Society:

(1) Cosmic ray research at various altitudes and latitudes.

o. New York University:

(1) Development of equipment for intercept and analysis of enemy missile guidance signals.

p. Purdue University:

(1) Development of equipment for intercept and analysis of enemy missile guidance signals.

q. Rensselaer Polytechnic Institute:

(1) Research on radar moving target indicator.

r. Texas A & M:

(1) Research on radar moving target indicator.

s. Boston College:

(1) Instrumentation for V-2 Upper Atmosphere research.

t. Franklin Institute:

(1) Instrumentation for V-2 upper atmoshpere research.

Effort of Service Agencies in Guided Missiles:

The Air Materiel Command is the supply service of the Army Air Forces. It is responsible for research, development, storage, issue and maintenance of items as, for instance, guided missiles, assigned by higher authority. The guided missiles responsibility assignment does not cover procurement, storage, issue, or maintenance for other arms and services. Air Materiel Command executes the War Department Guided Missile program under the supervision of Headquarters Army Air Forces.

The Ordnance Department, under overall AAF cognizance, is carrying on work on three guided missile projects; Hermes, Nike, and Ordcit. In addition, Ordnance is doing considerable work on warheads and fuses, solid fuel rockets and launching devices, and on non-integral JATO units. The Ordnance facilities now involved in guided missile work in addition to that on contract, are the Aberdeen Proving Ground, the Picatinny Arsenal, the Frankford Arsenal, and the Rock Island Arsenal.

The Signal Corps is responsible for development and supply of communication and electronics equipment to Army Ground Forces and for such other purposes as are not peculiar to the AAF. In the guided missile field, Signal Corps is cooperating in the White Sands project, is investigating jamming possibilities, and is working out communications facilities for systems of defense against

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guided missiles attack. The Signal Corps development agency is the Signal Corps Engineering Laboratories at Belmar, New Jersey.

The Corps of Engineers has done considerable work on launching devices in the past. This was taken over by the Ordnance Department in August 1945. In addition, the Corps of Engineers is at present working on the design of liquid oxygen producing apparatus and on mapping for guided missile navigation.

The Chemical Corps during the war developed a permanganate-peroxide system for launching JB-2 buzz-bombs from a German ramp. Present work covers a special warheads for guided missiles. There is a proposal in existence for assigning certain liquid propellant research to the Chemical Corps. Facilities involved are the Edgewood Arsenal, Maryland, and Camp Detrick, Maryland.

The AAF Technical Committee first met in July 1946. Its functions cover coordination between interested arms and services in development and standardization. The AAFTC is currently preparing the War Department Guided Missile Program, taking into consideration the basic technical abilities of all the services. New development projects are approved by the AAFTC, priorities assigned, and progress of work reviewed.

The Ordnance Technical Committee performs for the Ordnance Department the coordination and other functions of the AAF Technical Committee. This committee has turned over to the AAF the Ordnance Department guided missile projects.

The Signal Corps Technical Committee performs for the Signal Corps the functions listed for the AAFTC and OTC. The SCTC has turned over to AAF the Signal Corps guided missile projects.

Steps in the Organization of a National Program for Research and Development of Guided Missiles:

The Gilliland Committee was formed by the Navy Department in December 1944 and reported in May 1945 on the present and probable future status of guided missile development. The recommendations fo this committee guided the Navy Department in the planning and establishment of the Navy post-war guided missile program.

The "Dewey" Committee was established on 16 January 1945 as the Guided Missiles Committee of the Joint Committee on New Weapons and Equipment of the Joint Chiefs of Staff. Its functions was to set general U. S. Policy on guided missile development. Its principal product was a recommended "National Program for the Development of Guided Missiles" which, rather than laying out a program, advocated primary emphasis on basic research. This Committee was superseded by the Joint Research and Development Board Guided Missile Committee on 27 September 1946.

The Joint Research and Development Board was established on 3 July 1946 by the Secretaries of War and Navy, and set up its guided Missile Committee on 27 September 1946 to assume the functions of the defunct "Dewey" Committee.

Definition of a Guided Missile:

A guided missile would be considered to be any missile the trajectory of which is influenced by a mechanism incorporated in the missile.

Main Catagories of the Guided Missiles Research and Development Program:

a. Surface-to-Surface Missiles

b. Air-to-Air Missiles

c. Surface-to-Air Missiles

d. Air-to-Surface Missiles

e. Air Defense and Countermeasures

AAF Technical Report 5286

File No. 201-47

FINAL REPORT
OF INSPECTION, PERFORMANCE AND ACCEPTANCE OF CURTISS-WRIGHT XP-60A, C, AND E AIRPLANES

ARMY AIR FORCES
AIR TECHNICAL SERVICE COMMAND
Wright Field Dayton, Ohio

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WAR DEPARTMENT
AIR CORPS
MATERIEL DIVISION
DAYTON, OHIO

AIR CORPS TECHNICAL REPORT

No. 5286

FINAL REPORT OF INSPECTION, PERFORMANCE AND ACCEPTANCE OF CURTISS-WRIGHT XP-60A, C, & E AIRPLANES

Title

BY

W G Logan
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Classification cancelled changed to [illegible]
by authority of [illegible]
by [illegible] date [illegible]

Approved:

B S Kelsey
B. S. KELSEY, Colonel, Air Corps, Branch Chief
Chief, Aircraft Projects Section

By direction of the Chief of the Materiel Division.

L C Craigie
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Chief, Engineering Division

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FINAL REPORT OF INSPECTION, PERFORMANCE AND ACCEPTANCE OF CURTISS-WRIGHT XP-60A, C, & E AIRPLANES

OBJECT

The object of this report is to present a brief resume' of the development of the XP-60A, C, & E airplanes including the procurement, inspection and performance of the airplanes.

SUMMARY

The XP-60C & E airplanes were obtained as the result of a development program of the P-60A airplane after the cancellation of the production contract due to expected poor performance of the airplane called for in the production contract. The P-60A airplane was a low wing fighter of conventional design powered with an Allison engine and equipped with 4-blade Curtiss propeller and G.E. turbo supercharger. The landing gear was of the retractable type. The XP-60C differs from the P-60A in that it has a lengthened fuselage and is powered with a two stage R-2800 type "B" engine. The propeller is of the counter rotating type having a total of six blades. No turbo supercharger was used with this installation. The XP-60E was identical to the XP-60C except that it had a four blade Curtiss electric propeller in place of the six blade propeller.

EARLY DEVELOPMENT

The P-60A airplane was the production version of the XP-60 with a few changes incorporated which were found desirable as the result of the experience gained by the British during the early phases of the war. Production engineering on this airplane was started during the summer of 1941 at which time it appeared that the airplane would weigh a little over 9000 pounds. During late August and September conferences were held between the Army, the contractor and the N.A.C.A. Laboratories to discuss details of power plant installation and a wind tunnel test program.

On 25 October the contractor submitted a quotation for the construction of 1950 P-60A airplanes to be built in accordance with contractor's specification X8509 dated 1 March 1941. This letter was attached to A.F.P. No. 198141 and resulted in Contract No. W535-AC-22714 which was forwarded to Washington where it was approved by the Under Secretary of War on 31 October under the 12,000 airplane program as modified on 1 October 1941.

On 17 November 1941 the project officer, in an Inner Office Memorandum to the Assistant Chief of the Materiel Division, pointed out that the P-60A was under-powered and recommended the use of a more powerful engine or the construction of either P-47B or P-38 airplanes by Curtiss in lieu of the P-60A. As a result of this action, a series of conferences was held with Curtiss representatives during the latter part of November and December 1941 to discuss the P-60A project. The final conference on this subject was held 2 January 1942, and was attended by Brig. General G. C. Kenny, Cols. P. Schoneeberger and K. B. Wolf and Messrs. Jansen, Noonan, and Evans of the Curtiss-Wright Corporation, at which time it was

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agreed that the Curtiss-Wright Corporation would build 2400 P-47's, 700 P-40F's, 700 P-40E's, 100 P-62's and 1 each P-60A, P-60B, and P-60C. These latter three airplanes were procured since engineering was practically complete and construction was well under way. The airplanes were to be as follows:

1. The P-60A was to be equipped with an Allison engine and G.E. turbo; the same as the original production airplane.

2. The P-60B was to be the same as the P-60A, except that a Wright turbo was to be used in place of the G.E. turbo.

3. The P-60C was to be equipped with a Chrysler engine and a turbo to be selected later. It was also thought that these airframes could be used for flight testing the Ford and other aircraft engines then under development.

Work on the production P-60A airplanes had been stopped on 20 December when it became certain that the production contract would be cancelled, but was resumed on the three airplanes soon after the above meeting. During the middle of January the contractor submitted a quotation of $1,254,220.00 for the completion of the three airplanes to be delivered in July, September, and October. Also at about this same time, since the project was of an experimental nature, it was transferred from the Procurement Division to the Engineering Division and an "X" designation assigned to each airplane.

Shortly after the project was transferred to the Engineering Division a deviation in the interest of saving weight was granted to permit the contractor to use less conservative figures for tensil strength of non-heat treated extrusions. This deviation was allowed on the experimental airplanes to determine if a lighter structure could be obtained which would meet the minimum strength requirements.

During March of 1942 the contractor submitted a revised quotation for the XP-60A, B, and C airplanes which was divorced from the production program. This figure was for $1,169,143.00 and incorporated delay in the delivery until September, November and December respectively. This delay was considered desirable to enable the contractor to give higher priority to the P-47G and C-46 programs.

On 1 April 1942 the contractor submitted a preliminary study on the installation of the Chrysler engine in the XP-60C which indicated that it would be necessary to install several hundred pounds of lead in the tail of the existing airframe for ballast, or as an alternative to design a new fuselage. Since the delivery of the Chrysler engine was at this time somewhat in question, a decision on this study was held in abeyance.

The contractor's revised model specification covering the XP-60A, B, and C airplanes was delivered to the Materiel Command early in April for review. The recommendations of the laboratories and project officer were forwarded to the contractor and incorporated in a revision to this specification which was resubmitted during the last of May and incorporated into the contract by means of an engineering order. This revised specification was written to cover the XP-60A with an appendix covering the XP-60B. Since no information was available on the delivery of the Chrysler engine, no separate appendix was included to describe this version of the basic airplane.

In the months that followed the project progressed in a normal fashion; incorporating minor changes such as replacement of automatic gun chargers by manual gun chargers and other revisions of equipment to insure that the airplane when delivered would comply with the latest requirements.

During this time, however, the contractor was making various studies to determine, if possible, some way to improve the performance of this airplane. On 11 and 12 August 1942 the contractor visited the Materiel Command and proposed the installation of the Pratt & Whitney R-2800 two stage engine in one of the three airframes and the use of a six blade counter rotating propeller. This proposal was similar to a Materiel Command Aircraft Laboratory design which had just been completed by the Laboratory and was being favorably considered as an experimental project. Since the Curtiss proposal could be completed at a much earlier date than the laboratory design could be built by some other contractor, the two projects were combined.

On 25 August 1942, the contractor submitted a quotation for $136,700.00 for modification of the XP-60C airframe, which had been set up for use with the Chrysler engine. This airplane was also to be known as the XP-60C but was equipped with an R-2800 engine and dual rotation propeller. A few days later a conference was held between representatives of the Procurement and Engineering Divisions to discuss elimination of certain equipment in an effort to reduce the airplane weight to a minimum and thus increase performance. As a result of this conference, a request was sent to Washington for permission to use a light weight radio and an inertia starter in lieu of an electric starter permitting the use of smaller and lighter battery and generator. It was also recommended that certain instruments including the directional gyro, gyro horizon and rate of climb indicator be eliminated. Approval was granted for elimination of all items with the exception of the electric starter and rate of climb indicator. The small battery and generator were retained with the provision that instructions be included in the airplane to use an external power supply for starting when possible. During the latter part of September 1942 approval of this project was expressed by Washington and interest in a production quantity was becoming apparent. As a result, CTI-932 dated 30 September 1942 was issued directing the conversion of one airplane to carry the R-2800 engine. On 1 October 1942, a conference was held at Wright Field attended by Colonels M. S. Roth, M. E. Bradley and Maj. W. G. Logan of the Materiel Command, Col. Griswold and Lt. Col. H. D. Wagner from the Office of Military Requirements in Washington, Messrs. Flader, Crosswell and Noonan of the Curtiss-Wright Corporation and Messrs. Tellinghast and Cutting of the Pratt & Whitney Corporation. The Curtiss-Wright representatives were given verbal authority to proceed with the project with the understanding that magnesium would be used whenever possible and other steps would be taken to further save weight. Again in the interest of saving weight, approval was given for the investigation of the use of a landing gear which would retract hydraulically and extend by gravity.

During the latter part of October 1942, the XP-60A with the Allison engine made its initial ground run and encountered a minor fire in the engine compartment, resulting from overheating due to the lack of cooling air flow in the shrouds surrounding the exhaust manifold. No damage was encountered, however, and after minor modifications subsequent attempts to perform ground runs were made with the same result as on the first run. Because of this difficulty, combined with the lack of interest in the XP-60A in this configuration, the contractor was authorized to remove the turbo and long exhaust manifold and install short exhaust stacks so that flight testing could be conducted to investigate control forces to a limited extent. It was realized, however, that a true reading could not be obtained since the fuselage of the XP-60C had been lengthened 18 inches for balance and aerodynamic purposes.

Following the cooling difficulties encountered with the XP-60A and a heightened production interest in the XP-60C with the R-2800 engine, the contractor was notified on 26 October that the XP-60B which had an exhaust installation identical to the one in the P-60A, should be converted into an XP-60E which would be identical to the "C" except that a single four blade propeller would be used. This change was considered important because of the possibility that dual rotation gearing could not be made available for early production airplanes then being considered and the consequent desire to determine the difference in airplane performance resulting from the change from dual to single rotation propellers.

On 25 October and 19 November 1942, letters of quotation were received from the Curtiss-Wright Corporation which covered the cost of the XP-60C & E conversions. These quotations were for a total cost of $88,869.90 and were attached as Exhibits to A.F.P. No. 217653 dated 2 December 1942, which resulted in Change Order No. 2 to Contract W535-AC-28113.

The first flight of the XP-60A as modified with the short exhaust stacks was made on 1 November 1942, at which time elevator overbalance was noted. This was corrected by changes in the boost tab linkage and proved satisfactory on later flights.

In an attempt to produce an XP-60E that would have the best possible performance, it was decided that a larger diameter propeller would be used than was usually permitted on AAF airplanes because of reduced ground clearance. The reduction of ground clearance of 3 inches on a fighter of this type was not considered too serious because the airplane takes off in a tail low altitude. However, early in January of 1943 it was decided to use a 13 foot diameter propeller in lieu of a 13 foot 3 inch propeller since calculations by the Curtiss Propeller Company indicated that the decreased diameter propeller would not impair the performance but would give 1 1/2 inch additional ground clearance.

WIND TUNNEL TESTING

During the period of design and construction of the XP-60A, B, C, & E, extensive wind tunnel testing was carried on by the N.A.C.A. Laboratories at Langely Field. An 0.36 scale model of the P-60A was tested in the 19-foot pressure tunnel to obtain an efficient design, tests were also conducted in the propeller research tunnel on a full scale set of ducts and intercooler for the P-60A to obtain the most satisfactory duct system possible. The data from these tests were incorporated in the design of the airplanes with the Allison engine. Although the design incorporating the R-2800 engine was coordinated by the N.A.C.A. Laboratory no wind tunnel testing was conducted on this engine installation due to the urgency of completing the airplane at

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an early date for flight test purposes.

In addition to the testing mentioned above, complete spin tests were conducted on a 1/20th scale model of the XP-60A, C, & E and rough checks made on the spin characteristics of the XP-60C & E with various size tail surfaces which were tried by the contractor in an endeavor to lighten control loads. Checks were also conducted to determine if the spin characteristics were adversely affected when the engine was moved forward 10 inches to eliminate the unfavorable c.g. location.

A wind tunnel model of the XP-60A was also procured and tested in the Wright Field 5-foot wind tunnel to obtain an early check on airplane drag and stability.

During the period of modification of the intercooler scoop for the XP-60C & E the contractor conducted tests of various shapes in his own wind tunnel in an attempt to arrive at a shape which would offer the least drag.

CONTRACTOR'S FLIGHT TESTING

The first flight of the XP-60C was made 27 January 1943, and the airplane was, in general, pronounced satisfactory with the exception of high elevator and rudder forces. Between the date of this flight and the 2nd of May 1943, flight testing to further improve the airplane was carried on at the contractor's plant with frequent interruptions for inspection of propellers and dual rotation gearing, both of which had to be inspected every ten hours to determine their suitability for future use. The difficulty encountered with the propeller was high blade stresses which required magnaflux inspection of blades to detect indications of failures. In the engine a weakness in the pinnion gears in the dual rotation nose required frequent inspections. In most cases the gear box was removed from the engine and returned to Pratt & Whitney for the inspection. During the contractor's testing it was found that both rudder and elevator forces were higher than desired and that the airplane's speed could be increased by a redesign of the intercooler intake scoop to give it a higher critical speed. Also, it was found that the oil cooler efficiency was lower than desired and studies were made to effect a new installation which would be more efficient. In an endeavor to lighten the control loads on the tail surfaces, design work was started on surfaces having a shorter chord on the movable components. Because of the lighter weight propeller installation on the XP-60E, it was found necessary to move the engine ten inches forward from its comparative position in the XP-60C. It was also during this time that the contractor installed the one-way landing gear operating system. This gravity down lock system was never completely satisfactory due to the angle of the landing gear doors to the air stream whi h retarded the lowering of the gear to such an extent that it became necessary to yaw the airplane rather violently to lock the gear in the down position. For this reason the actuating system was modified prior to delivery of the airplanes to obtain hydraulic actuation of the gear in both directions. Difficulties were also encountered with radio noise level to such an extent that flight testing was delayed. This difficulty was overcome, however, by the installation of additional bonding.

The first engine ground runs were made on the XP-60E airplane at the contractor's plant on 11 May 1943. During the one-half hour following the first ground running the lower cylinders filled with oil and caused sudden stoppage when the next attempt was made to start the engine. This necessitated an engine change which delayed the first flight until 26 May.

On the first flights of the XP-60E the oil cooler air duct exit located on the bottom of the engine accessory cowl, proved unsatisfactory for cooling. Difficulty was also encountered with cooling of the engine itself. This trouble was totally unexplainable in view of the excellent cooling of the "C" airplane which had practically an identical installation except for the type propeller used. After a long period of flight testing and comparison of the XP-60E test data with the XP-60C test data it was concluded that the trouble lay in the engine itself. This theory was further strengthened when a similar experience was encountered by Douglas on an A-26 and was proven correct when a new engine was installed which cooled properly.

On 14 August 1943, a few days prior to the time the XP-60E airplane was to be released to the Army for official performance tests, the airplane made a forced landing at the Bell airport due to engine failure during a speed power calibration run by the contractor's pilots. The failure occurred on the number 13 cylinder. The major damage was sustained by the left wing and landing gear which struck the top of a tractor and the edge of a concrete runway under construction.

Since official performance had been obtained on the airplane with dual rotation propeller and not on the other airplane the contractor was requested to remove the engine installation from the XP-60C and install a single rotation power plant and propeller combination so that the performance could be obtained. This automatically changed the XP-60C to an "E" and the XP-60E to a "C".

The damage to the cracked-up airplane was surveyed by the contractor who estimated that by using the wings, landing gear and other items available from the XP-60A which had been set aside for this purpose it would be possible to repair the damaged airplane and set it up in the "C" configuration for approximately $44,420.00. Since little flight test data was available for use in a comparison of the single vs. dual rotation propellers, this expenditure was considered reasonable and work started immediately to repair the damaged airplane. This airplane was equipped with dual rotation propeller and was redesignated XP-60C so as to eliminate the necessity for reconverting each airplane to the original configuration.

The converted XP-60C had completed almost 20 hours flight time as an XP-60E when a forces landing was made on 18 September 1943 because of faulty action of the fuel gages which permitted the pilot to run out of fuel. Because the field selected for the landing was small, a wheels up landing was made resulting in damage to the flaps and intercooler scoop.

Since the damage was of a minor nature authorization to repair the airplane was granted on 25 September 1943. The airplane repairs were completed on 11 October 1943, and flights started to build up engine slow time and run a brief contractor's performance check. This flying was delayed by bad weather and a production crisis which required taking all experimental personnel to eliminate production line difficulties and it was not until 1 March 1944 that the XP-60E was made available to the Army Air Forces for official performance tests. No structural demonstration flights were made because the future program for these airplanes called for no more than propeller devel-

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opment work. Since the contractor's flight research and engineering departments were already overloaded, the Government agreed to waive these tests to permit the contractor to concentrate all efforts on projects more vital to the war effort.

GOVERNMENT TESTING

During the latter part of April 1943 the contractor was notified that the XP-60C would have to be at the Materiel Command within four days for comparative tests with other fighter airplanes. This information was received a few days after a piece of engine accessory cowl was lost in flight and at a time when the airplane was dismantled for rework of oil and intercooler ducting. In compliance with the above request the airplane was reassembled without incorporating the desired refinements and delivered to Patterson Field where propeller vibration tests were conducted and water injection equipment installed for operating the engine at war emergency powers.

During the period of testing at Patterson Field it was impossible to obtain full power. This was later found to be caused by a leak in the induction system caused by a rip in one of the rubber duct couplings. Also the experimental wing finish had cracked off the leading edge of the wing leaving it in worse condition than the bare wing would be. Inasmuch as this destroyed the laminar flow characteristics, it resulted in a further loss of speed. When the tests were about half completed a piece of the spinner tore off in flight and damaged the leading edge of the engine cowl. Fortunately the contractor's pilot who was making a functional check flight of the water injection system was able to land the airplane without further damage. However, the damage already encountered was of such a nature that it could not be readily repaired and further testing of the airplane at this time was terminated.

The following data was obtained on this airplane by the testing pilots prior to the accident:

Observations:

a. Ailerons compare with P-51 ailerons as to effectiveness and lightness. (Just fair)

b. Elevator loads are heavy at high speed. (Not production design)

c. Rudder requires very slight change of trim for change of speed or power and is slightly heavy. (Not production design)

d. Counter rotating propeller makes take-off very stable directionally.

e. Take-off is very short.

f. Landing is excellent but has slight tendency for tail wheel to shimmy.

g. Water injection is very desirable to obtain power increase beyond military power.

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h. Brakes are excellent.

i. Very easy to taxi and has no ground looping tendency.

j. Visibility in flight is slightly better than P-47.

k. Climb is excellent but engine runs slightly over maximum allowable heat at best climbing speed.

l. Shifting superchargers manually during climb is awkward and reduces effectiveness.

Recommendations:

a. Stick locking tail wheel be incorporated. Free swivelling otherwise.

b. Sliding canopy be retained.

c. Armor glass be incorporated as an integral part of the windshield.

d. Supercharger shift be made automatic.

e. Water injection be standardized for this installation and a thorough study be made to obtain information as to its most expeditious use.

f. At least 30 gallons of water be carried.

g. Cockpit floor be covered.

h. Recommend six (6) caliber .50 guns be installed with 275 rounds per gun as a minimum.

i. A comparative test be made to determine the comparative effectiveness of counter rotation and single propellers on this airplane.

Following the return of the XP-60C to the contractor's plant repairs were made and the airplane prepared for official performance tests which were conducted during the latter part of May and early June 1943. These tests were terminated by an engine failure which resulted in a forced landing. No damage was encountered in this landing and the airplane was again in commission after the installation of a new engine. However, since practically all desirable performance data had been obtained, no action was taken to continue the tests. During the tests no trouble was encountered with the exception of the erratic operation of water injection equipment and boost control.

The XP-60E was flown to Eglin Field for participation in the fighter conference there during January 1944. It was also desired that the XP-60C be available for this conference but repair of the damage resulting from the forces landing following engine failure could not be completed in time.

Performance testing of the XP-60E was conducted during the period of 1 March to 23 March 1944. No difficulty was encountered with the operation of either the airplane or engine during these tests.

From the above tests it was found that the airplane with the dual rotation propeller was slightly faster than the single rotation installation, but the rate of climb was worse at low altitudes and better at higher altitudes. The dual rotation installation definitely eliminated the torque effect and eliminated the rudder trim required with changes of power.

ENGINEERING ACCEPTANCE INSPECTION

The Engineering Inspection of the XP-60C airplane was conducted at the Air Technical Service Command between 25 and 28 January 1944 to determine that the airplane was safe for flight by Army Air Forces personnel and satisfactory for acceptance. The inspection was conducted by the following personnel who were assisted by the contractor's representatives, Mr. Rosenthal and Mr. Josylin, who were available in an engineering and service capacity:

W. G. Logan, Major, A.C.	Project Officer, Airc. Proj. Sec.
J. L. Carrell	Aircraft Laboratory
L. E. Easley	Aircraft Radio Laboratory
George R. Oscar	Armament Laboratory
E. B. Baldridge	Armament Laboratory
George R. Larkin	Inst. & Nav.
J. Tessman	Equipment Laboratory
Wm. H. Cooper, 1st Lt., A.C.	Equipment Laboratory
H. A. Barton, Capt., A.C.	Equipment Laboratory
W. O. Stashuk, W.O. j.g.	Misc. Branch, Equipment Lab.
H. R. Shute, Capt., A.C.	Equipment Laboratory
E. A. Terrats, 1st. Lt., A.C.	Propeller Laboratory
G. H. Schember	Power Plant Laboratory
J. Stahu, Capt., A.C.	Power Plant Laboratory
R. A. Stein	Power Plant Laboratory
Clarence J. Kuiper, Maj., A.C.	Equipment Laboratory
Charles Castellano	Aero Medical Laboratory

No major changes were required, however, a great many minor items of purely an inspection nature were found and corrected. Also, as the result of this inspection the contractor was notified of several items which should be improved in future designs, however, no action was required in connection with these items on airplanes on existing contracts as no production was scheduled for this airplane.

ACCEPTANCE AND DELIVERY

The XP-60A was presented to the Army Air Forces Plant Representative at the plant of the Curtiss-Wright Corporation for acceptance on 29 July 1943, since all useful flight data had been obtained on this airplane. Following acceptance this airplane was returned to the contractor for disassembly and storage as spare parts in accordance with the terms of Change Order No. 2 of the contract.

The XP-60C was ferried to Wright Field by the contractor's pilot on 22 January where the acceptance inspection was conducted. The XP-60E was ferried to Wright Field by an Army pilot on 22 May and after the acceptance inspection had been completed on the XP-60E action was taken to formally accept both the XP-60C & E. This action was completed on 5 June 1944 and the airplanes made

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available for propeller research and development.

COST

The following items were obtained on Contract W535-AC-28113 at a total cost of

$1,322,411.10

a. Three single place, single engine, interceptor pursuit airplanes, Models XP-60A, XP-60B, and XP-60C; one wind tunnel model of the XP-60A constructed in accordance with Specification 98-40043-F for testing in the Wright Field 5-foot wind tunnel; one free-spinning model of the XP-60A constructed in accordance with N.A.C.A. requirements for testing in the free-spinning tunnel of the N.A.C.A. Laboratories, final engineering data covering the airplanes procured on Contract W535-AC-28113; spare parts for the airplane at a cost of not more than 10 per cent of the cost of the airplanes.

b. By means of Change Order No. 2 to Contract AC-28113, the contractor was requested to do the following work at a cost of

$ 88,869.90

Remove the turbo from the XP-60A and install short exhaust stacks to permit flight test to obtain aerodynamic data, and eliminate complete testing of airplane.

Credit - $ 8,300.00

Dismantel the airplane and store those parts which are suitable for spares until contractor's flight testing of the XP-60C & E airplanes was completed and then to prepare them for shipment in accordance with instructions received from the procuring agency. Install an R-2800-53 engine in the XP-60C and complete this airplane in accordance with Appendix 5 to contractor's Model Specification No. 8509 as revised 10 October 1942.

$136,700.00

Remove the Allison engine and Wright turbo from the XP-60B airplane and install an R-2800-10 engine in this airplane in accordance with Appendix 6 to contractor's Model Specification No. 8509 as revised 10 November 1942, this airplane to be redesignated XP-60E.

$ 60,000.00

Modify the free-spinning model of the XP-60A to conform to the configuration of the XP-60C & E airplanes for testing in the free-spinning tunnel of the N.A.C.A. Laboratory at Langely Field.

$ 200.00

Eliminate delivery of the engineering data which was formerly required on the XP-60A. Reduce the cost of spare parts to an amount not to exceed $20,000.00

Credit - $ 99,730.10

c. By means of Change Order No. 3 the expenditure of $860,383.00 was authorized to cover an overrun resulting from an increase in price of materials and cost of labor.

$ 860,383.00

d. Change Order No. 6 was prepared on 17 December 1943 to cover the following items and resulted in an increase in cost of $107,455.45. Salvage of XP-60E airplane following a crash at Bell airport; conversion of XP-60C to an XP-60E; repair of damage to XP-60E airplane and to XP-60C; salvage and repair of XP-60E airplane following second forced landing and additional flight testing necessitated by the accidents.

$ 107,455.45

e. Change Order No. 11 was prepared 19 September 1944 to cover the overrun of cost not originally anticipated by the contractor and amounted to -

$ 100,000.00

f. Change Order No. 12 dated 27 October 1944 resulted in a credit to the Government of $14,714.14, resulting from a decrease in the quantity of spare parts procured on this contract.

Credit - - $ 14,714.14

Total authorized by Government - - - - - - $2,464,475.31

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OFFICIAL SUMMARY OF CHARACTERISTICS

Date of Issue

AIRPLANE

Manufacturer Curtiss-Wright Type Fighter Model XP-60A & B

Mfr. Model Spec. No. 8509 Contract No. W535-AC-28113 A. C. Type Spec. No. --

Crew 1 Wing Loading 34.9 lb./sq. ft. Power Loading 6.75 lb./bhp. Design Altitude 25,000 ft.

Wing Area 275.15 sq. ft. Span 41 ft. 3 3/4 in. MAC 86.79 in. Aspect Ratio 6.22 Airfoil NACA 66,2-118 -116

Wing Type Cantilever High Lift Devices Split flap. Landing Gear Type Conventional

ENGINES

Number 1 Mfr. Allison Spec. No. 152A Type Liquid Cooled

No. Cyl. 12 Supercharger Blower Ratios -- Turbo Type Model GE Type B-1A, XP-60A; WAC SU504-2, XP-60B

Prop. Gear Ratio 2.63:1 Compression Ratio -- Cooling Glycol

Carburetor Type PD 12K3 Setting -- Fuel 100 octane

Intake Type Ram Exhaust Type --

Rating:	Altitude ft.	Power b. hp.	Speed r. p. m.	Man. Pr. in. Hg	Time Limit minutes	Blower Ratio	Mixture F/A
Take-off	S. L.	1425	3000		5		
Normal	S. L.	1100	2600		-		
Normal	25,000	1100	2600				
Military	25,000	1425	3000		15		

PROPELLERS

Number 1 Mfr. Curtiss Type Automatic Rotation --

Diameter 11 ft. 8 in. No. of Blades 4 Type Control Electrical Setting 59° to 24° at 42"

Blade Dwg. No. 714Cc2 Hub Dwg. No. C-542S Series A

Clearances: —ground 9.5" —fuselage -- —between disks -- Weight each 492 lb.

WEIGHTS AND BALANCE

Design Useful load 1810 lb. Weight Empty 7806 lb. Design Gross Weight 9616 lb.

Crew @ 200 lb. each 180 lb.

Fuel @ 6.0 lb./gal. 696 lb. Balance with Design Useful Load—c. g. 24.7 % MAC

Oil @ 7.5 lb./gal. 98 lb. Safe Limits of c. g. % MAC to - % MAC

Armament & Bombs 829 lb.

Misc. Equipment - lb. Normal Fuel 116 gal. Max. Fuel 200 gal.

Supercharger oil 7 lb. Normal Bombs - lb. Max. Bombs - lb.

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OFFICIAL PERFORMANCE SUMMARY

Model XP-60A & B Date of issue ______

1. Level Flight Speeds at Design Altitude of - ft. with Design Gross Weight of 9616 lb.

	m. p. h. at	r. p. m. with	b. hp.	(% rated)
Maximum Speed	420	3000	1425	(29,000 % rated)
High Speed	324	3000	1425	(S.L. % rated)
Operating Speed	300			(15,000 % rated)
Cruising Speed			825	(% rated)

2. Optimum Range and Endurance with 116 gal fuel and 0 lb. bombs.

At High Speed ______ miles at ______ mi./gal. or ______ hrs. at ______ gal./hr. (s. f. c. ______)
At Operating Speed ______ miles at ______ mi./gal. or ______ hrs. at ______ gal./hr. (s. f. c. ______)
At Cruising Speed ______ miles at ______ mi./gal. or ______ hrs. at ______ gal./hr. (s. f. c. ______)

1 hour at normal power

3. Practical Range and Endurance with ______ gal. fuel and ______ lb. bombs.

At Operating Speed ______ miles at ______ mi./gal. or ______ hrs. at ______ gal./hr. (s. f. c. ______)
At Cruising Speed ______ miles at ______ mi./gal. or ______ hrs. at ______ gal./hr. (s. f. c. ______)

4. Climb Data with Gross Weight of 9976 lb.

Standard Altitude ft.	S.L.	10,000	20,000	25,000	35,000		
Climbing Speed m. p. h.	150	174	210	230	230		
Engine Speed r. p. m.	3000	3,000	3,000	3,000	3,000		
Total Power b. hp.	1425	1,425	1,425	1,425			
Maximum Rate f. p. m.	2560	2,260	1,690	1,450	110		
Minimum Time min.	0	4.2	10.4	12.4			

5. Ceiling: Normal Engine Operation: Service Ceiling 35,200 ft. Absolute Ceiling 36,000 ft.

6. Take-off and Landing Distances—To Clear 50 ft. Obstacle at Sea Level (no wind).

Take-off 2200 ft. at ______ m. p. h. 0 deg. flap. Gr. Wt. 9616 lb. Ground run ______ ft.
Land 2100 ft. at ______ m. p. h. 45 deg. flap. Gr. Wt. ______ lb. Ground run ______ ft.

7. References and Remarks:

Contractor's estimate.

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DESCRIPTION OF AIRPLANE

Model XP-60A & B Mfr. Model Spec. No. 8509 A. C. Model Spec. No. -
Overall Span 41 ft. 3 3/4 in. Overall Length 33 ft. 7 1/2 in. Overall Height 12 ft. 4 3/16 in.

WINGS

Type Internally braced Stagger - Gap - Aspect ratio 6.22 Total Wing Area 275.15 sq. ft.

	Span ft.	Root-Chord inches	Tip-Chord inches	Incidence deg. (T. L.)	Dihedral deg. L. E.	Sweepback deg. L. E.	Area sq. ft.	Airfoil Section
Upper								
Mid-								
Lower	41'3 3/4	120	40	-1 1/2	7 1/2	6° 45'	275.15	NACA 66,2-118 root 66,2-116 tip

HIGH LIFT DEVICES

Type Split flap Travel 0-45° Span 17' 1 1/8" Chord 20 7/8" Area 33.36 sq. ft.

AILERONS

Number 2 Type Sealed gap Location Outboard trailing edge
Balance Area 35.1 % Total Area 22.96 sq. ft. Travel: deg. Up 16 1/2 deg. Down 16 1/2
Trim Tab Area .55 sq. ft. deg. Up 20 deg. Dn. 20 Control Tab Area sq. ft. deg. Up deg. Dn.

MAXIMUM FUSELAGE SECTION

Location Forward end of canopy Dimensions 82 3/4 x 49 Area - sq. ft. Shape Eliptical

STABILIZER

Maximum Chord 4 ft. 1 1/16 in. Span 15 ft. 5 in. Area 34.88 sq. ft. Adjustable No

ELEVATORS

Span 15'5" Chord - Balance Area 21.6% Total Area 24.73 sq. ft. Hinge aft LELW 22'2 3/8"
Travel: deg. Up 30 deg. Down 20 Horizontal Tail Area Coefficient
Trim Tab Area 2.01 sq. ft. deg. Up 3 deg. Dn. 26 Control Tab Area sq. ft. deg. Up deg. Dn.

FIN

Number 1 Span - Chord 4' 2 11/16" Area 12.76 sq. ft. Adjustable No

RUDDER

No. 1 Span - Chord 2' 2 37/64 Bal. Area 15.8 % Area 18.15 sq. ft. Hinge aft LELW 22.4
Travel: deg. Rt. 25 deg. Lt. 25 Vertical Tail Area Coefficient
Trim Tab Area .96 sq. ft. deg. Rt. 20 deg. Lt. 20 Control Tab Area sq. ft. deg. Rt. deg. Lt.

ALIGHTING GEAR

Main
Type Retractable Wheel Base 19' 6 7/8"
No. Wheels 2 Size 34 x 9 Tread 12' 1/8"
Retracting System Hydraulic Brakes Hydraulic power boost

Auxiliary
Type Retractable
Location Tail Size 14.5"
Retracting System Hydraulic

REMARKS:

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DESCRIPTION OF AIRPLANE

Materials and Construction

Model XP-60A, B, C, & E Mfr. Model Spec. A. C. Spec.

WING

The monoplane wing is internally braced, mono-spar type with a leading edge torque section and is of all metal stressed skin construction. A rear spar is used to carry trailing edge flap and aileron hinge loads. The wing assembly consists of a center panel bolted to two outer panels having removable tips permitting replacement of individual assemblies in the event of damage. The center panel is bolted to the fuselage by means of bolts in shear to facilitate removal of the center panel from the fuselage.

CONTROL SURFACES

The horizontal stabilizer and fin are of all metal, full cantilever, multicellular construction. The stabilizer is constructed in one piece, internally braced and attached to the fuselage through fittings and stud. The fin is internally braced and attached to the stabilizer through fittings and stud. The elevator and rudder are of metal construction and covered with fabric. The flaps and ailerons are of metal construction with metal covering.

CONTROL SYSTEM

The pilot's cockpit control elements consist of rudder pedals, stick, flap control, and control units for the aileron, elevator, rudder and trim tabs which are mounted on the left side of the pilot's cockpit. The ailerons and elevators are controlled by a system of bellcranks, push-pull rods and torque tubes. Cables are used for the rudder control system.

FUSELAGE

The fuselage is of all metal monocoque construction employing transverse bulkheads, longitudinal strings, and a stressed skin covering.

ALIGHTING GEAR

The landing gear is of the brace-strut, pneumatic-oleo type and is retractable by hydraulic power into the wing. The landing gear is equipped with non-standard wheels and tires. The wheels are the roller bearing type and are provided with foot operated hydraulic brakes. The landing gear is readily removable without removing the wing fittings. The tail wheel is hydraulically retractable into the fuselage and is provided with pneumatic-oleo shock absorbing strut. The tail wheel is equipped with a smooth contour wheel and tire mounted on a standard knuckle.

DESCRIPTION OF POWER PLANT

Airplane Model XP-60A & B Number of Main Engines 1 Arrangement Tractor

ENGINE

Manufacturer Allison Mfr. Model Spec. - A. C. Designation V-1710-75
Mfg. Spec. No. 152A A. C. Spec. No. A. C. Approved
Type Liquid cooled V engine
No. Cyl. 12 Bore Stroke Compression Ratio Reduction Gear Ratio 2.63:1
* Supercharger Type Blower Ratios

Rating:	Altitude ft.	Power b. hp.	Speed r. p. m.	Man. Pr. in. Hg.	Time Limit minutes	Blower Ratio	Mixture F/A
Take-off	S. L.	1425	3000		5		
Normal	S. L.	1100	2600		-		
Normal	25,000	1100	2600				
Military	25,000	1425	3000		15		

Magneto Mfr. No./Eng. 2 Spark Plug Mfr. AC No./Eng. 24
Carburetor Mfr. Stromberg No./Eng. 1 Type PD12K3 A. C. Setting Fuel 100 octane
Mixture Control Automatic Type Air Intake Ram Normal Pressure
Cooling Liquid No. Radiators 2 Type Tube Total Coolant Capacity 16.9 gal.
Temp. Control Exit flap Radiator Location under engine Total Frontal Area sq. ft.
Intercooler Type Tube Location Aft of pilot Total Frontal Area sq. ft.
Type Exhaust System Single exit at turbo located aft bottom fuselage
Location of Discharge bottom Glare Shielded From Pilot Silencers -
Remarks:

LUBRICATION SYSTEM

Capacities, gal.: Normal 8.5 Maximum 16.5 No. Tanks 1 Location Forward of firewall
No. Oil Coolers 1 Location Under engine Temp. Control D-8 auto valve
Remarks:

FUEL SYSTEM

Capacities, gal.: Normal 116 Maximum 200 Main Reserve 40 Aux. - Bomb Bay -
No. Tanks 2 Location and Construction Wing tanks are self-sealing type.
Remarks:

AUXILIARY POWER PLANT

Description:

	XP-60A	XP-60B
* Supercharger	General Electric Type B-14	Wright Aeronautical Corp. SU-504-2

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DESRIPTION OF ARMAMENT

Airplane Model XP-60A & B Mfr. Model Spec. Date

DESCRIPTION OF ARMAMENT

No.	Type	Cal.	Rds. ea.	Location
6	Fixed	.50	200	Wing outboard of prop.

Gun Sight Type and Location: N-3A Located inside cockpit.

NORMAL BOMBS (Wt. None lbs.)

Sta.	Location	No.	Size	Type	Bomb Bay Tank
A				or	gals.
B				or	gals.
C				or	gals.
D				or	gals.
E				or	gals.
F				or	gals.

ALTERNATE BOMBS (Max. Wt. None lbs.)

Sta.	No.	Size	Type	No.	Size	Type	No.	Size	Type	No.	Size	Type
A			or			or			or			
B			or			or			or			
C			or			or			or			
D			or			or			or			
E			or			or			or			
F			or			or			or			

Bomb Sight Type and Location:

CHEMICALS (Smoke)

Type Tank None

Amount

Location

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DESCRIPTION OF EQUIPMENT

Airplane Model XP-60A & B Mfr. Model Spec. 8509 Date 1 March 1941
Rev. 15 March 1942

PYROTECHNICS

Item	Service No.	Service Location	Type	Spares Normal	Spares Alternate
Flares	None				
Signal					

PHOTOGRAPHIC

Normal Type and Location: None

Alternate Type and Location: None

RADIO

Interphone –

Radio Compass –

Marker Beacon –

Liaison –

Command 274N

NAVIGATION

Automatic Pilot –

Drift Meter –

MISCELLANEOUS

Oxygen High pressure system.

Type of Ice Elimination Glycol spray for windshield.

Type of Life Raft None

Type of Flotation –

Crew Accommodations:

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OFFICIAL SUMMARY OF CHARACTERISTICS

Date of Issue

AIRPLANE

Manufacturer Curtiss-Wright Type Fighter Model XP-60C

Mfr. Model Spec. No. 8509 Contract No. W535-AC-28113 A. C. Type Spec. No.

Crew 1 Wing Loading 38.2 lb./sq. ft. Power Loading 5.39 lb./bhp. Design Altitude 24,500 ft.

Wing Area 275.15 sq. ft. Span 41 ft 3 3/4 in MAC 86.79 in. Aspect Ratio 6.22 Airfoil NACA 66,2-118 -116

Wing Type Cantilever High Lift Devices Split flap Landing Gear Type Conventional

ENGINES

Number 1 Mfr. Pratt & Whitney Spec. No. A-8080 Type Radial Model R-2800-83

No. Cyl. 18 Supercharger Blower Ratios 7.80:1, 6.46:1, 7.93:1 Turbo Type —

Prop. Gear Ratio 2:1 Compression Ratio 6.65:1 Cooling Air

Carburetor Type Bendix Setting - Fuel 100 octane

Intake Type Ram Exhaust Type Ejector

Rating:	Altitude ft.	Power b. hp.	Speed r. p. m.	Man. Pr. in. Hg	Time Limit minutes	Blower Ratio	~~XXXXXX XXXX~~	
Take-off	S. L.	2000	2700		15	7.80:1		
Normal	S. L.	1675	2550			7.80:1		
Normal	21,500	1550	2550			7.80:1 +	7.93:1	High blower
War E.	20,000	2000	2700		5	7.80:1 +	7.93:1	High blower
Military	22,500	1650	2700		15	7.80:1 +	7.93:1	High blower

PROPELLERS

Number 1 Mfr. Curtiss Type Automatic Rotation Dual

Diameter 12 ft. 2 in. No. of Blades 6 Type Control Electric Setting 50° to 22° at 42"

Blade Dwg. No. 726 Hub Dwg. No. C(46)-615SP-C

Clearances: —ground 10 —fuselage —between disks Weight each 807 lb.

WEIGHTS AND BALANCE

Design Useful load 2087 lb.
Crew @ 200 lb. each 180 lb.
Fuel @ 6.0 lb./gal. 1068 lb.
Oil @ 7.5 lb./gal. 126 lb.
Armament & Bombs 613 lb.
Misc. Equipment lb.
Water 100 lb.

Weight Empty 8698 lb. Design Gross Weight 10,785 lb.

Balance with Design Useful Load—c. g. 26.8 % MAC
Safe Limits of c. g. % MAC to % MAC

Normal Fuel 178 gal. Max. Fuel 225 gal.
Normal Bombs lb. Max. Bombs lb.

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OFFICIAL PERFORMANCE SUMMARY

Model XP-60C .... Date of issue ....

*1. Level Flight Speeds at Design Altitude of .... ft. with Design Gross Weight of 10,525 lb. Altitude

Maximum Speed 414 m. p. h. at 2700 r. p. m. with 2000 b. hp. (20,350)
High Speed 402 m. p. h. at 2700 r. p. m. with 1635 b. hp. (20,900)
Operating Speed .... m. p. h. at .... r. p. m. with .... b. hp. (........ % rated)
Cruising Speed .... m. p. h. at .... r. p. m. with .... b. hp. (........ % rated)

2. Optimum Range and Endurance with 210 gal fuel and - lb. bombs.

At High Speed .... miles at .... mi./gal. or .... hrs. at .... gal./hr. (s. f. c. ....)
At Operating Speed .... miles at .... mi./gal. or .... hrs. at .... gal./hr. (s. f. c. ....)
At Cruising Speed .... miles at .... mi./gal. or .... hrs. at .... gal./hr. (s. f. c. ....)

3. Practical Range and Endurance with 210 gal. fuel and .... lb. bombs.

At Operating Speed .... miles at .... mi./gal. or .... hrs. at .... gal./hr. (s. f. c. ....)
At Cruising Speed .... miles at .... mi./gal. or .... hrs. at .... gal./hr. (s. f. c. ....)

* 4. Climb Data with Gross Weight of 10,525 lb.

Standard Altitude ft.	S.L.	3000	4000	12,800	13,600	16,500	3500
Climbing Speed m. p. h.							
Engine Speed r. p. m.	2700	2700	2700	2700	2700	2700	2700
Total Power b. hp.	1925	1930	1858	1993	1970	1980	880
Maximum Rate f. p. m.	3890	3990	3780	4140	3990	4100	500
Minimum Time min.	0						

** 5. Ceiling: Normal Engine Operation: Service Ceiling 37,900 ft. Absolute Ceiling 38,400 ft.

** 6. Take-off and Landing Distances—To Clear 50 ft. Obstacle at Sea Level (no wind).

Take-off 1325 ft. at .... m. p. h. .... deg. flap. Gr. Wt. 10,525 lb Ground run .... ft.
Land .... ft. at 89 m. p. h. 45 deg. flap. Gr. Wt. .... lb. Ground run .... ft.

7. References and Remarks:

* Data from AAF Memo. Rpt. ENG-19-1633-A dtd. 7 Aug. 1943
** Contractor's guarantees.

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OFFICIAL SUMMARY OF CHARACTERISTICS

Date of Issue ....

AIRPLANE

Manufacturer Curtiss-Wright Type Fighter Model XP-60E

Mfr. Model Spec. No. 8509 Contract No. W535-AC-28113 A. C. Type Spec. No. ......

Crew 1 Wing Loading 38.8 lb./sq. ft. Power Loading 533 lb./bhp. Design Altitude 24,500 ft.

Wing Area 275.15 sq. ft. Span 41 ft. 3 3/4 in. MAC 86.79 in. Aspect Ratio 6.22 Airfoil NACA 66,2-118 -116

Wing Type Cantilever High Lift Devices Split flap Landing Gear Type Conventional

ENGINES

Number 1 Mfr. Pratt & Whitney Spec. No. 8056 Type Radial Model R-2800-10

No. Cyl. 18 Supercharger Blower Ratios 7.80:1, 6.46:1, 7.93:1 Turbo Type ......

Prop. Gear Ratio 2:1 Compression Ratio 6.65:1 Cooling Air

Carburetor Type Bendix Setting ...... Fuel 100 octane

Intake Type Ram Exhaust Type Ejector

Rating:	Altitude ft.	Power b. hp.	Speed r. p. m.	Man. Pr. in. Hg	Time Limit minutes	Blower Ratio		
Take-off	S. L.	2000			15	7.80:1		
Normal	S. L.	1675				7.80:1		
Normal	21,500	1550				7.80:1 +	7.93:1	High blower
War. E.	20,000	2000			5	"	"	" "
Military	22,500	1650			15	"	"	" "

PROPELLERS

Number 1 Mfr. Curtiss Type Automatic Rotation Single

Diameter 13 ft. 0 in. No. of Blades 4 Type Control Electric Setting 44 to 17 at 54"

Blade Dwg. No. 836 Hub Dwg. No. C 542S-A

Clearances: —ground 4.5" —fuselage ...... —between disks ...... Weight each 546 lb.

WEIGHTS AND BALANCE

Design Useful load 2093 lb.
- Crew @ 200 lb. each 180 lb.
- Fuel @ 6.0 lb./gal. 1068 lb.
- Oil @ 7.5 lb./gal. 132 lb.
- Armament & Bombs 613 lb.
- Misc. Equipment ...... lb.
- Water 100 lb.

Weight Empty 8574 lb. Design Gross Weight 10,667 lb.

Balance with Design Useful Load—c. g. 28.1 % MAC

Safe Limits of c. g. ...... % MAC to ...... % MAC

Normal Fuel 178 gal. Max. Fuel 225 gal.

Normal Bombs ...... lb. Max. Bombs ...... lb.

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Model XP-60E .... Date of issue ....

* 1. Level Flight Speeds at Design Altitude of .... ft. with Design Gross Weight of 10,320 lb.

					Altitude
Maximum Speed	410 m. p. h. at	2700 r. p. m. with	2010 b. hp.	(	20,200 xxxxxx
High Speed	391 m. p. h. at	2700 r. p. m. with	1660 b. hp.	(	24,200 xxxxxx
Operating Speed	.... m. p. h. at	.... r. p. m. with	.... b. hp.	(	xxxxxx
Cruising Speed	348 m. p. h. at	2050 r. p. m. with	1111 b. hp.	(	17,500 xxxxxx

**2. Optimum Range and Endurance with 178 gal fuel and – lb. bombs.

At High Speed .... miles at .... mi./gal. or .75 hrs. at .... gal./hr. (s. f. c. ....)
At Operating Speed .... miles at .... mi./gal. or .... hrs. at .... gal./hr. (s. f. c. ....)
At Cruising Speed .... miles at .... mi./gal. or .... hrs. at .... gal./hr. (s. f. c. ....)

3. Practical Range and Endurance with .... gal. fuel and .... lb. bombs.

At Operating Speed .... miles at .... mi./gal. or .... hrs. at .... gal./hr. (s. f. c. ....)
At Cruising Speed .... miles at .... mi./gal. or .... hrs. at .... gal./hr. (s. f. c. ....)

*4. Climb Data with Gross Weight of 10,320 lb.

Standard Altitude ft.	S.L.	5000	10,000	13,200	17,600	25,000	
Climbing Speed m. p. h.							
Engine Speed r. p. m.	2700	2700	2700	2700	2700	2700	
Total Power b. hp.	2060	1955	1980	1990	1940	1530	
Maximum Rate f. p. m.	4200	4010	4210	4340	3920	2580	
Minimum Time min.	0	1.2	2.5	3.2	4.4	6.5	

5. Ceiling: Normal Engine Operation: Service Ceiling 38,000 ft. Absolute Ceiling 38,600 ft.

**6. Take-off and Landing Distances—To Clear 50 ft. Obstacle at Sea Level (no wind).

Take-off 1265 ft. at .... m. p. h. 0 deg. flap. Gr. Wt. 10,326 lb. Ground run .... ft.
Land .... ft. at 88 m. p. h. 45 deg. flap. Gr. Wt. .... lb. Ground run .... ft.

7. References and Remarks:

* Engin. Div. Memo. Rpt. ENG-47-1735-A
** Contractor's estimate.

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DESCRIPTION OF AIRPLANE

Model XP-60C & E Mfr. Model Spec. No. 8509 A. C. Model Spec. No. -
Overall Span 41' 3 3/4" Overall Length XP-60C 34' 1" XP-60E 33'11" Overall Height -

WINGS

Type Internally braced Stagger - Gap - Aspect ratio 6.22 Total Wing Area 275.15 sq. ft.

	Span ft.	Root-Chord inches	Tip-Chord inches	Incidence deg. (T. L.)	Dihedral deg. L. E.	Sweepback deg. L. E.	Area sq. ft.	Airfoil Section
Upper								
Mid-								
Lower	41' 3 3/4"	120	40	-1 1/2	7 1/2°	6° 54'	275.15	NACA 66,2-118 root 66,2-116 tip

HIGH LIFT DEVICES

Type Split flap Travel 0°-45° Span 17' 1 1/8" Chord 20 7/8" Area 33.36 sq. ft.

AILERONS

Number 2 Type Sealed gap Location Outboard trailing edge
Balance Area 35.1 % Total Area 22.96 sq. ft. Travel: deg. Up 16 1/2 deg. Down 16 1/2
Trim Tab Area .55 sq. ft. deg. Up 20 deg. Dn. 20 Control Tab Area sq. ft. deg. Up deg. Dn.

MAXIMUM FUSELAGE SECTION

Location Leading edge canopy Dimensions 83 1/2 x 49 Area sq. ft. Shape Eliptical

STABILIZER

Maximum Chord 49 1/16" Span 13' 7" Area 40.20 sq. ft. Adjustable No

ELEVATORS

Span 13'7" Chord 19.83 Balance Area % Total Area 14.26 sq. ft. Hinge aft LELW 24' 0.63"
Travel: deg. Up 30 deg. Down 20 Horizontal Tail Area Coefficient
Trim Tab Area 1.38 sq. ft. deg. Up 3 deg. Dn. 26 Control Tab Area 1.38 sq. ft. deg. Up 3 deg. Dn. 26

FIN

Number 1 Span Chord Area 11.06 sq. ft. Adjustable No

RUDDER

No. 1 Span Chord 33" Bal. Area % Area 10.35 sq. ft. Hinge aft LELW 24' 2.25"
Travel: deg. Rt. 25 deg. Lt. 25 Vertical Tail Area Coefficient
Trim Tab Area .74 sq. ft. deg. Rt. 20 deg. Lt. 20 Control Tab Area sq. ft. deg. Rt. deg. Lt.

ALIGHTING GEAR

Main
Type Retractable Wheel Base 21' 6 3/4"
No. Wheels 2 Size 34 x 9 Tread 12' 1/16"
Retracting System Hydraulic Brakes Hydraulic

Auxiliary
Type Retractable
Location Tail Size 14.5
Retracting System Hydraulic

REMARKS:

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DESCRIPTION OF POWER PLANT

Airplane Model XP-60C & E Number of Main Engines 1 Arrangement Tractor

ENGINE

Manufacturer Pratt & Whitney Mfr. Model Spec. A. C. Designation *
Mfg. Spec. No. ** A. C. Spec. No. A. C. Approved Yes
Type Air cooled radial
No. Cyl. 18 Bore Stroke Compression Ratio 6.65:1 Reduction Gear Ratio 2:1
Supercharger Type Two-stage, two-speed Blower Ratios 7.80:1, 6.46:1, 7.93:1

Rating:	Altitude ft.	Power b. hp.	Speed r. p. m.	Man. Pr. in. Hg.	Time Limit minutes	Blower Ratio		
Take-off	S. L.	2000	2700		15	7.80:1		
Normal	S. L.	1675	2550			7.80:1		
Normal	21,500	1550	2550			7.80:1 + 7.93:1		High blower
War E.	20,000	2000	2700		5	7.80:1 + 7.93:1		High blower
Military	22,500	1650	2700		15	7.80:1 + 7.93:1		High blower

Magneto Mfr. General Electric No./Eng. 2 Spark Plug Mfr. No./Eng. 36
Carburetor Mfr. Bendix No./Eng. 1 Type TP13F1 A. C. Setting Fuel 100 octane
Mixture Control Automatic Type Air Intake Ram Normal Pressure
Cooling Air No. Radiators - Type - Total Coolant Capacity gal.
Temp. Control Radiator Location Total Frontal Area sq. ft.
Intercooler Type Tube Location Fuselage Total Frontal Area sq. ft.
Type Exhaust System Ejector
Location of Discharge Sides Glare Shielded From Pilot Silencers None
Remarks:

LUBRICATION SYSTEM

Capacities, gal.: Normal 16.8 Maximum 19.5 No. Tanks 1 Location Forward of firewall
No. Oil Coolers 1 Location Fuselage Temp. Control Auto valve
Remarks:

FUEL SYSTEM

Capacities, gal.: Normal 178 Maximum 225 Main 210 Reserve 15 Aux. - Bomb Bay
No. Tanks 3 Location and Construction Wings - Self-sealing & Fuselage
Remarks:

AUXILIARY POWER PLANT

~~Description~~ Note:

	XP-60C	XP-60E
*	R-2800-53	R-2800-10
**	A-8080	N-8056

DESRIPTION OF ARMAMENT

Airplane Model XP-60C & E Mfr. Model Spec. 8509 Date 1 Mar. 1941
Revised 1 Dec. 1943

DESCRIPTION OF ARMAMENT

No.	Type	Cal.	Rds. ea.	Location
4	Fixed	50	250	2 in each wing

Gun Sight Type and Location: N3A located on centerline of airplane forward of pilot.

NORMAL BOMBS (Wt. lbs.)

Sta.	Location	No.	Size	Type		Bomb Bay Tank
A	None				or	gals.
B					or	gals.
C					or	gals.
D					or	gals.
E					or	gals.
F					or	gals.

ALTERNATE BOMBS (Max. Wt. lbs.)

Sta.	No.	Size	Type		No.	Size	Type		No.	Size	Type		No.	Size	Type
A	None			or				or				or			
B				or				or				or			
C				or				or				or			
D				or				or				or			
E				or				or				or			
F				or				or				or			

Bomb Sight Type and Location:

CHEMICALS (Smoke)

Type Tank None.

Amount

Location

DESCRIPTION OF EQUIPMENT

Airplane Model XP-60C & E Mfr. Model Spec. 8509 Date 1 Mar. 1941
Revised 1 Dec. 1943

PYROTECHNICS

Item	Service No.	Service Location	Service Type	Spares Normal	Spares Alternate
Flares	None				
Signal	None				

PHOTOGRAPHIC

Normal Type and Location: None

Alternate Type and Location: None

RADIO

Interphone None

Radio Compass None

Marker Beacon None

Liaison None

Command 274-N

NAVIGATION

Automatic Pilot None

Drift Meter None

MISCELLANEOUS

Oxygen Low pressure demand type.

Type of Ice Elimination None

Type of Life Raft None

Type of Flotation None

Crew Accommodations:

RELATED DOCUMENTS

Contractual:

1. Contract W535-AC-22714 dated 27 October 1943 (Production contract for P-60A airplanes)

2. Contract W535-AC-28113 approved 24 July 1942

3. Supplement No. 1 dated 15 January 1943

4. Change Order No. 2 dated 31 December 1942

5. Change Order No. 3 dated 26 May 1943

6. Supplement No. 5 dated 29 July 1943

7. Change Order No. 6 dated 17 December 1943

8. Change Order No. 7 dated 14 February 1944

9. Supplement No. 8 dated 20 July 1944

10. Change Order No. 9 dated 24 June 1944

11. Change Order No. 11 dated 19 September 1944

12. Change Order No. 12 dated 27 October 1944

13. Change Order No. 13 dated 15 June 1944

14. Engineering Order No. 1, Serial No. X-2458 dtd. 31 July 1942

15. Engineering Order No. 2, Serial No. X-2459 dtd. 1 Aug. 1942

16. Engineering Order No. 3, Serial No. X-2571 dtd. 26 Aug. 1942

17. Engineering Order No. 4, Serial No. X-2597 dtd. 5 Sept. 1942

18. Engineering Order No. 5, Serial No. X-2934 dtd. 2 Jan. 1943

19. Engineering Order No. 6, Serial No. X-3764 dtd. 11 Aug. 1943

20. Engineering Order No. 7, Serial No. X-3855 dtd. 16 Sept. 1943

21. Contract Change Notification No. 1, Serial No. N-1017 dated 27 October 1943.

22. Contract Change Notification No. 2, Serial No. N-1568 dated 11 November 1943.

23. Contract Change Notification No. 3, Serial No. N-1762 dated 8 November 1943.

24. Contract Change Notification No. 4, Serial No. N-4700 dated 24 January 1944.

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25. Contract Change Notification No. 5, Serial No. N-12979 dated 24 July 1944.

REPORTS SUBMITTED

Report No.	Title
9138	Engine Pressure Recovery Data From Flight Tests of the XP-60E and XP-60C Airplanes dtd. 1 Sept. 1944
8509	Final Revised Model Specification dtd. 1 March 1941, revised 1 December 1943.
	Curtiss-Wright Pilot's Handbook of Flight Operation Instructions.
	Curtiss-Wright Handbook of Maintenance Instructions
9381	Actual Weight and Balance Summary
9091	Actual Weight and Balance Summary dtd. 19 June 1943
8952	P-60 Calculated Moments of Inertia dtd. 7 December 1942
9044	Actual Weight and Balance Summary dtd. 18 February 1943
8626	Tail Surface Analysis dtd. 4 November 1942
8628	Control System Analysis dtd. 11 August 1942
8509	Appendices V and VI to Model Spec. 8509 dtd. 1 Mar. 1941, Revision No. 1 dtd. 15 Mar. 1942
8905	Basic Design Criteria dtd. 14 January 1943
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8631	Tail Wheel Analysis dtd. 26 February 1942
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8630	Landing Gear Analysis dtd. 6 May 1942
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8610	Calculated Moments of Inertia dtd. 15 October 1941
S-617	Curtiss Finish Specification dtd. 15 November 1941

FLIGHT TEST REPORTS

Memorandum Report Serial No. ENG-19-1633-A dtd. 7 August 1943, Subj.- Performance Tests

Engineering Division Memorandum Report Serial No. ENG-47-1735-A dtd. 17 April 1944, Subj. - Flight Tests on the Curtiss XP-60E Airplane, AAF No. 42-79425

Memorandum Report Serial No. ENG-47-1792-A dtd. 22 August 1944, Subj.- Flight Comparison of Dual and Single Rotating Propellers as Installed on the XP-60C and XP-60E Airplanes.

Memorandum Report Serial No. ENG-47-1800-A dtd. 12 September 1944, Subj. - Power Required at 17,500 Feet.

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Curtiss XP-60A front view

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Curtiss XP-60A 3/4 front view.

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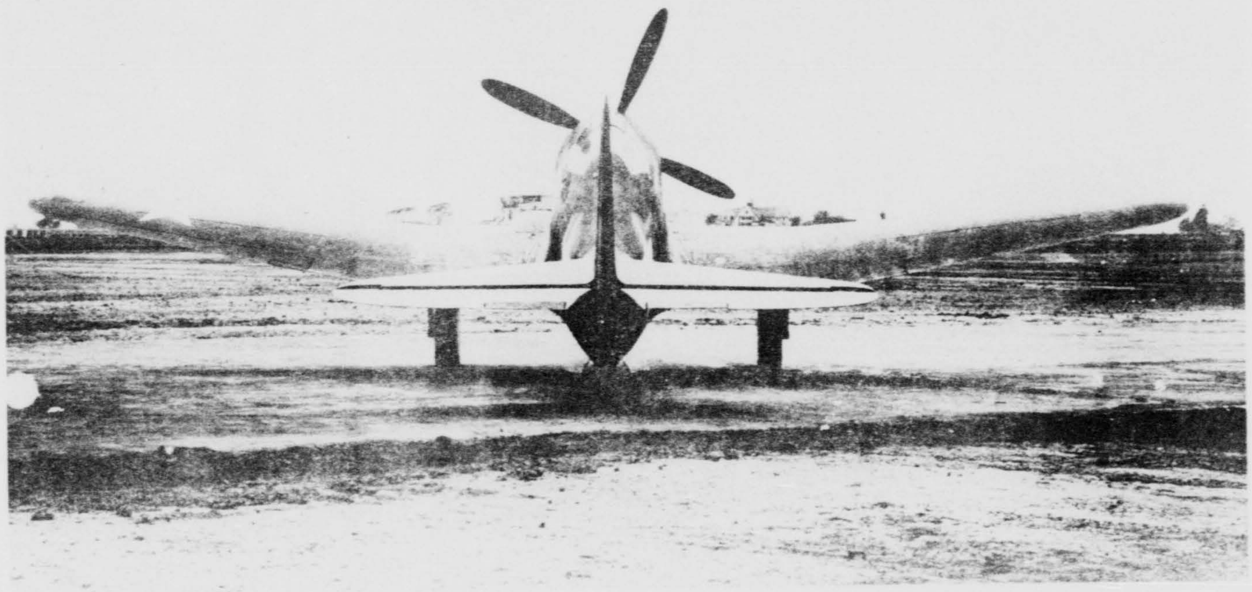

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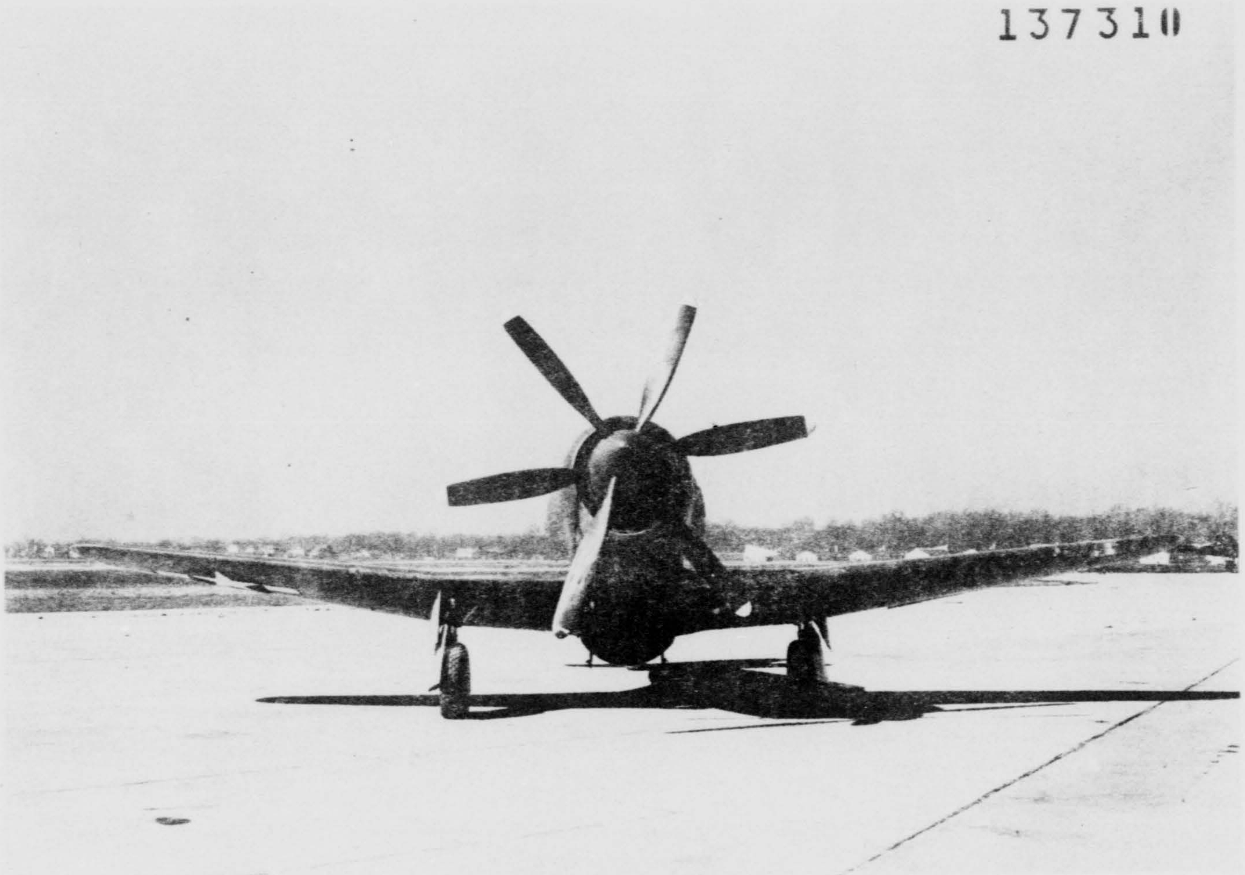

Curtiss XP-60C front view

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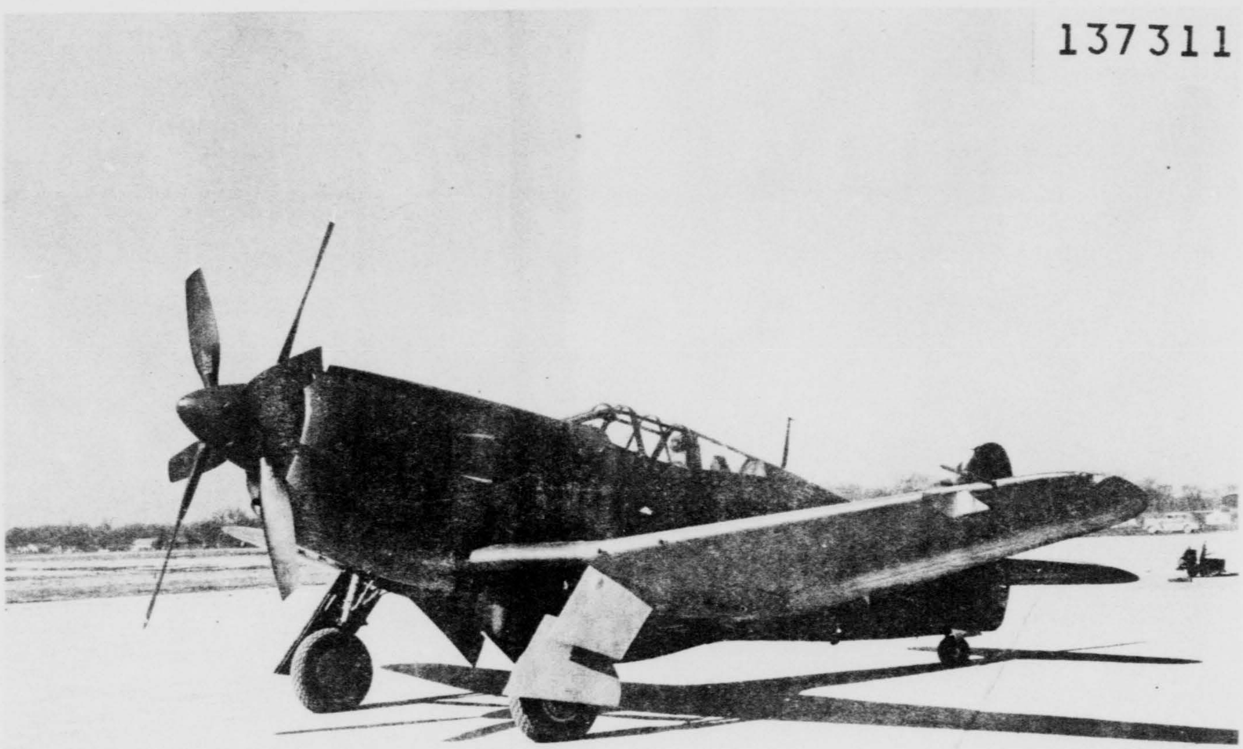

Curtiss XP-60C 3/4 front view

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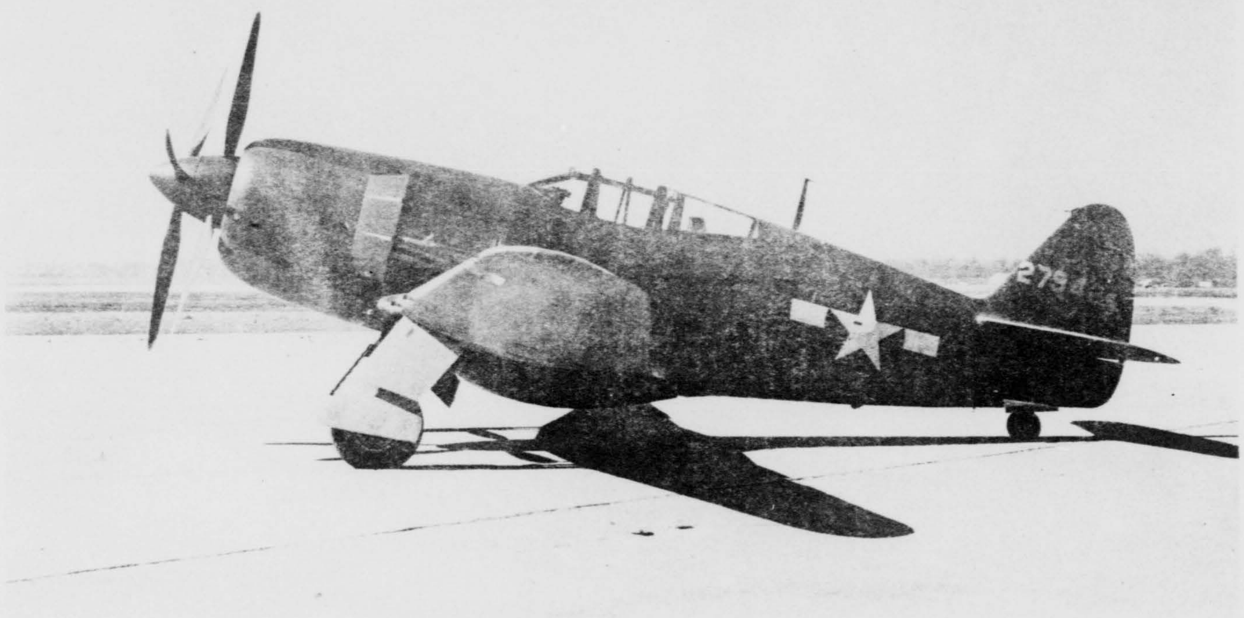

Curtiss XP-60C side view

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Curtiss XP-60C 3/4 rear view

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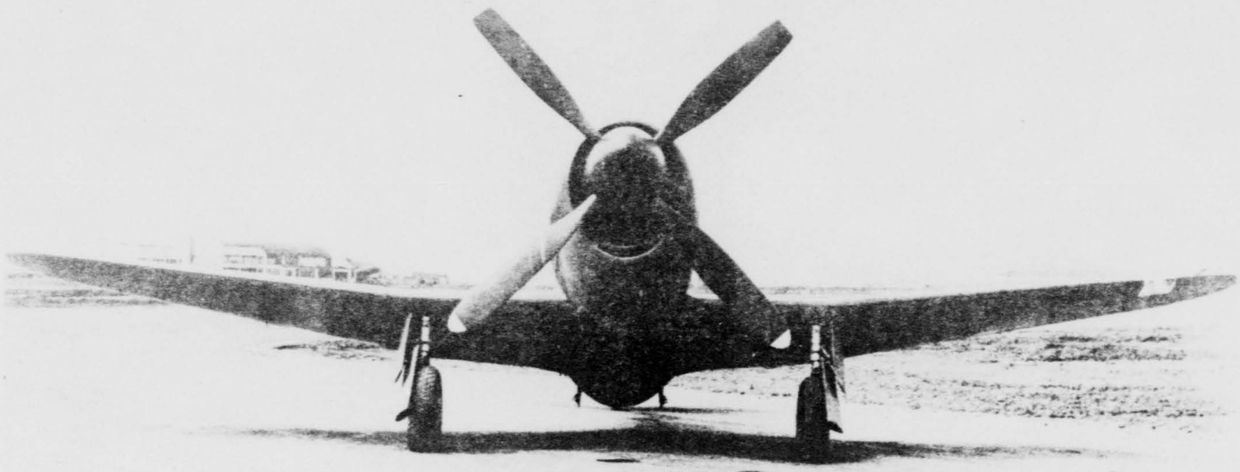

Curtiss XP-60E front view

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Curtiss XP-60E side view

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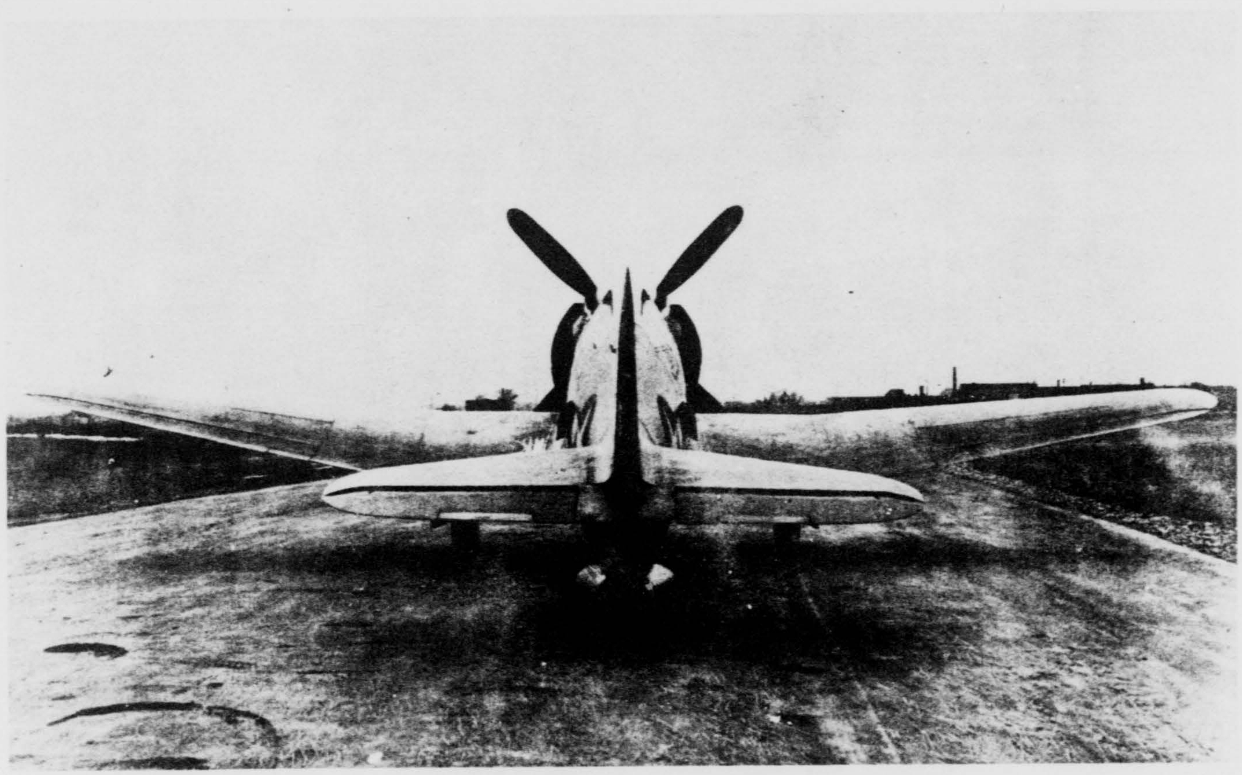

Curtiss XP-60E rear view

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RESEARCH AND DEVELOPMENT PROJECTS

OF THE

Engineering Division

ENGINEERING DIVISION
MATERIEL COMMAND A.A.F.

FOURTH EDITION
JAN. 1, 1944

Foreword

For the information of all concerned, there is presented herein the fourth edition of a consolidated report of the major research and development projects that are being pursued by the Engineering Division, AAF Materiel Command, Wright Field, Dayton, Ohio as of 1 January 1944.

In the past few years the activities of the Engineering Division have increased to such an extent that it has become increasingly difficult for anyone to be acquainted with the background and status of even the major projects. It is, therefore, believed that this publication, revised semi-annually, fulfills a need in covering in brief each one of these projects.

The volume is divided into eleven chapters, the first chapter containing the projects of the Technical Staff, and the other chapters covering the activities of each of the Laboratories of the Engineering Division. A subject index is provided at the back of the book. The chapters are sub-divided into sections which are strip-tabbed for convenience, under which projects of the same general subject are grouped.

In this edition several additional modifications have been made in order to increase the usability and convenience of the book. The projects carried on by the National Defense Research Committee for the Laboratories of the Engineering Division have been grouped together and placed at the end of the Technical Staff projects. The subject index has been expanded and made more comprehensive in order to provide a more ready reference.

H. Z. Bogert

H. Z. BOGERT,
Colonel, Air Corps,
Chief, Technical Staff,
Engineering Division.

F. O. Carroll

Approved: F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

"RESEARCH AND DEVELOPMENT PROJECTS"

OF THE ENGINEERING DIVISION

Copy Number 7

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Receipt of copy number 7 of 4th Edition of confidential book entitled "Research and Development Projects" of the Engineering Division is acknowledged.

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SECTION 1

FIGHTER AIRCRAFT PROJECTS

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XP-47J AIRPLANE

430-142 Expenditure Order No.	Republic Aviation Corp. Farmingdale, L. I., N. Y. Mfg. or Activity Charged with Development
None Classified Project No.	W-535-AC-39160 Contract No.

DESCRIPTION: This is a 12,500 pound single engine, single place, offensive fighter airplane, powered by a Pratt & Whitney R-2800-61 engine in combination with a turbo supercharger and equipped with six (6) caliber .50 machine guns. This airplane incorporates the use of a dual rotation propeller and a blower fan. A high speed of 455 miles per hour from 30-35,000 feet is guaranteed with a 2415 horsepower War Emergency rating. In general, this airplane is an extension of the P-47 series airplanes.

PURPOSE: To continue the development of the P-47 type airplane by providing a dual rotation propeller, an engine cooling fan, and a higher rated turbo supercharger.

AUTHORITY: Chief, Engineering Division.

REMARKS: This airplane was first submitted as a lightened version of the P-47D series of airplanes. In August of 1942 the Republic Aviation Corporation submitted a model specification for an airplane taking advantage of the newest requirements for fighter type airplanes. Upon receipt of the quote letter in March, 1943, Authority for Purchase was written requesting that a cost-plus-fixed-fee contract be negotiated with Republic Corporation to cover the procurement of two (2) XP-47J airplanes. On 18 June 1943, contract was approved. Satisfactory progress was made during the summer of 1943 and the airplane was completed and initially flown 16 November 1943. The initial flight as well as a series of preliminary flight tests were conducted with an R-2800-57 engine and a single rotation propeller installed. This installation, however, is temporary pending the availability of the R-2800-61 engine and a dual propeller. In September 1943 when it was evident that production of this model airplane would not materialize, steps were taken to reduce the quantity of airplanes from two to one as well as to terminate the requirements for a static test article.

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XP-51F, G & J AIRPLANES

430-134
Expenditure Order No.

North American Aviation, Inc.
Inglewood, California
Mfg. or Activity Charged with Development

MX-356
Classified Project No.

W-535-AC-37857
Contract No.

DESCRIPTION: The XP-51F airplane represents the contractor's attempt to produce an improved version of the P-51 series of airplanes. It will have an appearance similar to the P-51 except for the raised canopy which is intended to improve rearward vision. Design gross weight will be about 6950 pounds and stress analysis will be based on eleven factors. Two (2) caliber .50 machine guns will be installed in each wing panel. The Packard V-1650-3 engine and Aeroproducts three-bladed propeller will be installed. Contractor's estimated high speed at 29,000 feet is 461 m.p.h.

PURPOSE: To develop a high performance offensive fighter type aircraft with reduced weight.

AUTHORITY: Authorization for this project originated in a telephone conversation between General Echols and General Carroll on 6 February 1943.

REMARKS: This project was submitted to the Materiel Command in January, 1943, by representatives of North American Aviation, Inc. This model, NA-105, was proposed by North American in order to continue the development of their present P-51 series, incorporating such changes as are considered necessary as a result of experience gained with fighter aircraft during the war. In preparing the original Model Specification, Report No. NA-5656, the contractor has made reference to the Spitfire Mark IX and states that the NA-105 will be constructed to British load factors where a reduction in weight can be effected. Subsequent conferences with North American engineers, however, resulted in the decision to construct the airplane to eleven (11) factors and to employ the recent revisions to A.A.F. Specification C-1803-A. The contractor has also been authorized to eliminate all reference to the Handbook of Instructions for Airplane Designers in the Model Specification. The first article is scheduled for flight in February 1944. Negotiations with the contractor during June 1943 resulted in a decision to procure five (5) XP-51F airplanes. Two of these airplanes will be designated XP-51G's as soon as the contractor obtains more information on the Rolls-Royce RM-14SM engines which will be installed in these two airframes. In addition, authority has been granted to procure two (2) additional airplanes on this contract for incorporation of the Allison V-1710-119 engine. This airplane has been designated XP-51J.

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XP-40Q AIRPLANE

430-165
Expenditure Order No.

Curtiss-Wright Corporation
Buffalo, New York
Mfg. or Activity Charged with Development

None
Classified Project No.

(W33-038)44-4537
Contract Number

DESCRIPTION: The XP-40Q is a standard P-40 which has been modified in the following manner. The top of the fuselage aft of the pilot has been cut down and a bubble canopy installed. Vision over the nose will be 7° on the third airplane. A two-stage Allison engine V-1710-101 replaces the single-stage engine and the coolant radiators have been moved to the position of the inboard wing guns. The wing tips have been replaced by square wing tips to permit greater maneuverability.

PURPOSE: To further improve and modernize the P-40 airplane so that it may operate efficiently and to the best advantage in combat.

AUTHORITY: Directive from M.M.&D, dated 6 December 1943, based on R & R sheet, dated 4 December 1943, to Assistant Chief, Air Staff, M. M. & D. from Chief of Air Staff.

REMARKS: During the spring of 1943 the Production Division, Materiel Command made a P-40N airplane available to the contractor for development work and the installation of the two-stage Allison engine. The contractor completed this modification at no cost to the Government and Army Air Forces designation XP-40Q was assigned. As the result of increased performance and improved visibility obtained by this modification, the interest of the Army Air Forces was increased to the point where the Army Air Forces considered it advisable to procure two more airplanes for further development and protection of the development against delay which would result if the first airplane were lost. The second airplane will contain some improvements not found in the first airplane. The third airplane will contain all improvements considered advisable to make at this time. The second airplane will fly approximately six weeks after date of contract and the third airplane will be ready for delivery 145 days after date of contract.

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XP-47E AIRPLANE

430-92
Expenditure Order No.

Republic Aviation, Corp.
Farmingdale, L. I., N. Y.
Mfg. or Activity charged with Development

MX-146
Classified Project No.

W-535-AC-15850
Contract No.

DESCRIPTION: This model designation represents a modification of the P-47B airplane for the incorporation of a pressurized cabin.

PURPOSE: To develop a pressurized cabin version of the P-47 series airplane and thus increase the pilot efficiency and determine the advisability of introducing this requirement in subsequent production of this airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: Early in 1941, the Republic Aviation Corporation was requested to investigate the feasibility of modifying a P-47B airplane in order that a pressurized cabin section might be installed and tested. The Republic Aviation Corporation submitted their initial proposal on 8 May 1941. Delivery was promised for six months from the contract date. Authority for Purchase 182427 was initiated 1 October 1941 and resulted in Change Order No. 12, Serial No. 5387 under Contract W-535-AC-15850. This Change Order was approved 19 November 1941 and provided for the modification of a P-47B airplane Serial No. AC-41-5904. Satisfactory progress during the design phase of this project was accomplished although some trouble was experienced in obtaining the supercharger pump and other essential equipment. The design of the pressurizing equipment provides for the maintenance of an altitude equivalent to 10,000 feet, when flying at an altitude of 35,000 feet. The cabin is designed for a pressure differential of 6.65 pounds per square inch at 35,000 feet. The contractor estimates that the increase in weight of the airplane due to the addition of this equipment, will be about 400 pounds, of which 180 pounds represents the weight of the necessary equipment, and 220 pounds for structural weight increase. Several flight tests were made in the early part of 1943, but difficulty was encountered with the supercharger impeller and the airplane was grounded pending development of a new impeller. The revised impeller was received in October 1943 and the airplane was again flight tested in November 1943. Subsequent flights have proven satisfactory and a cabin altitude of between 10 and 11,000 feet has been maintained at 35,000 feet. The airplane will remain at Republic for additional flight time to the extent of between 50 and 60 hours for high altitude research.

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XP-54 AIRPLANES

430-55	Vultee, Aircraft, Inc. Vultee Field, Calif.
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-12	W-535-AC-15019
Classified Project No.	Contract No.

DESCRIPTION: A single engine, pusher type fighter airplane having a gross weight of 16,145 pounds and a guaranteed high speed of 476.5 m.p.h. at 30,000 feet, using military power. It is powered by a Lycoming XH-2470-1 engine supercharged to deliver a2200 h.p. military rating at 30,000 feet. The armament consists of two caliber .50 machine guns and two 37 mm. cannons located in the front portion of the fuselage. The entire nose section containing all the armament can be rotated about a span-wise axis. The purpose of this feature is to allow adjustment of the guns in flight in order to compensate for range, air density, and angle of attack, the exact amount of compensation being computed by a compensating gun sight. The armament and pilot compartments of the fuselage are located forward of the wing center section directly in front of the engine which is mounted on the center section. The tail surfaces consist of twin rudders and stabilizers mounted on the ends of the horizontal surfaces. The tail assembly is supported on twin booms which are faired into the wings. All ducts are located in the leading edge of the wing sections between the fuselage and the booms.

PURPOSE: To develop a high performance prototype fighter airplane.

AUTHORITY: Authority for this project is contained in 1st Indorsement dated 31 May 1940 from Major General H. H. Arnold approving the recommendations of the board of Officers who evaluated the designs submitted under Request for Data R-40-C.

REMARKS: The original design submitted under R-40-C was for a 9,000 pound airplane incorporating a Pratt and Whitney X-1800 A4G engine equipped with a two-speed blower. The design placed first in the competition and Contract W-535-AC-15019 was prepared calling for data and wind tunnel model and contained an option for the purchase of one experimental airplane. The contract was approved 22 June 1940. Authority for Purchase No. 165272 provided for the testing of a powered wind tunnel model, construction of a mockup, engineering data, and one experimental airplane. Due to the discontinuance of the development of the Pratt and Whitney X-1800 series engines, Contract W-535-AC-15019 was amended by Change Order No. 2, Serial No. 3984 which authorized an engine change and certain performance adjustments at no additional cost. This Change Order was approved 27 March 1941. The necessary action for the addition of "Wright" turbo superchargers and a pressurized cabin, together with the purchase of one additional airplane was started with the initiation of Authority for Purchase No. 179053, dated 28 November 1941, which

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resulted in supplement agreement No. 1 to Contract W-535-AC-15019, approved 17 March 1942, which increased the gross weight from 11,000 pounds to 16,145 pounds. The first airplane made its initial flight on 15 January 1943, and since that date flight testing has been conducted at the contractor's plant. The actual gross weight has been established at 16,255 pounds. Performance thus far obtained has been disappointingly low due in part to failure of the engine-turbo combination to deliver full military horsepower at 30,000 feet, in part to small external "dirtiness" and partly to a bad separation at the aft end of the fuselage. The contractor obtained a maximum speed of 401 at the lowered critical altitude of 28,500 during flight testing. The first airplane was delivered to Wright Field for final inspection, flight tests and acceptance on the 28 November 1943. An agreement was made whereby the first airplane would be delivered without armament and pressurized cabin blower providing the contractor left a certain amount of flight testing instrumentation in the airplane. During flight tests at Wright Field, considerable difficulty was experienced with oil scavenging and the impeller was found to be damaged enough to necessitate removal of the engine and shipping to Lycoming for overhaul. The engine will not be returned until February 1944. The second airplane will be completed sometime in March 1944 and will be delivered with armament and complete pressurized cabin. It is tentatively planned to send this plane to Eglin Field for armament tests after completion of a short period of flight testing at Wright Field.

XP-55 AIRPLANE

430-56
Expenditure Order No.

MX-13
Classified Project No.

Curtiss-Wright Corp.
St. Louis, Mo.
Mfg. or Activity charged with Development

W-535-AC-29013
Contract No.

DESCRIPTION: A single place pusher type fighter, interceptor having a gross weight of 7600 pounds and a guaranteed speed of 419 at 19,300 feet with 1100 h.p. obtained from an Allison V-1710-95 engine. The armament consists of four free-firing M-2 caliber .50 machine guns with 250 rounds each installed in the nose section. The configuration of the airplane is unusual being neither the stable wing or Canard type, it is essentially a flying wing with a controllable nose elevator. The wings are located aft of the CG and employ considerable sweepback with the vertical tail surfaces mounted near the tips.

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PURPOSE: To develop a high performance low altitude fighter for the purpose of destroying hostile aircraft employing an unusual configuration for added performance, visibility and a free firing gun installation on the centerline of the fuselage.

AUTHORITY: Authority for Project MX-13 is contained in 1st Indorsement dated 31 May 1940 from Major General H. H. Arnold approving the recommendations of a board of officers who evaluated the designs submitted under Request for Data R-40C.

REMARKS: Vultee Model XP-54, Curtiss-Wright Model XP-55 and Northrop Model XP-56 were submitted on R-40C which called for airplanes of an unconventional design and powered with a Pratt & Whitney X-1800-A3G engine in an attempt to obtain the high performance prototype airplane. The XP-55 design placed second in the competition and Contract W-535-AC-15020 was prepared calling for data, wind tunnel models and the option for the purchase of one experimental airplane. Due to the amount of funds expended on the preliminary phases of this project, it was decided to proceed with the tests of the powered wind tunnel model obtained under the contract. The necessary action to proceed with these tests was begun with the initiation of Authority for Purchase No. 108905 dated 2 November 1940, which resulted in Change Order No. 1, Serial No. 3549, approved 10 January 1941. Consideration was again given to the development of this project during the F.Y. 1942 Research and Development Program. Due to the fact that the Materiel Command was not entirely satisfied with the results of the wind tunnel tests, the Curtiss-Wright Corporation proceeded on their own to construct a low powered full scale flying model designated as their model 24-B. When the construction of this model was almost complete, the Army Air Forces decided to sponsor this project and test the model at the Muroc Bombing Range, Muroc, California. Procurement action for the flying model began with the initiation of Authority for Purchase No. 182443, dated 29 September 1941, which resulted in Contract W-535-AC-22239 approved 28 November 1941. After the completion of tests except for spin demonstrations on the 24-B flying model, actual procurement of three airplanes was begun by the initiation of Authority for Purchase No. 179068 dated 1 April 1942, which resulted in the preparation of Contract W-535-AC-29013 which was approved 10 July 1942. The first airplane under contract was completed and delivered to Scott Field for flight tests 8 July 1943. Initial flight was conducted 13 July 1943. Authority for Purchase No. 329630 was initiated 8 August 1943 to cover procurement of a full scale elevator and nose section suitable for testing in the Wright Field 20' tunnel and the Moffett Field 16' high speed tunnel to ascertain the effect of the nose elevator on diving characteristics. From 13 July 1943 through 6 November 1943, forty-three shakedown flights were performed by the contractor in an effort to improve stability and control characteristics and cooling difficulties. Stall tests were requested by the Materiel Command prior to Army familiarization flights. A series of stall flights were made in which falling leaf gyrations and parachute descents were experienced.

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quite similar to the actions of the spin tunnel model. During stall tests the first article crashed on 15 November 1943, after a inverted parachute descent resulting from stall tests. A conference was held at the contractor's plant 18 November 1943 and methods were evolved for possible correction of stall difficulties. The 1/5 scale model of the XP-55 will be in the Wright Field 20' tunnel approximately 5 January 1944 for a series of tests to determine effects of variations in configuration. The spin tunnel model is at Langley Field for spin tunnel tests to commence early in January 1944. A 689 Engineering Inspection was held on the second article 29 November 1943, and the initial flight on this airplane should occur early in January 1944. Flights are restricted to high speed, climb and cooling runs until wind tunnel data is available. The third airplane is scheduled for completion early in January 1944. The contractor has modified the nose elevator and ailerons which should greatly improve flight qualities. To date, performance data is scarce, but the data obtained indicates a high speed somewhat lower than the guaranteed speed but modifications on the second airplane should improve the performance.

XP-56 AIRPLANE

430-57 Expenditure Order No.	Northrop Aircraft, Inc., Hawthorne, California. Mfg. or Activity Charged
MX-14 Classified Project No.	AC-15021 & AC-25060 Contract Nos.

DESCRIPTION: A single engine pusher type fighter having a gross weight of 11,350 pounds and a guaranteed high speed of 467 m.p.h. at 25,000 feet, using military power. It is powered by a Pratt and Whitney R-2800-29 air-cooled engine installed in the rear of the nacelle and cooled by means of a fan mounted on the propeller gear extension shaft. The armament consists of four caliber .50 machine guns and two 20 mm. cannons installed in the nose of the crew nacelle. The airplane is of the flying wing or tailless type. Lateral and longitudinal control is obtained by the use of elevons which are deflected together for longitudinal control and differentially for lateral control. Directional control is obtained by the use of wing tip rudders.

PURPOSE: To investigate unconventional means of obtaining a high performance prototype fighter airplane.

AUTHORITY: Authority for this project is contained in 1st Indorsement dated 31 May 1940 from Major General H. H. Arnold approving the recommendations of the board of Officers who evaluated the designs submitted under Request for Data R-40-C.

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REMARKS: The original design submitted under R-40-C was for a 9,755 pound airplane powered by a Pratt and Whitney X-1800-A3G engine. The design placed third in the competition and Contract W535 AC-15021 was prepared calling for data and wind tunnel models and contained an option for the purchase of one experimental airplane. The contract was approved 22 June 1940. Authority for Purchase No. 165270 dated 5 August 1940 was initiated to cover the cost of taking up the option and provided for the construction of a mock-up, engineering data and one experimental airplane. The design was designated as the Air Force Model XP-56 airplane and Change Order No. 1, Serial No. 3295 calling for the delivery of the above listed items was approved 26 September 1940. Due to the discontinuance of the development of the Pratt and Whitney X-1800 series engines, Contract W535 AC-15021 was amended by Change Order No. 2, Serial No. 4000 which authorized the change to the R-2800-29 engine and certain performance adjustments at no additional cost. This Change Order was the result of Authority for Purchase No. 168920, dated 14 February 1941 and was approved 21 July 1941. Action for the purchase of a second XP-56 airplane identical to the first one was started by the initiation of Authority for Purchase No. 179055, dated 5 December 1941 which resulted in Contract W535 AC-25060 approved 13 February 1942. Flight of the first airplane was expected early in May 1943. However, due to engine and propeller vibration troubles and engine failure, this date could not be met. A new engine and gear box was installed. Following preliminary ground runs at the contractor's plant during the latter part of August, 1943, the airplane made two low straight flights at Muroc Lake on 6 September which indicated that the airplane was unstable directionally. This was corrected and on 8 October the airplane made additional straight flights. The fifth run was a high speed taxi run at 130 m.p.h. During this run the left main wheel tire blew out causing the airplane to ground loop to the left after which it tumbled backward two and one-half turns and was completely demolished. The second airplane is expected to be completed early in January 1944. The C.G. has been moved forward and new improved tires have been supplied to prevent a similar accident.

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XP-58 AIRPLANE

432-12	Lockheed Aircraft Corporation, Burbank, California.
Expenditure Order No.	Mfg. or Activity Charged With Development
MX-2	W535-AC-15867
Classified Project No.	Contract No.

DESCRIPTION: This is a 40,294 pound, two place, twin engine, heavy cannon fighter powered by two Allison V-3420 engines, having a guaranteed high speed of 430 miles per hour at 28,000 feet. Pilot's and gunner's compartments are pressurized. The forward firing armament consists of an alternate installation of one 75 mm. cannon and two .50 caliber machine guns, or four 37 mm. high velocity cannon. Both installations will have compensating gun sight. The flexible armament consists of two remotely controlled turrets, one upper and one lower, each containing two (2) .50 caliber machine guns.

PURPOSE: To develop a high speed, high altitude fighter airplane with flexible firing guns which in combination with the fixed forward firing weapons will provide the means for exploring the potentialities of the heavy cannon fighter type airplane.

AUTHORITY: The first airplane is being obtained under a foreign release agreement with the Lockheed Aircraft Corporation as approved by the Assistant Secretary of War on 17 April 1940, whereby one airplane of advanced design is to be delivered to the Government without cost for release for foreign sale of the P-38 type airplanes. Procurement of an additional airplane is authorized by CTI-670 dated 27 May 1942 and contract W535-AC-39212 approved 4 May 1943.

REMARKS: The airplane in its original form incorporated Continental XI-1430 engines which were changed to the Pratt and Whitney X-1800-A2G engines (XH-2600) in the Model Specification No. 1870 revised September 10, 1940. Change Order No. 1 to this contract covered among other things, the change from the X-1800-A2G engines to the Wright Tornado R-2160 engines. This was necessitated due to the discontinuance of the development of the Pratt and Whitney X-1800 engine. When it became apparent that the Wright R-2160 engines would be delayed indefinitely, it was decided to change to Allison V-3420 engines as these engines were immediately available. This change was authorized by CTI-670 which further authorized the change to a heavy cannon fighter for the purpose of destroying enemy bombardment. This required a change in the original forward firing armament from two 20 mm. cannons and four .50 caliber machine guns to the 75 mm. cannon or the 37 mm. cannon as outlined in the paragraph entitled "Description" above. The above changes were covered by Change Order No. 3, dated 5 May 1943. Flutter and vibration surveys are scheduled for 5 January 1944 on the first airplane. The accelerated P-38 program caused a delay in the originally estimated flight dates. It is now estimated that the first airplane will make its initial flight approximately 20 January 1944, and the second airplane about 1 March 1944.

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XP-60C AIRPLANE

430-99
Expenditure Order No.

Curtiss-Wright Corp.
Buffalo, New York
Mfg. or Activity Charged
with Development

MX-313
Classified Project No.

AC-28113 Change Order No.3
Contract No.

DESCRIPTION: The XP-60C airplane is a single engine single place interceptor fighter of approximately 10,525 pounds gross weight with a design high speed of 415 m.p.h. at 23,000 feet with 1800 brake horsepower. This airplane is powered with a Pratt and Whitney R-2800 engine equipped with a six-blade Curtiss electric dual rotation propeller. Water injection for war emergency engine operation has been added which increases performance.

PURPOSE: To provide in a minimum period of time a fighter type airplane with a high rate of climb.

AUTHORITY: Authority for the installation of the R-2800 engine in this airplane is contained in CTI-932 dated 30 September 1942.

REMARKS: This is the same XP-60C airplane previously intended to be used with the Chrysler engine. The installation of the R-2800 engine in the XP-60C was proposed by Curtiss in August 1942, since the status of Chrysler engine was very indefinite. The XP-60C actually weighs in the neighborhood of 10,700 pounds but preliminary performance tests by Army Air Forces pilots were conducted at 10,525 pounds which was the estimated weight of the production version of this airplane. The first flight of this airplane was made 27 January 1943. Preliminary performance tests by Army Air Forces pilots were conducted during 19 May to 4 June 1943. These flight tests were terminated due to engine failure. This airplane was converted to a XP-60E to prevent delay in obtaining performance data on the XP-60E following the damage to the XP-60E resulting from a forced landing. The damaged XP-60E is being repaired and converted into a XP-60C and should be ready for delivery to Wright Field during February of 1944, and will be used for evaluation of the advantages of the dual rotation propeller and further propeller development work.

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XP-60E AIRPLANE

430-99
Expenditure Order No.

Curtiss-Wright Corporation
Buffalo, New York
Mfg. or Activity Charged with Development

MX-313
Classified Project No.

AC-28113 Change Order No. 2
Contract No.

DESCRIPTION: The XP-60E airplane is a single engine single place interceptor fighter with approximately the same characteristics as the XP-60C airplane. This XP-60E is also powered with an R-2800 engine but differs in that it will be fitted with a four-bladed Curtiss electric single rotation type propeller.

PURPOSE: The purpose of this project is to provide a second fighter type airplane with a high rate of climb and to obtain information as to the relative advantages of the six-bladed dual rotation and four-bladed single rotation propellers.

AUTHORITY: Chief, Engineering Division.

REMARKS: This airplane was originally designated as the XP-60B. See "Remarks" on XP-60A and XP-60C. This airplane made its initial flight during the latter part of May 1943. Due to inadequate engine cooling the contractor was forced to modify the engine cowling and intercooler scoop design. During this period the airplane was damaged as the result of a forced landing resulting from engine failure. In order to expedite the flight test program and obtain information on the advantages of the dual rotation propellers over the single rotation propellers, the single rotation propeller was installed on the XP-60C thus making it an E and the damaged airplane was rebuilt as an XP-60C. Official performance tests are scheduled for this airplane during the latter part of January 1944, after which the airplane will be delivered to Wright Field for acceptance and further comparison with the XP-60C to evaluate the two propeller installations.

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YP-60E AIRPLANE

430-136
Expenditure Order No.

None
Classified Project No.

Curtiss-Wright Corporation
Buffalo, New York
Mfg. or Activity Charged with Development

AC-35373
Contract Number

DESCRIPTION: A single place, single engine, interceptor fighter having a gross weight of 10,200 pounds. It is powered with a Pratt and Whitney R-2800 two-stage type C engine and equipped with a four-blade Curtiss electric propeller. The armament consists of two M-2 caliber .50 machine guns with 267 rounds of ammunition installed in each wing panel. Space and structural provisions will be provided for an additional .50 caliber machine gun in each wing panel. Normal fuel consists of 178 gallons of gas located in two wing tanks. A 190 gallon tank is located in the fuselage and is included in the design gross weight. The 190 gallons of fuel, however, is considered as alternate load. The airplane has a free-blown canopy and the pilot is so located that he has 8° vision over the nose. The contractor guarantees a high speed of 425 miles per hour and climb to 15,000 feet in 4.2 minutes using military power. With War Emergency power it is estimated that a speed of 445 and climb to 20,000 feet in five minutes will be obtained.

PURPOSE: To develop an interceptor fighter with a high rate of climb and high speed capable of operating efficiently at 25,000 feet.

AUTHORITY: Authority for this project is contained in Addendum No. 1 to CTI-1328 dated 7 June 1943.

REMARKS: This airplane is a development of the XP-60E airplane which was procured on contract W535-AC-28113. The Production Division became interested in the development of the XP-60C and E airplanes early in November 1942 and started negotiations for production airplanes at that time. Early in December, a letter of intent was sent to Curtiss-Wright Corporation covering the procurement of 500 P-60A-1CU airplanes. These airplanes were to be equipped with a single rotation Type B engine since dual rotation engines were not available in production quantities. The development of production airplanes progressed normally until the issuance of CTI-1328, Reduction in Number of Fighter Types of Airplanes to be Procured, dated 18 May 1943. This CTI authorized the reduction in the number of P-60 airplanes to be procured from 500 to 20, these 20 to be used as service test quantity. On 7 June 1943, Addendum No. 1 to CTI further reduced the number of airplanes to two. At this time the decision was reached that these two airplanes would be handled by the Engineering Division rather than by the Production Division. Soon after the transfer of these airplanes to the Engineering Division, the decision was reached to install Type C engines in lieu of Type B engines in order to improve the perform-

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ance of these two airplanes and obtain early flight test data on the engines. Flight testing of the airplane has been delayed because of late delivery of the engine by Pratt and Whitney. The engine was delivered on 31 December 1943, and the first flight is now scheduled for 10 February 1944.

XP-62 AIRPLANE

403-79 Expenditure Order No.	Curtiss-Wright, Buffalo Mfg. or Activity charged with Development
MX-88 Classified Project No.	AC-19440 Contract No.

DESCRIPTION: The XP-62 airplane is a single engine, single place, high altitude interceptor fighter of 14,660 pounds gross weight having a design high speed of 448 m.p.h. at 27,000 feet with 2250 b.h.p. The airplane is powered with a Wright Aeronautical Corporation R-3350-17 engine and has a General Electric Type CM Turbine Supercharger and Curtiss dual rotating six-bladed propeller. The airplane also has a pressure cabin designed to maintain a 10,000 feet cabin altitude at 35,000 feet. Provisions are made for eight (8) 20 mm. cannons mounted in the wing panels.

PURPOSE: The purpose of this project is to develop a high altitude heavily armed fighter type airplane with a pressure cabin.

AUTHORITY: Authorization for this project is contained in teletype No. C-581 dated 7 January 1941 from General Echols.

REMARKS: Early in January, 1941, negotiations were started with the Curtiss Wright Corporation, Buffalo, New York, for the procurement of two XP-62 airplanes with eight 20 mm. cannons. The contract was approved on 27 June 1941. The mock-up inspection was held on 15 December 1941. Under the terms of the contract the first airplane was to be delivered in September, 1942 and the second airplane in December, 1942. Due to the change to the Type C.M. turbosupercharger necessitated by the unavailability of the XE Type, the contractor's delivery date was advanced one month for both airplanes. In August of 1942 the General Electric Company announced that the Type C.M. turbo would be delayed until January, 1943; however, they stated that an improved Type XE could be delivered in September. In order to prevent further delay in delivery of the airplane, arrangements were again made to install the improved XE type turbo in the first airplane. Arrangements were also made to install a Birmann turbo instead of the General Electric turbo in the second airplane. The initial flight of this airplane with an intermediate engine installed was made 21 July 1943. Considerable difficulty has been encountered by the contractor in providing adequate engine cooling. This has been partly due to

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faulty carburetion. Testing of this airplane is scheduled to be completed at the contractor's plant during February 1944, after which the airplane will be turned over to Wright Aeronautical Corporation on a bailment contract for high altitude engine development. The second airplane on this contract was cancelled in accordance with the requirements of CTI-1492 because of lack of an engine. Parts which have been completed will be used as spares for maintaining the first airplane.

XP-67 AIRPLANE

431-25 — Expenditure Order No.

McDonnell Aircraft Corporation, St. Louis, Missouri. — Mfg. or Activity Charged with Development

MX-127 — Classified Project No.

W535-AC-21218 — Contract No.

DESCRIPTION: A twin engine, long range interceptor fighter of 21,000 pounds having a guaranteed high speed of 448 m.p.h. at 25,000 feet with a 1600 horsepower military rating. The engines to be supplied are the Continental XI-1430-19 and XI-1430-17 engines rated 1600 h.p. at 25,000 feet when equipped with turbine superchargers. The second airplane will be equipped with dual rotation engine and propellers. The airplane is equipped with a pressurized cabin and has a maximum range of 2,000 miles with all fuel carried in internal self-sealing tanks. The armament consists of six Type M-4, unsynchronized, compensated 37 mm. cannon located in the laminar flow wing sections between the engine nacelles and the fuselage. The use of true laminar flow airfoil sections with cross-sections varying in thickness from the wing tip to the center line obviates the necessity for filleting and produces a center section of generous size which is used to advantage for the concentration of armament along the center line of the airplane, as well as for housing large quantities of fuel.

PURPOSE: To develop a long range fighter of advanced design, providing a means of comparing the installation of a battery of four or more 37 mm. cannons with an installation of one 75 mm. cannon. The airplane also provides an operating bed for the Continental experimental XI-1430 engine.

AUTHORITY: This airplane was procured to comply with the instructions contained in CTI-320 dated 6 August 1941.

REMARKS: The original design, incorporating a submerged Allison 3420 engine driving two pusher propellers through right angle drives, was submitted under Circular Proposal R-40-C, early in 1940. Although the design did not place among the first three competitors,

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Purchase Order No. 40-8292 was let to secure engineering data. Negotiations for two airplanes began in April 1941. The airplane was redesigned along more conventional lines utilizing Continental engines and six 37 mm. cannons. Authority for Purchase No. 182428, based on McDonnell Model Specification No. S-23A, dated 3 May 1941, and McDonnell quote letter of 23 July 1941, was initiated on 2 August 1941, and resulted in Contract W535-AC-21218 which was approved 29 October 1941. It called for two XP-67 airplanes, wind tunnel models and related data. The mock-up was inspected in April, 1942. Firing tests on a mock-up of the 37 mm. cannon installation were conducted at the Materiel Command in May, June and July 1942. Extensive wind tunnel testing was accomplished throughout the summer and fall of 1943 on the one-quarter scale model and the full-scale nacelle both at N.A.C.A. and Wright Field. These tests indicated the need for a change in the leading edge duct openings in order to provide adequate cooling. This change is being accomplished as rapidly as possible. During October 1943 it was found necessary to replace all hinge pins in the wing structure which resulted in approximately one month's delay in date of first flight. Vibration and flutter survey was conducted the latter part of November 1943 and 689 inspection was accomplished 1, 2 and 3 December 1943. Following 689 inspection, high speed taxi tests were successfully conducted and a slight lift-off accomplished. On 8 December 1943 fires occurred simultaneously in both engine nacelles during high power ground run-ups of the engines. Modification of exhaust pipes should prevent recurrence of such fires. Repairs have been accomplished and first flight should occur in the very near future.

XP-72 AIRPLANE

430-106 Expenditure Order No.	Republic Aviation, Corp., Farmingdale, L. I., N. Y. Mfg. or Activity Charged with Development
MX-189 Classified Project No.	W-535-AC-37379 Contract No.

DESCRIPTION: The XP-72 airplane is a single engine, tractor, interceptor fighter of 14,450 pounds having a guaranteed high speed of 478 miles per hour at 30,000 feet with 2600 horsepower military rating. It is powered by a Pratt & Whitney (R-4360-13) X-Wasp engine equipped with a two (2) stage variable speed supercharger to give a military rating of 2600 horsepower to 25,000 feet, and a war emergency power of 3000 horsepower to 25,000 feet. The engine drives a dual rotation six (6) bladed propeller. The airplane is equipped with six (6) .50 caliber machine guns installed outboard of the propeller disc.

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PURPOSE: To develop an interceptor fighter primarily for the interception and destruction of enemy bombers. The airplane provides an operating bed for the X-Wasp engine and provides a means of comparison between the X-Wasp engine and other high powered aircraft engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: Originally, the XP-72 was submitted as a high altitude interceptor fighter of 21,000 pounds powered by a Pratt & Whitney X-Wasp engine equipped with a turbo supercharger and 8-blade dual rotation propeller. The airplane was to be armed with four (4) 37 mm. cannons installed in the wing section outboard of the propeller disc and was to be equipped with a supercharged cabin. Such an installation was to afford an opportunity for comparing effectiveness of a battery of 37 mm. cannons with a 75 mm. installation as requested in CTI-302. In its original state the airplane was to be an entirely new airplane but in the latter part of 1942 interest in the project declined mainly because of the size and weight of the airplane and the priority of other projects. It was considered advisable to install an X-Wasp engine in an experimental version of the P-47D airplane at an approximate weight of 13,500 pounds. Therefore, negotiations were started and in the latter part of January a model specification for such an airplane was submitted by the contractor. Upon receipt of the quotation letter, Authority for Purchase was initiated and subsequently on 18 June 1943 contract for two (2) airplanes was approved. The first airplane is expected to fly with single rotation propeller and single stage supercharger the early part of February, 1944, and the second airplane is expected to fly with dual rotation propeller and two stage supercharger in April, 1944.

XP-75 AIRPLANE

430-120 Expenditure Order No.	Fisher Body Division, General Motors Corporation, Detroit, Michigan. Mfg. or Activity Charged with Development
MX-317 Classified Project No.	W535-AC-33962 Contract No.

DESCRIPTION: There are two versions of the XP-75 airplane. The original version, to which the first two experimental airplanes only will conform, is an interceptor fighter powered by one Allison V-3420-19 two-stage engine mounted behind the pilot and driving a twelve foot seven inch dual rotation Aeroproducts propeller through twin extension shafts and forward nose gear. Design gross weight is

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12,537 pounds with 210 gallons of fuel and guaranteed high speed is 440 m.p.h. at 20,000 feet with 2300 h.p. Armament consists of four synchronized .50 caliber nose guns. The airplane is constructed by fitting P-40 type wing panels, A-24 type empennage, Navy F4U type main landing gear and P-40 type windshield, sliding canopy and instrument panel to a newly designed and constructed fuselage and center section. The second version and the one to which the last six experimental airplanes and all production airplanes will conform is an offensive fighter, long range. This version is identical to the interceptor version except for additional tankage in the center section, six .50 caliber wing guns additional and design refinements such as retractable tail wheel, free-blown canopy and improved ailerons. The gross weight becomes 16,110 pounds with 539 gallons of internal fuel and ten .50 caliber guns. High speed guarantee is reduced to 430 m.p.h. but range with internal fuel is approximately 2500 miles.

PURPOSE: To develop a long range fighter airplane for escorting bombardment aircraft deep into enemy territory and to accomplish this development as rapidly as possible by utilizing components of existing production airplanes.

AUTHORITY: Action for purchase of first two airplanes initiated by direction of Chief, Engineering Division. Action for purchase of six additional airplanes and static test article initiated by direction of Assistant Chief of Air Staff, M. M. & D.

REMARKS: At a conference 10 September 1942, at Wright Field, Fisher Body Division submitted preliminary data covering an interceptor fighter. These data were also submitted to Assistant Chief of Air Staff, M. M. & D. and was discussed at a conference in Washington on 11 September 1942. Following these conferences, a formal proposal for construction of two experimental airplanes was submitted by the contractor in letter dated 7 October 1942, which resulted in Letter Contract dated 10 October 1942. Mock-up inspections were held at the contractor's plant on 1, 2 and 3 March 1943, and 18 May 1943. Wind tunnel tests were conducted in the five-foot wind tunnel at Wright Field during December 1942 and July 1943. Before the contract was signed, a conference was held 6 July 1943 in the Office, Assistant Chief of Air Staff, M. M. & D. which resulted in a directive to procure six additional experimental airplanes with all possible internal gasoline and also a static test article. Contract W535 AC-33962 dated 11 September 1943, covering procurement of all eight airplanes resulted and Contract W535 AC-41011 for a production quantity of these airplanes is being negotiated. Wind tunnel tests on a 6.5:1 model were conducted in the M. I. T. tunnel during September 1943 and spin tunnel tests were conducted at N.A.C.A. during November 1943. Vibration and flutter survey was conducted on the first airplane on 9 and 10 November 1943 and first flight occurred 17 November 1943. The second and third airplanes are very nearly ready for flight and the third and fourth airplanes will be sent to Eglin Field for flight testing during the winter

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months. Development of the engine consists of a three phase program involving model testing at Allison and Wright Field and loan of one XP-75 to Allison for flight calibration, coordination of engine controls and flight development. Improved ailerons for the XP-75 airplane are being installed in a P-40 for flight testing at N.A.C.A. In addition to this development, the contractor is designing and will install on one or more of the last experimental airplanes and all production airplanes, the following items: free-blown canopy, retractable tail wheel, increased vertical tail area. The contractor is investigating the possibility of installing compressibility flaps, metal control surfaces and four 20 mm. cannon in the wings as an alternate for the six .50 caliber wing gun installation.

XP-77 AIRPLANE

430-112 Expenditure Order No.	Bell Aircraft Corporation Buffalo, New York. Mfg. or Activity Charged with Development
MX-272 Classified Project No.	W-535 AC-30864 Contract No.

DESCRIPTION: A single engine, single place, light-weight interceptor fighter constructed principally of wood and having a high speed of 350 m.p.h. at 8500 feet with 520 horsepower. The airplane is powered with a Ranger XV-770-17 engine incorporating a Hamilton-Standard nine foot diameter propeller. This model will be equipped with two (2) caliber .50 synchronized machine guns. A laminar-flow type airfoil and tricycle landing gear will also be incorporated in this design. Design gross weight is 3600 pounds.

PURPOSE: To develop a small, highly maneuverable fighter which can be produced for a fraction of the cost and time of the average fighter type airplane.

AUTHORITY: C.T.I. 715 dated 16 June 1942 authorized the procurement of six airplanes and obtained the release from the Navy Department of six Ranger engines for use in these airplanes.

REMARKS: As stated above, the purpose of this project was primarily to develop a light-weight interceptor airplane constructed principally of wood and so designed as to lend itself to rapid and low cost production. Six airplanes were originally contracted for on Contract W-535 AC-30864 which was approved 10 October 1942. During the course of design and construction, difficulties arose with the sub-contractor for the wing panel which also increased the costs considerably over the original estimates. These difficulties to-

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gether with delays and increase in costs culminated in a conference in June 1943, in which it was decided to find another source for the manufacture of wing panels and to reduce the number of airplanes from six to two. This latter action was confirmed in C.T.I. 1429 dated 26 August 1943.

The basic concept that a wooden fighter airplane incorporating the requisite strength requirements could be constructed efficiently and expeditiously because of being constructed of wood has not been borne out by this project although it is possible after the development of the prototype which has been slow and costly, that production airplanes could be produced rather rapidly and at a somewhat lower cost than the equivalent metal airplane.

At this time, January 1944, normal progress is being made on the project. The contractor has completed his static test article and conducted tests. The first airplane is scheduled to be delivered during the latter part of January 1944, with the static test article for test by the AAF following in February and the second airplane in March 1944.

XA-38 AIRPLANE

427-62 Expenditure Order No.	Beech Aircraft Corporation, Wichita, Kansas Mfg. or Activity Charged with Development
MX-297 Classified Project No.	W-535 AC-33348 Contract No.

DESCRIPTION: An attack airplane of 29,900 pounds design gross weight with 620 gallons of fuel, powered by two Wright R-3350-43 engines and having a high speed of 370 m.p.h. at 17,000 and 1900 h.p. per engine. The airplane has a conventional twin-engine arrangement with tail wheel and is armed with one fixed forward firing automatic 75 mm. nose cannon, two fixed forward firing .50 caliber nose machine guns and two remotely controlled turrets, one upper and one lower, each containing two .50 caliber machine guns. Bombs are all carried externally. The crew consists of the pilot who controls the nose armament and the gunner who controls the turrets.

PURPOSE: To develop a high performance ground attack airplane incorporating the automatic firing 75 mm. cannon.

AUTHORITY: C.T.I. 861 dated 19 August 1942.

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REMARKS: This airplane was originally conceived as a destroyer type fighter airplane with full compensating and range finding equipment for the 75 mm. cannon. Preliminary data was initially presented in March 1942. In August 1942 the contractor was informed that the airplane should be changed to meet the then current requirements for a destroyer type airplane. Contractor submitted formal quote for two airplanes, static test article and engine and nose armament and test rigs, in letter dated 9 September 1942. This resulted in letter contract dated 23 September 1942 and contract W-535 AC-33348 dated 2 December 1942. Mock-up inspections were held in October 1942 and April 1943. Firing tests of the simulated nose section were conducted in July 1943. Delay in delivery of engines has resulted in delay of first flight until March or April of 1944. However, one engine has been delivered and installed in the ground test rig and the second engine is scheduled to be delivered in January.

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BOMBARD-MENT

SECTION 2

BOMBARDMENT AIRCRAFT PROJECTS

LIGHT BOMBARDMENT PROJECTS

HEAVY BOMBARDMENT PROJECTS

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XA-26 AIRPLANE

427-18
Expenditure Order No.

Douglas Aircraft Co., Inc.
El Segundo, California
Mfg. or Activity Charged with development

MX-73A
Classified Project No.

W535-AC-17946
Contract Number

DESCRIPTION: A two engine light bombardment airplane of 26,700 pounds design gross weight, having a high speed of 372 m.p.h. at 17,000 feet at 1,6000 HP per engine. The airplane is powered by two Pratt & Whitney R-2800-27 engines and equipped with two forward fixed .50 caliber guns and two remotely controlled turrets. These turrets will each have two .50 caliber guns. One turret is mounted in the upper deck and one in the lower deck of the fuselage aft of the bomb bay.

PURPOSE: To develop a light bombardment airplane for advanced design and improved performance with remote control turrets.

AUTHORITY: The Under Secretary of War, 2 June 1941.

REMARKS: In November, 1940, negotiations were started with Douglas Aircraft Company, Inc., El Segundo, California, for the procurement of this airplane. Quotation covering the cost of one light bombardment airplane was received from the Douglas Company on 23 January 1941. The final mockup was completed 29 May 1941.

The first flight was made 11 July 1942, and the 689 Inspection conducted in August, 1942. The airplane has been undergoing extensive flight tests at the contractor's plant and is scheduled for delivery to Wright Field 1 February 1944.

XA-26A AIRPLANE

427-18
Expenditure Order No.

Douglas Aircraft Co., Inc.
El Segundo, California
Mfg. or Activity Charged

MX-73
Classified Project No.

W535-AC-17946
Contract Number

DESCRIPTION: A two engine night fighter airplane of 25,800 pounds design gross weight, having a high speed of 365 m.p.h. at 17,000 feet at

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1,600 HP per engine. The airplane is powered by two Pratt and Whitney R-2800-27 engines and equipped with four forward firing fixed 20 mm cannons mounted in the lower deck of the fuselage and four .50 caliber guns in a remotely controlled turret mounted in the upper deck of the fuselage. This airplane has the AGL-1 equipment installed.

PURPOSE: To develop a night fighter airplane of advanced design with a four gun turret, four 20 mm cannons installed and AGL equipment.

AUTHORITY: The Under Secretary of War, 2 June 1941.

REMARKS: In November, 1940, negotiations were entered into with the Douglas Aircraft Company, Inc., El Segundo, California, for the procurement of this Airplane. Quotations covering the cost of one night fighter airplane were received from the Douglas Company 28 January 1941. The mock-up was completed 8 December 1941. The first flight was made 27 January 1943. This airplane has General Electric AGL equipment installed and is to be used as a flying laboratory for AGL tests at Wright Field.

XA-32 & XA-32A AIRPLANES

427-39 Expenditure Order No.	Brewster Aero. Corporation Long Island City, N.Y. Mfg. or Activity Charged with Development
MX-136 Classified Project No.	W535-AC-21434 Contract Number

DESCRIPTION: The XA-32 and XA-32A airplanes are conventional, single place, mid-wing, tractor monoplanes of semi-monocoque construction powered with one R-2800-37 engine each. These engines are single stage, two speed gear driven types and develop 2,100 HP for take-off. The guaranteed maximum speed is 325 m.p.h. at 16,000 feet at 1,600 HP at the design gross weight of 15,512 pounds. The guaranteed range at this weight is 800 miles at 200 m.p.h. The two airplanes differ only in their gun arrangements. Installed in the wings of the XA-32 are six .50 caliber machine guns and four 20 mm cannon. The XA-32A has four 37 mm anti-tank cannons installed in the wings. Each airplane has two 500 pound bomb stations in the fuselage and two 500 pound stations externally on the wings. These stations may be utilized also for carrying depth charges, chemical tanks and bomb of lesser weight. In addition, a fuselage bomb [illegible]

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station may be used to carry either a 1,000 pound bomb, 1,600 pound bomb, 2000pound bomb or a 2,000 pound torpedo when the two 500 pound bomb stations are not being used. Approximately 920 pounds of armor plate are installed to protect the pilot and equipment. These airplanes incorporate dive brakes to limit the terminal velocity to approximately 300 m.p.h.

PURPOSE: To develop a close support army cooperation airplane capable of supplying offensive support of ground units.

AUTHORITY: CTI-266, dated 9 June 1941.

REMARKS: The mock-up inspection was held on 11 May 1942. The first flight was made on 22 April 1943 at the contractor's plant. The 689 inspection has been completed and the airplanes should be delivered by March 1944.

XA-41 AIRPLANE

427-68 Expenditure Order No.	Consolidated Vultee Vultee Field, Calif. Mfg. or Activity Charged with Development
MX-312 Classified Project No.	W535-AC-34942 Contract Number

DESCRIPTION: The XA-41 airplane is a conventional, single place, mid-wing, tractor monoplane of semi-monocoque construction powered with one R-4360-9 engine. This engine is a multi-row, radial air-cooled type with a single stage variable speed supercharger and single rotation single speed propeller reduction gears. The engine develops 3000 HP for take-off. Normal armament consists of two (2) 37 mm M-9 cannon and four (4) .50 caliber machine guns installed in the wings outboard of the propeller disk. Rapid field installation of two additional 37 mm cannon or two additional .50 caliber machine guns may be made. Provisions are made for carrying up to 6400 pounds of bombs. Approximately 780 pounds of armor plate protection are provided for the pilot and engine. The guaranteed high speed is 353 mph at 15,500 feet at the normal design gross weight of 18,800 pounds. Range at 12,000 feet with manual lean power (1475 BHP), normal fuel (350 gallons) at 270 mph is 800 miles.

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PURPOSE: To develop a support airplane that fulfils the military characteristics for the support type airplane established on 10 May 1943 by the Director of Military Requirements.

AUTHORITY: CTI-935 dated 1 October 1942 as amended by Addendum No. 2 dated 22 November 1943.

REMARKS: A letter of intent was issued to the Consolidated Vultee Aircraft Corporation on 10 November 1942 and a contract was signed on 30 April 1943, providing for the procurement of two airplanes and a static test article. By reason of a change in requirements affecting airplanes of this class, the project was cancelled in its entirety by CTI-935 Addendum No. 1 dated 13 November 1943. However, when it was pointed out that the first airplane was about 75% complete it was decided to carry this airplane to completion. The contract provides that the first airplane shall be complete and ready for flight testing on 24 February 1944. Recent progress reports indicate that this date will probably be met.

XB-19A AIRPLANE

426-39 Expenditure Order No.	General Motors Corp. Detroit (Fisher Body) Mfg. or Activity Charged with Development
MX-309 Classified Project No.	W535-AC-33362 Contract Number

DESCRIPTION: A four engine, heavy bombardment airplane of 140,230 pounds design gross weight. This airplane will be the result of installing turbo-supercharged Allison V-3420 engines in the XB-19 in lieu of the Wright R-3350-5 engines previously used. The complete power plant and nacelle forward of the firewall are substantially identical to those in the XB-39 airplane, except that cabin supercharging equipment is eliminated in the XB-19A airplane. The turbo supercharger installation is designed for military power of 2,600 h.p. at 40,000 feet.

PURPOSE: To improve the performance of the XB-19 airplane and to serve as a test installation of the XB-39 power plant.

AUTHORITY: Teletype EX-909 dated 16 September 1942, from Assistant Chief of Staff, Engineering, of the Materiel Command.

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REMARKS: Negotiations for the installation of the Allison V-3420 engines in the XB-19 were started with the General Motors Corporation in May, 1942. Authority for the project was received in September, and the contract was approved 31 December 1942. On 11 November 1942, the XB-19 was delivered to Wayne County Airport, Romulus, Michigan, where the conversion work is being accomplished. Shelters, to be used as workshops, were built over the wings of the airplane. The rear portions of the nacelles were modified so that the XB-39 engine installation could be fitted directly to the airplane. Due to the failure of the turbo supercharger cooling caps with resulting loss of time due to redesign and fabrication, the completion of this project has been repeatedly delayed. As of 1 January 1944, estimated first flight date is 15 January 1944.

XB-29 AIRPLANE

425-29
Expenditure Order No.

Boeing Aircraft Company
Seattle, Washington
Mfg. or Activity Charged with Development

MX-17
Classified Project No.

W535-AC-15429 and
W535-AC-15075
Contract Numbers

DESCRIPTION: The XB-29 is a mid wing, heavy bombardment tractor airplane of all metal semi-monocoque construction, powered by four R-3350-13 engines, each developing 2,2000 h.p. for take-off at 2,800 r.p.m. The guaranteed maximum speed is 378 m.p.h. at 25,000 feet, the present estimated gross weight is 105.000 pounds and the range at this weight is 4,798 miles with 2,000 pounds of bombs. However, due to the necessity for reducing propeller diameter to 16'-6", installing non-retractable in lieu of retractable turrets, and increase of 252 pounds for engines, 538 pounds for turrets, and other miscellaneous changes, the guaranteed speed will be reduced to 368 m.p.h. and its range to approximately 4,476 miles. Cabin supercharging is accomplished by an engine driven supercharger mounted on each inboard engine while engine supercharging is by means of a dual installation of Type B-11 turbo superchargers for each engine. The defensive armament consists of a total of ten .50 caliber machine guns and one 20 mm cannon mounted as follows: two .50 caliber machine guns and one 20 mm cannon mounted in the tail-turret and two .50 caliber in each of four (2 upper and 2 lower) fuselage non-retractable turrets all remotely controlled from three sighting stations, located one in forward

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pressurized compartment for the top and bottom forward turrets and two in the rear pressurized compartment for the three rear turrets. Normal ammunition is 500 caliber .50 and 60-20 mm for each gun. Normal bomb load of 2,000 pounds, or maximum alternate bomb load of 16,000 pounds is made up of 300, 500, and 1,600 pound and 1,000 2,000 and 4,000 pound bombs.

PURPOSE: To develop a high altitude, pressure cabin, heavy bombardment airplane incorporating the latest defensive armament and having ready interchangeability of bomb and fuel loads.

AUTHORITY: Bids submitted in response to Request for Data R-40B dated 29 January 1940 were reviewed (6 May to 19 May 1940) by evaluation board which recommended procurement of engineering data from Boeing and Lockheed which was approved by Chief of Air Corps on 4 June 1940 on recommendations of General Brett, Chief of Materiel Division.

REMARKS: In reply to request for engineering data R-40B, Boeing Aircraft Company submitted design proposals. On 27 June 1940, the Acting Secretary of War approved Contract W535-AC-15075 to cover preliminary engineering data for the XB-29 airplane. This design was to fulfill the requirements of Air Corps Type Specification XC-218A dated 8 April 1940. The Assistant Secretary of War approved Contract W535 AC-15429 and 6 September 1940 which covered procurement of two XB-29 airplane and engineering data, and on 6 November 1940, Change Order Serial No. 3499 was initiated to procure a third XB-29 airplane. The mock-up inspection was held at the contractor's plant on 7 April 1941. Contract delivery dates for the three XB-29 airplanes as required by the contract and change order #1 (6 March 42, 6 May 42 and 6 July 42) were changed by Change Order 5, 15, and 17 to permit delivery of airplanes in the stripped condition (see Report D-3547 for 1st and 2nd and D-4553 for 3rd). The 1st and 2nd airplanes (AF-41-2 and AF-41-3) were instrumented for the flight test program (estimated at 200 hours) and the 3rd airplane (AF-41-18335) was completed in accordance with specification requirements. The 1st article made 22 flights from 21 September 1942 to 28 December 1942 and changes made to include combat engines and miscellaneous changes to conform more closely to production articles and to eliminate possible fire hazards. The 2nd article made 8 flights from 30 December 1942 to 18 February 1943. It caught fire and crashed on the 8th flight after 19 minutes in the air. The 3rd article made 8 flights from 6 June 1943 to 23 June 1943 and was then ferried to Wichita, Kansas for participation in armament tests which are still in progress. No. 1 XB(AF41-2) was also sent to the 58th Bombardment Group, Wichita, Kansas for accelerated flight testing and was returned to Boeing Aircraft Company, Seattle, Washington in November 1943 to continue flight testing required under contract

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W535-AC-15429. From 4 December to 28 December - 13 flights were completed. Completion of the 1st and 3rd articles was accomplished under production contract W535-AC-19673.

XB-32 AIRPLANE

425-30 Expenditure Order No.	Consolidated Vultee San Diego, California Mfg. or Activity Charged
MX-21 Classified Project	W535-AC-15540 Contract No.

DESCRIPTION: The XB-32 is a high wing, twin tail, heavy bombardment tractor airplane of all metal semi-monocoque construction and powered by four R-3350-13 engines each developing 2,200 HP for take-off at 2,800 r.p.m. The guaranteed maximum speed is 376 m.p.h. at 25,000 feet. The current gross weight is 102,423 pounds and the estimated range at this weight is 4,459 miles with a bomb load of 2,000 lbs. Cabin supercharging is accomplished by an engine driven supercharger mounted on each inboard engine while engine supercharging is by means of a dual installation of type B-11 turbo superchargers for each engine. The defensive armament consists of a total of fourteen .50 caliber machine guns and two 20 mm cannon mounted as follows: two .50 caliber machine guns and one 20 mm cannon mounted in the rear of each outboard engine nacelle; one .50 caliber machine gun mounted in the leading edge of the wing outboard of each outer propeller disc; 4 ea. .50 caliber machine guns mounted in the retractable turrets located on the upper & lower CL of the fuselage. All guns are controlled remotely from three computer stations.

PURPOSE: To develop a high altitude, pressure cabin, heavy bombardment airplane incorporating the latest defensive armament and having ready interchangeability of bomb and fuel load.

AUTHORITY: The Chief of the Air Corps in letter to Assistant Secretary of War, dated 10 November 1939, requested authority for issuance of request for manufacturing data to possible contractors. First indorsement thereto, by the Assistant Secretary of War, addressed to Chief of the Air Corps, dated 2 December 1939, approved the issuance of request for data R-40B, and second indorsement thereto by the War Department, Air Corps, Materiel Division, Washington, D.C. to the Assistant Chief of the Materiel Division, Wright Field, dated 7 December 1939, transmitted the above for necessary action. Letter from General Arnold to the Adjutant General, dated 16 July

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1940, submitted Research and Development FY-1941 Expenditure Program which included two each R-40B airplanes from three sources, one of which was Consolidated. Approval of this program was first indorsement by the Adjutant General, dated 31 July 1940. Authority for procurement of the third XB-32 airplane was contained in CTI-107, dated 10 October 1940.

REMARKS: In reply to request for engineering data, R-40B, Consolidated Aircraft Corporation submitted design proposals. On 27 June 1940, the Acting Secretary of War approved Contract W535 AC-15043 which covered design data for the XB-32 airplane. This design was to fulfill the requirements of Air Corps Type Specification XC-218A, dated 8 April 1940. The Assistant Secretary of War approved Contract W535 AC-15549 on 6 September 1940 which covered procurement of two XB-32 airplanes, mockup, wind tunnel models, and engineering data, and on 6 November 1940, Change Order, Serial No. 3493 was initiated to procure a third XB-32 Airplane. The mockup inspection was held at the contractor's plant on 6 January 1941. However, the complete power plant mockup inspection was not made until 7 April 1941.

The first airplane made its initial flight in stripped condition 7 September 1942. Thirty flights were completed by the first airplane making a total of 41 hours, and 32 minutes flying time. On 10 May 1943 this airplane crashed on take-off and was completely wrecked. The cause is attributed to attempted take-off with the flaps unintentionally in the retracted position. The second airplane made its initial flight 2 July 1943. The third airplane made its initial flight 17 September 1943. Engineering Inspection was conducted on second airplane at Fort Worth, Texas, 9 November 1943. Official performance checks are to be run in January 1944 after which the Government expects to accept the second airplane. The single vertical tail and production power plant nacelles will be installed on the third airplane and tested for the B-32 airplanes.

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XB-35 AIRPLANE

425-56
Expenditure Order No.

Northrop Aircraft, Inc.
Hawthorne, California
Mfg. or Activity Charged with Development

MX-140
Classified Project No.

W535-AC-21341 & AC-21920
Contract Number

DESCRIPTION: The XB-35 is a flying wing (tailless) design of long range, heavy bombardment type airplane powered by four XR-4360 submerged engines driving dual rotation pusher propellers through long drive shafts. Each engine develops 3,000 HP for take-off at 2,700 r.p.m. Guaranteed speed at 35,000 feet and military power is 386 m.p.h. Range with 10,000 pounds of bombs is 5,200 miles and service ceiling is 40,000 feet at .3 range. The present design gross weight is 155,000 pounds with a useful load of 74,023 pounds. Trend of design at present indicates that the design gross weight will be increased. Weight Report of 15 December 1943 gives design gross weight of 161,640 pounds and a useful load of 71,230 pounds. The maximum bomb load of 32,000 pounds in combinations of 4,000, 2,000, 1,000 and 500 pound bombs consist of 24,000 pounds carried internally and 8,000 pounds externally. The maximum bomb load may also be 51,200 pounds if made up entirely of (32) 1,600 pound armor piercing bombs. The armament consists of 20 caliber .50 machine guns mounted in remotely controlled turrets as follows: four in a flexible tail turret, two upper and two lower 2 gun .50 caliber wing turrets and one upper and one lower four gun .50 caliber cabin turrets. Normal ammunition includes 1,000 rounds for all guns except cabin turrets which will have about 650 rounds each with provisions for reloading in flight. Turrets are remotely controlled from the cabin, in which a pressure at the 8,000 foot level is maintained up to 35,000 foot altitude by cabin superchargers mounted on the inboard engines. Engine turbo superchargers are installed in a plenum chamber. Consideration is being given to the possibility of supercharging the cabin with air from the engine turbo superchargers in order to save weight.

PURPOSE: To develop a high altitude, long range, heavy bombardment airplane of improved design with adequate defensive armament and interchangeability of bomb and fuel load.

AUTHORITY: Purchase of first airplane was authorized in conference between General Arnold, General Echols and General Carroll in the office of the Chief, Materiel Division on 9 September 1941 as reported in Memorandum Report EXP-M-50-590, dated 12 September 1941.

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REMARKS: As the results of miscellaneous discussion on the possibilities of the Northrop flying wing, Northrop was requested on 27 May 1941 to submit a study based on certain general requirements and utilizing any added performance to increase the range to the maximum possible value. As a result, Mr. Northrop visited Wright Field on 2 July 1941 with a preliminary design for conference with Materiel Command personnel. Agreement was reached on contractural requirements for design investigation including wind tunnel and flying models, mockup, etc.

Action was initiated on 13 July 1941, which resulted in approval on 3 October 1941 by Secretary of War of Purchase Order 42-2552, covering:

Phase I — Engineering data for evaluation of design and release for development.

Phase II — Tests of models and reports of contractor's flying mockup.

Phase III — Construction and test of a .3 or .4 scale flying mockup. Delivery to be completed in 360 days.

Concurrently with above, negotiations for one airplane were initiated on 6 August 1941, and contract W535-AC-21920 was approved by Secretary of War on 22 November 1941. This contract was later amended by Change Order, Serial No. 3727 for one additional airplane and approved 2 January 1942 by direction of Secretary of War. The second airplane was contracted for to avoid the possibility of losing the experiment in case of an accident to the first airplane. Work progressed satisfactorily, and the mockup was inspected 6 July to 17 July 1942.

The estimated flight date of the first airplane is 15 April 1945.

Change Order No. 3, dated 19 September 1942, was issued for two additional N-9-M flying models to avoid delays due to accident to No. 1 and to give the Materiel Command a model for study. The first N-9-M was ground tested 20 December 1942; first flight of 55 minutes on 27 December 1942, and crashed on its 45th flight after 22 hours and 32 minutes of flight testing.

A change Order is being negotiated on Contract W535 AC-21920 for an N-9M-B model which will accurately represent the XB-35 including all changes authorized to date. N-9M-B will use Franklin O-540-5 eight cylinder engines. The second N-9-M made its first flight on 24 June 1943. The second and third N-9-M's have been made available to the contractor for continuation of the flight test program. The third model N-9-M will be ready for first flight on 1 March 1944 and the fourth model N-9-MB on 15 April 1944.

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XB-36 AIRPLANE

425-58
Expenditure Order No.

Consolidated Vultee
Fort Worth, Texas
Mfg. or Activity Charged with Development

MX-149
Classified Project No.

W535 AC-22352
Contract Number

DESCRIPTION: The XB-36 airplane is a high wing, single tail, long range bombardment airplane powered by six R-4360-5 engines in a pusher arrangement. Each engine develops 3,000 HP for take-off at 2,700 r.p.m. The maximum speed is 367 m.p.h. at 30,000 feet, the present estimated gross weight is 271,076 pounds, and the range at this gross weight is 10,000 miles with 10,000 pounds of bombs or approximately 4,790 miles with 72,000 pounds of bombs. Cabin supercharging is accomplished by one engine driven supercharger mounted on each inboard engine and engine supercharging is by dual B-M turbo superchargers. The armament consists of forward upper and lower fuselage turrets, locally operated and pressurized. Each of these turrets contains two 37 mm. cannon with 100 rounds of ammunition per gun. Two aft fuselage turrets remotely controlled, one upper and one lower, each containing four .50 caliber guns with 1,000 rounds of ammunition. A tail turret with one 37 mm. cannon with 300 rounds of ammunition and two .50 caliber guns having 1,000 rounds per gun. The tail turret is also remotely controlled.

PURPOSE: To develop a high altitude, long range, heavy bombardment, pressure cabin airplane capable of adequately defending itself and carrying a bomb load of 10,000 pounds for a range of 10,000 miles.

AUTHORITY: The Assistant Chief, Materiel Division, Wright Field was notified by radio C-120, dated 16 October 1941, from Chief of Materiel Division, Washington, D.C. that General Arnold had given approval to proceed with procurement of two Consolidated long range bombers.

REMARKS: On 11 August 1941, negotiations were begun with the Consolidated Aircraft Corporation, San Diego, California, for preliminary design studies of a long range bombardment airplane. As a result of the design proposed Purchase Order No. 42-2371 was approved by the Under Secretary of War, 3 October 1941 to cover preliminary design studies. On 16 October 1942, General Echols authorized the Experimental Engineering Section to proceed with negotiations for procurement of two airplanes and on 15 November 1941, the Under Secretary of War approved Contract W535 AC-22352 which covered two airplanes now designated as XB-36, mockup, wind tunnel models, and engineering data. The initial contract delivery dates for the two airplanes are as follows: First airplane 15 May 1944, second airplane 15 November 1944. However, due to the accumulation of a

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number of retarding conditions and factors, the above dates will not be met. The principal causes for this delay are (1) revision of armament and resulting delay in mockup construction and inspection. (2) Change of airfoil section and consequent wing redesign, change from single to dual turbo superchargers. (3) Also change from twin vertical tail to single vertical tail. (4) The importance of weight and balance control which has resulted in the necessary expenditure of additional engineering effort. (5) Delay in receipt of engine for full scale nacelle test. (6) Delay in wind tunnel test due to higher priorities which were necessarily given to other projects on production prototypes. (7) Difficulty experienced by the contractor with regard to vendors development work. This was caused because only two airplanes were involved in the subject contract. However, this condition has been relieved somewhat since the letter of intent has been issued for production of B-36 airplanes. (8) Difficulties encountered in obtaining experienced manpower. As a result of the above, Change Order No. 7 dated 25 October 1943 was initiated to put into effect the revised model specification ZD-35-001-A dated 1 June 1943 and to authorize a delay of 120 days in delivery of the two airplanes. The contractor now estimates initial flight for 1 September 1944. The mockup inspection was held at the contractor's San Diego plant 20 July 1942. The XB-36 project was moved to the contractor's Fort Worth plant in September 1942.

Engineering on items necessary for stripped flight conditions as of 15 December 1943 have been completed as follows: Wing 88%, Fuselage 77%, Landing gear 88%, Power Plant 81%, Control Surfaces 29%, Controls Plane 78%, Radio 73%, Electrical 51%, Hydraulics 57%, Armament 80% and Furnishings 91%. A considerable number of wing bulkheads are being completed and work is progressing on the wing assembly fixture and on the bomb bay truss tables. The nose fuselage fixture has a considerable number of bulkheads and belt frames installed and the nose wheel well structure assembled. The fixture for the tail fuselage section is now being completed. The number of men now assigned to this project is 531 in engineering and 543 in the shops.

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XB-39 AIRPLANE

425-78
Expenditure Order No.

Fisher Airc. Div., G.M.
Cleveland, Ohio
Mfg. or Activity Charged with Development

MX-230
Classified Project No.

W535 AC-27331
Contract Number

DESCRIPTION: A four engine, heavy bombardment airplane of 110,397 pounds design gross weight, having a high speed of 400 m.p.h. at 2,600 HP per engine, at 25,000 feet altitude. This airplane is similar to the B-29 except that turbo-supercharged Allison V-3420-11 engines are installed in lieu of turbo-supercharged Wright R-3350-13 engines. This installation requires the design and construction of complete new engine nacelles. All items of radio, equipment, and armament will be the same as in the B-29 airplanes.

PURPOSE: To improve the performance of the B-29 airplane, and to provide an alternate source of power plant supply.

AUTHORITY: Teletype C-229, dated 16 March 1942, from Brigadier General O.P. Echols, Chief, Materiel Division.

REMARKS: Negotiations for the development of an Allison V-3420 engine installation for the B-29 airplane were started with the General Motors Corporation in March, 1942. Contract W535 AC-27331 with the General Motors Corporation covers construction of the following: A full scale inboard engine nacelle mockup; a full scale engine air induction system, including intercoolers, superchargers, etc. for test by the N.A.C.A. at Langley Field; a full scale powered inboard test nacelle for ground test by Allison and wind tunnel test at N.A.C.A. at Langley Field; four engine nacelles for installation in a B-29 airplane delivered to the contractor by the Government. The turbo supercharger installation is to be designed for full power operation (2,600 HP per engine) at 40,000 feet altitude, but guarantees of performance are based on 25,000 feet. Analysis of tests on the full scale induction system at N.A.C.A. indicates that the design is generally satisfactory. Ground tests of the full scale powered nacelle at Allison have been successfully completed, and tests at N.A.C.A. are scheduled to be completed 31 March 1944. The first YB-29 AAF No. 41-36954, was allocated for this project and was delivered to the contractor as G.F.E. on 11 November 1943. All fire control installations were removed and returned to Smoky Hill Army Air Base for use in the B-29 program.

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XB-42 AIRPLANE

427-75 Expenditure Order No.	Douglas Aircraft Co., Inc. Santa Monica, California Mfg. or Activity Charged with Development
MX-392 Classified Project No.	W535 AC-40188 Contract Number

DESCRIPTION: A two engine bombardment type airplane of 25,000 pounds design gross weight, having a high speed of 440 mph at 26,000 feet at 1200 HP per engine. The airplane is powered by two Allison V-1710-103 engines and is equipped with two forward-firing fixed .50 caliber guns, and two .50 caliber gun emplacements in each wing.

PURPOSE: To develop a bombardment airplane of advanced design and improved performance.

AUTHORITY: Commanding General, Materiel Command, May, 1943 (verbal).

REMARKS: In April, 1943, negotiations were started with Douglas Aircraft Company, Inc., Santa Monica, California for the procurement of two flight models and one static test article. Quotation was received 18 May 1943, and a letter contract was issued to Douglas on 19 May 1943. The mockup was inspected 13 September 1943. The first airplane is to be ready for preliminary flight 4 March 1944, and the second airplane July 1944. The static test article has been cancelled.

Since the airplane is somewhat unconventional in that the engines are installed in the fuselage and drive a dual rotation propeller through a gear box located in the aft end of the fuselage, the first article will be flown in a stripped condition to evaluate its flying characteristics.

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SECTION 3

MISCELLANEOUS AIRCRAFT PROJECTS

MISCELL-ANEOUS

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YC-62 AIRPLANE

416-204 Expenditure Order No.	Waco Aircraft Corporation Troy, Ohio Mfg. or Activity charged with Development
None Classified Project No.	AC-22368 Contract No.

DESCRIPTION: This airplane is a low performance cargo transport airplane constructed of plywood. It is powered by two R-1830-92 engines and has been designed for a gross weight of 27,000 pounds and an alternate gross weight of 33,500 pounds. The guaranteed high speed is 150 m.p.h. at sea level, and the range with full built-in fuel tanks is 600 miles. Take-off and landing distances over 50 ft. distances are 1950' and 1300' respectively. The cargo compartment has a rectangular cross-section approximately 7-1/2' by 6-1/2' and is 25 ft. long, loaded by ramps in rear. Cockpit is arranged to accommodate pilot, co-pilot, and radio operator - navigator.

PURPOSE: To develop a cargo airplane constructed of non-strategic materials for operation out of unprepared airports.

AUTHORITY: (a) CTI-342, dated 4 October 1941, to procure 13 airplanes.
(b) Letter of intent, dated 24 January 1942 for 240 additional airplanes, approved 31 January 1942.
(c) TI-1537, dated 20 July 1943, reducing contract to 13 airplanes.
(d) TWX from AC/AS, MM&D, dated 21 December 1943, reducing contract to one airplane.

REMARKS: (a) With reference to Authority (a), this project was initiated to provide a suitable cargo transport for the South American trade, and the service test quantity was considered a minimum requirement.
(b) Due to the demand of the ATC and TCC for immediate production of this airplane to augment the number of C-47 airplanes being delivered, the quantity of airplanes being procured was increased to 253.
(c) The excessive delay in delivery of the first C-62 outlived the ATC and TCC demand for this airplane. Furthermore, the shortage of aluminum evident in 1942 had been eliminated by the date of Authority (c).
(d) In view of the close similarity between the C-62 and C-76 airplanes (of which 20 to 25 are being procured), it was apparent that service tests on the C-76 airplane would in a large measure be applicable to the C-62. Consequently, very little additional useful information, other than flying and structural characteristics, can be obtained. In view of the immoderately high costs, it then appeared that any technical knowledge gained by building more than one flying article would be expensive inordinately beyond any reasonable justification. Hence, Authority (d)

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XC-82 AIRPLANE

416-205	Fairchild Aircraft Division, Hagerstown, Maryland
Expenditure Order No	Mfg. or Activity charged with development
None	W 535 AC 30435
Classified Project No	Contract Number

DESCRIPTION: A twin engine, twin boom, medium range, cargo transport airplane having a normal gross weight of 42,000 pounds or an alternate gross weight of 50,000 pounds. Powered by two Pratt & Whitney R 2800-51 engines, rated at 1,450 horsepower normal at 13,000 feet and 2,000 horsepower take off. This airplane has a guaranteed high speed of 213 m.p.h and cruises at 167 m.p.h for a range of 3,000 miles with 2185 gallons of fuel. The cargo cabin, loaded by means of a short ramp in the rear, is approximately 8' x 8' x 40' and will accommodate 42 fully equipped paratroopers, or 75 casualties when used as an ambulance. All metal structure, tricycle landing gear, and a heated-wing type anti icing system is employed. The airplane is suitable as a glider tug.

PURPOSE: To develop a cargo transport airplane of advanced design and improved performance.

AUTHORITY: C.T.I. 673, dated 27 May 1942.

REMARKS: In January, 1942, negotiations were started with Fairchild Aircraft Division, Hagerstown, Maryland, for procurement of two experimental airplanes and one static test article. The contract was prepared in June, 1942, calling for these airplanes in conformance with Fairchild Specification 78001, dated 15 June 1942. A Mock-Up Inspection was conducted by Materiel Command personnel on 15 September 1942, and a Change Order was prepared embracing all the modifications to date including the change from wood construction to all-metal, and substituting revised Specification No. 78001 A, dated 12 January 1943, into the Contract. Subsequently, Model Specification 78001-B, dated 20 November 1943 was substituted into Contract by Change Order.

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XC-97 AIRPLANE

416 222
Expenditure Order No.

Boeing Aircraft Company
Seattle, Washington
Mfg. or Activity charged with Development

None
Classified Project No.

W 535 AC-34438
Contract Number

DESCRIPTION: This airplane is a cargo version of the B-29 having a redesigned pressurized fuselage. Provisions are to be made for transporting a total of 142 fully equipped paratroopers of 85 casualties. A guaranteed high speed of 332 m.p.h. at 25,000 feet should be met with 49,400 pounds design useful load and 120,000 pounds gross weight with 2,000 horsepower per engine. Range at optimum cruising speed at 25,000 feet will be 2,700 miles carrying 20,000 military load at an average speed of 253 m.p.h. With R-3350 engines the take-off distance at sea level is 6130 feet. The airplane is loaded through a rear loading door. Maximum range at 15,000' at 217 m.p.h. with full fuel and 11,000 load is 4045 miles.

PURPOSE: To develop a high altitude troop transport and cargo airplane utilizing the maximum number of components and assemblies of the B-29 airplane.

AUTHORITY: On 15 July 1942, General Echols stated that he desired to get a proposal worked up by Boeing to convert the B-29 into a cargo transport airplane.

REMARKS: The proposal and quotation were submitted and considered acceptable, hence an Authority for Purchase was prepared to procure three (3) airplanes and one static test fuselage from Boeing, Seattle. Another Authority for Purchase followed to cover a Change Order on Contract W 535 AC-19673 for the procurement of three sets of wing group components, three landing gears, three tail assemblies, three sets of wing and engine nacelles, and one extra vertical fin from Boeing, Wichita. An Authority for Purchase to cover a Change Order on Contract W 535 AC-28748 was initiated to procure three complete sets of engine assemblies and propellers from the Fisher Body Division of General Motors. Airplane Contract was approved 23 January 1943 calling for Delivery 23 March 1944. Mock-up was inspected on 15 March 1943. Negotiations under way for use of a heated wing with the R-3350 and R-4360 engines.

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XC-99 AIRPLANE

416-225 Expenditure Order No.	Consolidated-Vultee Aircraft Corp., Ft. Worth, Texas Mfg. or Activity charged with Development
MX-304 Classified Project No.	W 535 AC-34454 Contract Number

DESCRIPTION: This airplane is a cargo transport version of the XB-36 having a guaranteed high speed of 335 m.p.h. at 30,000 feet with military rated power of 3,000 horsepower per engine and 265,000 pounds take-off gross weight. Optimum range at 10,000' with 10,000# load is 8100 miles at average speed of 180 m.p.h. Range 1700 miles with 100,000# load at 10,000' and 200 m.p.h. Maximum range (full fuel tanks) and 1500# load at 10,000' and 173 m.p.h. is 9250 miles. A cargo loading door for loading troops and/or equipment is to be provided at the forward and aft sections of the fuselage. The cabin, divided into two floors, will be provided with two ramps leading from the ground to the lower level, and one ramp in the forward part of lower fuselage to the upper floor. The aft part of upper fuselage is loaded by hoisting this hatch.

PURPOSE: To develop a troop and cargo airplane utilizing the maximum number of components and assemblies of the B-36 airplane.

AUTHORITY: General Echols forwarded copies of correspondence between himself and Consolidated-Vultee with a request that the Engineering Division initiate action toward the procurement of one cargo version of the XB-36.

REMARKS: A proposal was obtained and an Authority for Purchase was initiated to cover one (1) XC-99 airplane, complete with Engineering data. The contract was approved 31 December 1942 and called for delivery 31 September 1944 but not earlier than three months after delivery of first XB-36. However, authority was subsequently granted to delay delivery an additional period of approximately three months because of the priority work necessary on the contractor's XB-32 airplane. The mock-up was inspected at Fort Worth, Texas, on 24 February 1943.

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XR-1 AIRCRAFT

420-1-23
Expenditure Order No.

Platt LePage Aircraft Co.
Eddystone, Pennsylvania.
Mfg. or Activity charged with Development

None
Classified Project No.

W 535 AC-15375
Contract No.

DESCRIPTION: A twin rotor helicopter of 4,510 pounds design gross weight, powered by a Pratt & Whitney R-985-23 engine installed in the center section of the fuselage. Accommodations for a crew of two, seated in tandem, are provided in the forward section of the fuselage. Two pylons, extending on each side of the fuselage, support three-bladed rotors, each 30 feet, 6 inches in diameter, which rotate in opposite directions. All control as well as translational flight, is obtained through a combination of collective and cyclic rotor blade pitch control.

PURPOSE: To develop a rotary wing aircraft "in the interest of adequate national defense and the further interest of the needs of other governmental activities and of American commercial and civil aeronautics." Public No. 787, 75th Congress.

AUTHORITY: Recommendations of evaluations board as approved by Assistant Secretary of War in teletype CS-662 dated 20 June 1940.

REMARKS: Type Specification No. XC-417, dated 25 August 1939, was prepared and C.P. No. 40-260 was advertised. On 27 and 28 May 1940, an Evaluations Board met to review the bids submitted, and recommended that a contract be entered into with Platt-LePage Aircraft Company for one helicopter, which, at that time, was more than half complete. On 10 July 1940, Platt-LePage signed Contract W 535 AC-15375. A mock-up inspection was conducted 26 and 27 September 1940, by Materiel Command representatives. The first flight of the XR-1 was made on 12 May 1941. Lateral and longitudinal control were found to be insufficient. In addition, some vibration difficulties were encountered. Several modifications and changes of the rotor hub, blades, and control mechanism have been made and it appears that the undesirable conditions will be completely remedied in the near future. Changes completed include an irreversible, rigid control system, increased cyclic pitch control, differential collective pitch control, now pitch bearings, and new type blades. Flight tests in May, 1943, by Materiel Command representatives indicated substantial progress has been made in improvement of control and elimination of rotor roughness and vibration. During a test flight in June, 1943, the aircraft was damaged in an accident. Repairs will be completed approximately 1 March 1944.

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XR-1A AIRCRAFT

420-1-27	Platt LePage Aircraft Co. Eddystone, Pennsylvania.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-167	42-4609
Classified Project No.	Contract No.

DESCRIPTION: XR-1A is a twin rotor helicopter of 4,760 pounds gross weight, powered by an R-985-AN-1 engine. The rotors are carried on two pylons which extend out from the center section of the fuselage. The three-bladed rotors are each 30 feet, 6 inches in diameter and rotate in opposite directions. A crew of two are seated in tandem in the nose of the aircraft. The crew stations are the reverse of those in the XR-1; in the XR-1A the observer sits in front of the pilot. Cyclic and collective pitch control are provided.

PURPOSE: To provide an additional twin rotor helicopter for experimental test purposes.

AUTHORITY: Inter-Office Memorandum from Chief, Materiel Division, Washington, D. C., dated 6 August 1941.

REMARKS: On 26 April 1941 Platt-LePage proposed construction of an additional helicopter in order that a spare aircraft might be available. Action on this proposal was held in abeyance pending flight test of the XR-1, which was scheduled for about that time. On 28 July 1941, after the XR-1 had made several flights, authority to procure a second helicopter was requested by Inter-Office Memorandum to the Chief, Materiel Division. On 6 August 1941, authority for procurement was obtained. Purchase Order No. 42-4609, calling for one helicopter was approved 29 October 1941. The aircraft is now complete and was first flown in October 1943. Test flights are in progress, the aircraft performing satisfactorily. Seven additional XR-1A's will be procured.

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YR-4A AIRCRAFT

420-1-28 Expenditure Order No.	Sikorsky Aircraft Div. Bridgeport, Conn. Mfg. or Activity charged with Development.
MX-245 Classified Project No.	W 535 AC-29005 Contract No.

DESCRIPTION: YR-4A is a two place, single main rotor helicopter, substantially similar to the XR-4. The engine to be installed is a Warner R-550-1 rated at 180 horsepower at sea level for continuous operation and 190 horsepower for take-off. This engine provides 15 more horsepower for continuous operation than is now available in the XR-4. The three-bladed main rotor is 38 feet in diameter. An auxiliary tail rotor, 7 feet 10 inches in diameter, rotates in a vertical plane and counteracts the torque reaction of the main rotor. The crew of two are seated side by side in an inclosed cabin in the nose of the fuselage. Design gross weight is 2,427 pounds, of which 551 pounds is useful load. Control and translational flights are obtained through a combination of collective and cyclic rotor blade pitch changes.

PURPOSE: To procure a service test quantity of helicopters for test with the Ground Arms and determination of the utility of this new and novel type of aircraft.

AUTHORITY: Technical Instructions 1096 dated 5 May 1942, and Technical Instructions 800, dated 19 November 1942.

REMARKS: On 20 April 1942, the XR-4 was demonstrated to representatives of the Governmental agencies interested in rotary wing aircraft and proven to be a successful and practical helicopter. Immediately after this demonstration, negotiations for procurement of additional helicopters were begun. On 4 May 1942, in a conference in the Office, Commanding General, AAF Materiel Command, Washington, D. C., it was decided to procure a service test quantity of helicopters. In a letter dated 29 April 1942, the British Air Commission formally requested two helicopters similar to the XR-4. Accordingly, and in compliance with TI-1096, dated 5 May 1942, Contract W 535 AC-29005 was negotiated with Sikorsky, calling for fifteen YR-4A aircraft. Subsequently, 13 additional aircraft were requested by the British and one by the U. S. Navy, and the contract was increased to a total of 29 aircraft. Engineering Inspection of the first article was held at the contractor's plant on 24 and 26 May 1943, inclusive, and the recommendations of the committee are being incorporated in the aircraft. Delivery of all these aircraft will probably be completed by February 1944.

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YR-4B AIRCRAFT

420-28	Sikorsky Aircraft Div. Bridgeport, Conn.
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The YR-4B aircraft are identical to the YR-4A's except that they will have structural provision for bomb racks, and for the external attachment of an inclosed litter.

PURPOSE: To procure helicopters suitable for bombing operations and for the transport of injured personnel.

AUTHORITY: Chief, Engineering Division.

REMARKS: The delivery of these aircraft will be completed by February 1944.

XR-5 AIRCRAFT

420-1-29	Sikorsky Aircraft Div. Bridgeport, Conn.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-256	W 535 AC-29845 DAW 535 AC-2514
Classified Project No.	Contract No.

DESCRIPTION: XR-5 is a two-place, single main rotor helicopter. An auxiliary tail rotor rotates in a vertical plane to counteract the torque reaction of the main rotor. An R-985-AN-1 engine is installed in a novel manner, completely submerged in the center section of the fuselage with the crankshaft vertical. A reduction gear transmission system transmits power to the main and auxiliary rotors. The crew of two are seated in tandem in the nose of the aircraft. Design gross weight is 4,200 pounds of which 1,225 pounds is useful load. Control and translational flight are obtained through a combination of collective and cyclic rotor blade pitch changes. The main rotor is 48 feet in diameter and has three blades.

PURPOSE: To develop aircraft suitable for use with the Ground Arms and for investigation of missions which this new and novel type of aircraft can perform.

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AUTHORITY: Technical Instructions 1124 dated 27 May 1942.

REMARKS: In an Inter-Office Memorandum to the Chief, Materiel Command, dated 28 May 1942, authority was requested to procure two large helicopters from Vought-Sikorsky. The British Air Commission, in a letter to the War Department dated 29 April 1942, formally requested that two large Vought-Sikorsky helicopters be allocated to them for test purposes. As a result, Technical Instructions 1124, dated 27 May 1942, directed that four helicopters be procured; the two for the British to be procured with Lend-Lease funds. The first article is scheduled for delivery March 1944, and the remaining three are scheduled for delivery within three months thereafter. The second and fourth articles will be transferred to the British Air Commission after acceptance by the Army Air Forces. In addition, 250 R-5's are being procured by Production Engineering Section. The first XR-5 was first flown in September, 1943, and was damaged in an accident. The second article is now flying satisfactorily.

XR-5A AIRCRAFT

420-1-29 Expenditure Order No.	Sikorsky Aircraft Div. Bridgeport, Conn. Mfg. or Activity charged with Development
MX-256 Classified Project No.	DAW 535 AC-2514 Contract No.

DESCRIPTION: The XR-5A will be generally similar to the XR-5 aircraft. The differences will be those required for the installation of special equipment for the British Government for whom the two XR-5A's are being procured.

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XR-6 AIRCRAFT

420-1-31	Sikorsky Aircraft Div. Bridgeport, Conn.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-333	W 535 AC-35340
Classified Project No.	Contract No.

DESCRIPTION: XR-6 is a two-place, single main rotor helicopter. An auxiliary tail rotor rotating in a vertical plane counteracts the torque reaction of the main rotor, and also functions as a means of directional control. A Lycoming O-435-7 engine is installed in the center section of the fuselage with the crankshaft vertical. A planetary reduction gear transmission system transmits power to the main and auxiliary rotors. A 75 gallon fuel tank is installed providing 50 gallons above normal fuel load for ferrying purposes. The main rotor is 38 feet in diameter and has 3 blades. The crew of two are seated side by side in the nose of the aircraft and have a complete unobstructed view forward, above, to either side and down. Provision is made for installation of bomb racks to carry six 100-pound bombs or two 325-pound bombs externally. Longitudinal and lateral control and translational flight are obtained through a combination of collective and cyclic rotor blade pitch changes. Designed gross weight is 2,300 pounds and designed useful load is 600 pounds.

PURPOSE: To develop a light aircraft suitable for use with the Ground Arms and for the performance of light bombing missions.

AUTHORITY: Technical Instructions 1279, Addendum 1, dated 28 October 1942.

REMARKS: Conferences with representatives of Vought-Sikorsky regarding a light, two-place helicopter with greater power than that in the XR-4 and YR-4A were begun at the time the XR-4 was delivered to Wright Field. During these discussions, the design of the XR-6 crystallized and Sikorsky was asked to submit a proposal for a Change Order on Contract W 535 AC-29005 to convert the 15th YR-4A to an XR-6. While negotiations were still in progress, authority was obtained to procure two XR-6's for the Army Air Forces and three for the Navy. The mock-up of this aircraft was inspected on 7 December 1942. The first article flew in October, 1943, and should be delivered by March, 1944.

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XR-6A AIRCRAFT

420-1-31	Sikorsky Aircraft Div. Bridgeport, Conn.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-333	None
Classified Project No.	Contract No.

DESCRIPTION: The XR-6A was previously designated the XR-7 but was changed by direction of higher authority in order to identify it as of the class of XR-6's. The aircraft is identical to the XR-6 except that a Franklin 0-405-9 engine of 245 h.p. engine will be installed. This will necessitate several changes in the power plant installation.

PURPOSE: To procure an XR-6 with an alternate engine installation.

AUTHORITY: Chief, Engineering Division.

REMARKS: The XR-6A is being procured as the result of a change order on the XR-6 contract and will replace the first four XR-6 aircraft scheduled for delivery to the Army Air Forces.

XR-8 AIRCRAFT (SYNCHROPTER)

420-33	Kellett Aircraft Corp. Upper Darby, Pa.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-348	W 535 AC-40711
Classified Project No.	Contract No.

DESCRIPTION: The XR-8 helicopter has two rotors, each of three blades, mounted side by side in such a manner that the axes of rotation form a "V" with an included angle of 25 degrees. The rotors are each 34 feet in diameter and intermesh, each blade passing over the hub of the opposite rotor. The two hubs are four feet apart. One blower cooled Franklin 0-405-9 engine, installed with its crankshaft tilted approximately 30 degrees from the vertical, drives both rotors through a clutch and reduction gear transmission system. The design gross weight of XR-8 is 2664 pounds, of which 656.5 pounds are useful load. The crew of two are seated side by side in the nose of the aircraft, which is fabricated largely of transparent plastic material.

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PURPOSE: To develop a twin rotor aircraft of greater efficiency, in that the power losses involved in the torque correcting tail rotor of the single rotor type will be eliminated. At the same time, the weight and vibration penalties involved in the laterally separated twin-rotor type will be avoided.

AUTHORITY: Teletype EX-579 from Asst. Chief of Staff (E) dated 7 January 1943.

REMARKS: The Materiel Command, in October 1940, contracted with the Kellett Autogiro Corporation for tests of a model synchropter type helicopter. At that time, and on several occasions since then, construction of a full scale aircraft was discussed. However, it was decided to postpone construction of the full scale aircraft until results of the model tests were available. These tests were sufficiently complete by the end of 1942 to indicate that this type helicopter might have certain advantages over other types, and that construction of a full scale aircraft was a logical step. Accordingly, military characteristics for the synchropter were prepared on 11 November 1942, and submitted for consideration and approval. On 11 January 1943, Authority for Purchase No. 296830 was prepared to cover procurement of one XR-8 and complete engineering data. A letter contract was issued to Kellett in February, 1943, and work is now progressing approximately on schedule. Engineering is now in progress and inspection of a mock-up was held on 26 July 1943. Completion of the first article is scheduled for April, 1944.

XR-9 AIRCRAFT

420-37 Expenditure Order No.	G & A Aircraft, Inc. Willow Grove, Pa. Mfg. or Activity charged with Development
MX-463 Classified Project No.	W 33-038 AC-1708 Contract No.

DESCRIPTION: A single rotor helicopter of 1333 pounds design gross weight and powered with a Lycoming XO-290-5 engine rated at 126 h.p. at 3000 r.p.m. The aircraft is normally single place machine but emergency provisions are made for carrying one passenger seated behind the pilot. The main rotor has three blades and is 28 ft. in diameter. The solidity of the rotor is .061. There is a torque correcting rotor provided on the extreme aft end of the aircraft that rotates in a vertical plane. The torque correcting rotor has two blades and a diameter of 6.5 feet. Control is obtained thru a combination of cyclic pitch of the main rotor and collective pitch of the torque correcting rotor. Thrust required for translational flight is obtained by a combination of cyclic and collective

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pitch changes of the main rotor. A rotor governor is provided on this aircraft that automatically changes the collective pitch to maintain a constant rotor, (and engine), speed thru the normal operating range of the engine throttle. This aircraft is also provided with a special main rotor hub, which is designed to reduce the magnitude of flapping of the main rotor blades and is expected to reduce vibration problems peculiar to this type of aircraft.

PURPOSE: To procure two of this type of aircraft to determine the practicability of the new and novel rotor hub and to determine the utility of the aircraft for infantry liaison purposes.

AUTHORITY: Letter from AC/AS, MM&D, dated 26 October 1943.

REMARKS: Having received a proposal for a helicopter as described above from G & A Aircraft, Inc., Willow Grove, Pa., authority to procure two such aircraft for test was requested from AC/AS, MM&D. in Materiel Command Teletype dated 26 October 1943. Authority was granted as indicated above. Procurement action was subsequently initiated. The delivery of the first aircraft is anticipated in the month of December, 1944.

XO-60 AIRCRAFT

435-1-25 Expenditure Order No.	Kellett Aircraft Corp. Upper Darby, Pa. Mfg. or Activity charged with Development
MX-156 Classified Project No.	W 535 AC-31921 Contract No.

DESCRIPTION: Two-place, direct-control autogiro, powered by a Jacobs R-915-3 engine rated at 300 horsepower at sea level for continuous operation, and 330 horsepower for take-off. Design gross weight is 2,640 pounds, of which 680 pounds is useful load. The crew of two are seated in tandem. Provision is made for jump take-off.

PURPOSE: To develop an aircraft suitable for cooperation with the Ground Arms and observation and for control of artillery fire.

AUTHORITY: Technical Instructions 802 dated 3 July 1941.

REMARKS: As part of this project, Kellett has undertaken a vibration and resonance study in an effort to eliminate one of the major problems

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encountered in rotary wing aircraft. This program, which is being pursued in cooperation with the N.A.C.A. and the Materiel Command, has produced some results which have influenced the design of the XO-60 aircraft. The mock-up of the XO-60 was inspected by Materiel Command personnel and representatives of the Ground Arms on 12 January 1942. These aircraft, together with the six XO-61 autogiros being built by AGA Aviation Corporation, will constitute a service test squadron, and will be put through extensive tests with the Ground Arms to determine their suitability for performance of short-range observation liaison missions. The first article flew in April, 1943, and should be delivered by 1 February 1944.

XO-61 AIRCRAFT

435-1-26	G & A Aviation Corp. Willow Grove, Pa.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-157	W 535 AC-21450
Classified Project No.	Contract No.

DESCRIPTION: The XO-61 is a direct control autogiro. A Jacobs R-915-3 engine, rated at 300 horsepower at sea level for continuous operation and 330 horsepower for take-off is installed at the rear of the nacelle and drives a pusher propeller. The tail surfaces are supported by twin booms which extend rearward from the landing gear stubs. The three bladed rotor is 48' in diameter. Design gross weight is 3,200 pounds, of which 702 pounds is useful load. The crew of two are carried in the forward portion of the nacelle. Provision is made for jump take-off.

PURPOSE: To develop an aircraft suitable for cooperation with the Ground Arms and for observation and control of artillery fire.

AUTHORITY: Technical Instructions 802 dated 3 July 1941.

REMARKS: A mock-up of the XO-61 was inspected by Materiel Command personnel and representatives of the Ground Arms on 15 October 1941. As part of this project, G & A Aviation Corporation has investigated the use of laminar flow airfoils for rotor blades. A model was built by G & A and tested by the N.A.C.A. in its wind tunnel. As a result of these tests, G & A Aviation Corporation fabricated a rotor for a British owned PA-39 autogiro in which laminar flow airfoils sections were used for the outer portion of the blade. The test results showed quantitative and qualitative improvement in the autogiro's performance, and laminar flow airfoil sections will be used

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for the outer 3/8 of the XO-61 rotor blades. On 17 December 1941, G & A Aviation Corporation submitted an informal report on work being done on molded rubber rotor blades. However, due to the critical rubber situation, this project has been discontinued. Upon completion of these six aircraft and the seven Kellett XO-60 aircraft, a service test squadron will be formed and extensive tests in cooperation with the Ground Arms will be conducted. The first aircraft flew in April, 1943. Several mechanical failures have occurred during ground rev-ups and ground resonance has been encountered. The contractor is redesigning portions of the rotor starting drive and hub in an effort to correct these unsatisfactory conditions.

XPQ-14 - XPQ-14C AIRCRAFT

665-58
Expenditure Order No.

Culver Aircraft Corp.
Wichita, Kansas
Mfg. or Activity charged with Development

MX-264
Classified Project No.

W 535 AC-18662
Contract No.

DESCRIPTION: A single engine radio controlled airplane target of 1800 pounds design gross weight. This aircraft is powered by one Type XO-300-3 (6 cylinder opposed Franklin) engine rated at 155 H.P. at 2930 R.P.M. A direct drive fixed pitch propeller is installed. Provisions are made for a pilot for short range ferry and check flights. This aircraft was designed to have the following performance:

	Target	Pilot
High speed at sea level (m.p.h.)	200	195
High speed at 17,000 feet (m.p.h.)	185	180
Endurance, (hours)	3.8	3.7
Range (miles)	714	666
Service ceiling (feet)	24,900	23,600
Landing speed (m.p.h.)	59.0	62.8
Take-off over 50 ft. obstacle (feet)	1,150	1,300

PURPOSE: To develop a more advanced type of radio controlled airplane target.

AUTHORITY: CTI-11 dated 5 January 1940.

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REMARKS: In May 1941, negotiations were started with Culver Aircraft Corporation for the procurement of a more advanced type radio controlled airplane target and a contract was negotiated for one each Type XPQ-9 and XPQ-10 aircraft. Design and construction of the XPQ-9 continued until 22 March 1942 when the XPQ-9 aircraft crashed due to flat spin characteristics. The contract was revised to change the general configuration of the XPQ-9 fuselage and the revised aircraft was redesignated as the XPQ-14. Procurement of the XPQ-10 was cancelled. Mock-up of the XPQ-14 aircraft was held on 1 October 1942 and preliminary Engineering Inspection of the XPQ-14 was held at the contractor's plant on 15 June 1943.

Procurement of the service test Type PQ-9 and PQ-10 aircraft on contract W 535 AC-19214 has been held in abeyance. Upon satisfactory acceptance of the XPQ-14 aircraft, contract W 535 AC-19214 will be revised to call for 100 Type YPQ-14A aircraft in lieu of 50 each Type PQ-9 and PQ-10 aircraft.

The XPQ-14C aircraft is the XPQ-14 aircraft revised to have the XO-300-9 engine installed in lieu of the XO-300-3 engine that was installed in the first experimental article of this type. The XO-300-9 engine now being installed in this aircraft is a geared version of the Franklin 300 series engine. Type test has not been conducted on this engine but it is believed that the model test conducted is sufficient to warrant its use to obtain further information on this configuration. Performance figures are not yet available.

YPQ-14A - YPQ-14B AIRCRAFT

665-58 Expenditure Order No.	Culver Aircraft Corp. Wichita, Kansas Mfg. or Activity charged with Development
MX-264 Classified Project No.	W 535 AC-19214 Contract No.

DESCRIPTION: A single engine radio controlled airplane target of 1820 pounds design gross weight. These aircraft are powered by a type YO-300-11 (6 cylinder opposed Franklin) engine rated at 155 h.p. at 2930 r.p.m. Provisions are made for a pilot for short range ferry and check flights. The performance of these aircraft are as follows:

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High Speed (at sea level)	187 m.p.h.
High Speed (at 17,000 ft.)	159 m.p.h.
Endurance	2.32 hrs.
Range	370 mi.
Service Ceiling	17,100 ft.
Landing Speed	65 m.p.h.

PURPOSE: To procure a more advanced type radio controlled airplane target in sufficient quantity to permit suitable service tests to be conducted.

AUTHORITY: CTI-11 dated 5 January 1940 requested the Materiel Command to procure a suitable aircraft for use as a radio controlled airplane target.

REMARKS: The subject contract originally called for fifty (50) each PQ-9 and PQ-10 targets but when procurement of the XPQ-9 and XPQ-10 aircraft was cancelled, action was taken to revise this contract to call for seventy-five (75) type YPQ-14A and twenty-five (25) type YPQ-14B aircraft. The YPQ 14A and YPQ-14B aircraft differ only in the type control equipment installed, the type A 3 servo unit being used in the YPQ-14A and the YPQ-14B having the type A-4 servo unit installed. The first type YPQ 14A aircraft has been delivered to the Materiel Command and is now undergoing tests at Wright Field. It is anticipated that the first type YPQ-14B aircraft shall be delivered during February, 1944.

XBQ-1 CONTROLLABLE BOMB

673-20	Fleetwings, Inc., Bristol, Pa.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-53	W 535 AC-29834
Classified Project No.	Contract No.

DESCRIPTION: A twin engine power driven controllable bomb type aircraft of 7488 pounds design gross weight. This aircraft is powered by two (2) Type XO-405-7 (6 cylinder, geared and supercharged Franklin) engines rated at 230 H.P. at sea level, with 250 H.P. available for take-off. This aircraft is capable of carrying one 2,000 pound bomb. Provisions are made for a pilot for long range ferry and check flights. This aircraft is being designed to have the following performance:

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	Bomb	Ferry	Pilot
High speed (m.p.h.)	222*	181**	209*
Oper. speed at 75% power (M.p.h)	191*	160**	182*
Service ceiling (ft.)	24,000	24,000	25,900
Stalling speed (m.p.h.)	77.5	73	70
Take-off over 50 ft. obstacle (ft.)	3,480	2,740	1,670
Maximum Range	1,806	3,021	

* At 17,000 feet
** At sea level

PURPOSE: To develop a power driven controllable bomb capable of carrying a 2,000 pound bomb and being controlled remotely, by use of television and radio control, into an enemy target.

AUTHORITY: Chief, Engineering Division.

REMARKS: In May 1942, negotiations were started with Fleetwings, Inc. for the procurement of a long range type power driven controllable bomb capable of carrying a 2,000 pound bomb. The contract was approved on 10 July 1942 for one (1) XBQ-1 and one (1) XBQ-2A. Delivery of the XBQ-2A aircraft was scheduled for 10 May 1943 and delivery of the XBQ-1 aircraft was scheduled for two months after delivery of the XBQ-2A. The XBQ-2A aircraft was delivered to the Materiel Command on 15 December 1943, and performance tests are being conducted prior to tests being conducted to check the radio control characteristics

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XBQ-2A CONTROLLABLE BOMB

673-20	Fleetwings, Incorporated Bristol, Pa.
Expenditure Order No	Mfg. or Activity charged with Development
MX-53	W 535 AC-29834
Classified Project No.	Contract No.

DESCRIPTION: A twin engine power driven controllable bomb type aircraft of 7606 pounds design gross weight. This aircraft is powered by two (2) Type R-680-13 (Lycoming) engines rated at 280 H.P. at sea level with 295 H.P. available for take-off. This aircraft is capable of carrying one (1) 2000 pound bomb. Provisions are made for a pilot for long range ferry and check flights. This aircraft is being designed to have the following performance:

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	Bomb	Ferry	Pilot
High speed at sea level (m.p.h.)	209	190	192
Oper. speed at sea level, 75% power (m.p.h.)	187	170	173
Service ceiling (ft.)	15,390	14,800	17,810
Take-off over 50 ft. obstacle (ft.)	3,115	2,600	1,710
Stalling speed with flaps (m.p.h.)	78.5	78	72.5
Maximum range (miles)	1,725	2,955	

PURPOSE: To develop a power driven controllable bomb capable of carrying a 2000 pound bomb and being controlled remotely, by use of television and radio control, into an enemy target.

AUTHORITY: Chief, Engineering Division.

REMARKS: In May 1942, negotiations were started with Fleetwings, Incorporated, for the procurement of a long range type power driven controllable bomb capable of carrying a 2,000 pound bomb. The contract was approved on 10 July 1942 for one (1) XBQ-1 and one (1) XBQ-2A. Delivery of the XBQ-2A aircraft was scheduled for 10 May 1943 and delivery of the XBQ-1 aircraft was scheduled for two months after delivery of the XBQ-2A. The XBQ-2A aircraft was delivered to the Materiel Command on 15 December, where necessary tests are being conducted.

XBQ-3 CONTROLLABLE BOMB

673-26	Fairchild Aircraft Div. Hagerstown, Md.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-53	W 535 AC-32134
Classified Project No.	Contract No.

DESCRIPTION: A twin engine power driven controllable bomb type aircraft having a gross weight of 15,100 pounds with full load of gasoline and bombs. This aircraft is powered with two Type V-770-15 (Ranger) engines rated at 450 H.P. at 12,000 feet with 520 H.P. available for take-off. The design is such that the aircraft can carry either two torpedoes, two 2,000-pound bombs, or one 4,000-pound bomb. In the first condition, the torpedo or bomb load can be dropped and the aircraft may be returned to the base or in the latter two conditions, the aircraft can be flown into the target by use of radio and television control with the bombs being armed remotely during the last stage of the bombing run. Provisions are made for a pilot and navigator for long range

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ferry and check flights. This aircraft is being designed to have the following performance:

	Bomb	Ferry
High speed at 12,000 feet (m.p.h.)	220	220
Oper. speed at 12,000 feet (m.p.h.)	205	200
Range at oper. speed (miles)	1,500	2,900
Service ceiling (feet)	14,000	16,000
Take-off over 50-foot obstacle (feet)	4,000	3,300
Stalling speed (m.p.h.)	96	92

PURPOSE: To develop a power driven controllable bomb capable of carrying a 4,000-pound bomb load and to be controlled remotely by use of radio and television control into an enemy target.

AUTHORITY: Chief, Engineering Division

REMARKS: In June 1942, negotiations were started with Fairchild Aircraft Division for the procurement of the subject type aircraft using as much of the parts previously designed for the XAT-14 as was possible. The contract was approved 1 October 1942 and the first aircraft was to be delivered to the Materiel Command 15 July 1943 with the second aircraft being delivered two months later. At present, it appears that the first XBQ-3 aircraft will not be delivered until 15 March 1944.

XBQ-4 CONTROLLABLE BOMB

673-1-30	Interstate Eng. & Airc. Co. DeKalb, Illinois
Expenditure Order No.	Mfg. or Activity charged with development
MX-53	None
Classified Project No.	Contract No.

DESCRIPTION: A twin-engine, monoplane type controllable bomb weighing approximately 6,300 pounds in the bomb loaded condition and having an estimated high speed of 172 M.P.H. at sea level with 440 horsepower. The power will be supplied by two Lycoming 6-cylinder, geared engines rated at 220 horsepower at 3,000 R.P.M. at sea level. The range of this aircraft in the bomb condition is approximately 425 miles. In the pilot operated condition for check or ferry flights, the gross weight will be approximately 4,800 pounds and the high speed at sea level is estimated to be 152 M.P.H. The range of the aircraft in the pilot operated condition is approximately 375 miles. In the bomb loaded condition, the aircraft is

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capable of carrying either one torpedo, or two 650-pound bombs and two 325-pound bombs.

PURPOSE: To provide a short-range controllable bomb capable of carrying approximately 2,000 pounds of bomb load.

AUTHORITY: Chief, Engineering Division.

REMARKS: The XBQ-4 controllable bombs are identical to the Navy XTDR-1 aircraft except that provisions will be made to have the Army Air Forces type control equipment installed. Two of the subject aircraft are being procured from the Navy Department. These aircraft were supposed to have been delivered in April, 1943. The first TDR-1 has been delivered to the Materiel Command. Necessary changes will be made to modify this aircraft to an XBQ-4.

XBQ-5 CONTROLLABLE BOMB

673-1-30	Interstate Eng.&Avn.Corp. DeKalb, Illinois
Expenditure Order No.	Mfg. or Activity charged with Development
MX-53	Navy Contract
Classified Project No.	Contract No.

DESCRIPTION: A twin-engine, monoplane type controllable bomb weighing approximately 10,300 pounds in the bomb loaded condition and having an estimated high speed of 227 M.P.H. at sea level with 900 horsepower. The power will be supplied by two XO-805-2 Franklin, 12-cylinder, geared engines rated at 450 horsepower for take-off The range of this aircraft in the bomb condition is estimated to be approximately 1,400 miles. In the pilot operated condition for ferry flights, the gross weight will be approximately 9,800 pounds and the high speed at sea level is estimated to be 185 M.P.H. The range of the aircraft in the ferry condition is approximately 1,600 miles. In the bomb loaded condition, the aircraft is capable of carrying either one torpedo, two 650-pound bombs and two 325-pound bombs, one AN-M34 bomb, or one AN-M66 bomb.

PURPOSE: To provide a controllable bomb having the 12-cylinder opposed engines installed and capable of carrying a 2,000-pound bomb load.

AUTHORITY: Chief, Engineering Division.

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REMARKS: The XBQ-4 controllable bombs are identical to the Navy XTD2R-1 aircraft except that provisions will be made to have the Army Air Forces type control equipment installed. Two of the subject aircraft are being procured from the Navy Department. These aircraft are scheduled for delivery in June, 1943, but recent information is that these aircraft will not be available until March, 1944.

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SPECIAL PROJECT

SECTION 4

SPECIAL PROJECTS

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WINTERIZATION

446-20	Technical Staff
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This project covers a general program of testing of aircraft under extremely cold weather conditions to determine those features which must be improved and those items of equipment which must be developed in order to insure suitable operation; after discovery of the unsatisfactory items, the Laboratories concerned take the necessary action to improve existing equipment or develop new items when needed.

PURPOSE: To make AAF aircraft operable in extremely low temperature conditions.

AUTHORITY: CTI-1300.

REMARKS: Extensive low temperature tests were conducted during the winter of 1942-1943 at Ladd Field, Alaska, and along the Northwest Ferry Route in temperatures as low as -60°F. As a result of these tests certain items of equipment, as well as maintenance procedures, were found unsatisfactory for this type of operation. A test program was set up for the winter 1943-1944 at Ladd Field on all combat aircraft and all cargo aircraft, C-60 and larger, on the following subjects:

1. Development of low temperature pneumatic hydraulic shock absorber strut packings, hydraulic hose, synthetic compounds for hydraulic packings, and synthetic diaphragms in pressure accumulators and regulators.

2. Testing of each type of hydraulic unit within the range of -65°F to +160°F for proper operation.

3. Development of a new type of propeller de-icing.

4. Development of propeller feathering systems for cold weather operation.

5. Development of an oil dilution indicator or automatic dilution control.

6. Development of oil systems to eliminate the possibility of engine and oil system failures during cold weather starts.

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7. Development of high volatile fuel systems for cold starting.

8. Elimination of scavenging troubles on V-1710 and V-1650 engines when operating with 30% diluted oil.

9. Service testing and development of oil heaters for oil servicing trucks.

10. Service testing and development of non-structural plastic parts.

11. Development of airplane cockpit and cabin heating and windshield defrosting systems with emphasis on heat distribution.

12. Service testing of armament and bombing equipment to bring out malfunctions due to low temperatures.

13. Development of all weather hydraulic fluids, lubricating oils and greases.

14. Development of photographic equipment, both aerial and ground, for satisfactory operation in the low temperatures and lighting conditions encountered in Arctic regions.

15. Service testing of radar, recognition and communication and navigational equipment to determine necessary design improvements so as to keep maintenance at a minimum and to permit satisfactory operation at low temperatures.

16. Study of physiological and psychological effect on personnel under arctic conditions.

17. Development of improved clothing, housing, and rations for arctic existence.

18. Development of cold weather operating techniques including preflight, flight, and postflight procedures. Also development of cold weather maintenance procedures.

19. Testing of all winterization items that were incorporated in production airplanes as a result of 1942-1943 winter tests.

Evaluation of the tests to determine the operation of the above items has not been completed to date. Results of these tests will determine winterization modification in present aircraft and winterization items to be included in production.

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DESERTIZATION

441-31	Technical Staff
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This project covers a general program of testing aircraft under conditions of heat, sand, and dust, such as is encountered in tropical and desert areas.

PURPOSE: To meet the requirements of the CTI, which states that all aircraft and components shall be operable within the temperature range -65°F to +160°F.

AUTHORITY: CTI-1300.

REMARKS: Extensive tests were conducted during the summer 1943 at Blythe Army Air Base, California. Blythe is situated in an area of desert terrain and high air temperatures. The following test program was conducted and action has been taken to correct unsatisfactory conditions:

1. Observation of operation of all aircraft accessories and components under conditions of high outside air temperature.

2. Observation of effect of heat, sand and dust on airplane engine, instruments, armament, landing gear, and de-icing equipment.

3. Development of improved oil and air intake filters.

4. Test of winterization items to establish their suitability over the temperature range -65°F to +160°F.

5. Measurement of temperatures in all critical areas of the airplane while on the ground and in flight at various altitudes, information to be used in future design.

6. Observation of effect of heat and dry air on wooden airplane structures.

7. Service testing of airborne and ground radio equipment to determine malfunctions both mechanical and operational caused by high air temperatures and desert terrain.

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8. Study of physiological and psychological effect on personnel under desert conditions and development of improved desert rescue methods.

9. Development of improved clothing, housing, and rations for desert existence.

10. Test of heat reflectivity of various airplane finishes.

11. Service testing of all-weather hydraulic fluid, lubricating oils and greases.

12. Development of photographic equipment, both aerial and ground, for satisfactory operation in the climatic conditions encountered in desert regions.

Results of these observations were reported in various memorandum reports and changes recommended for incorporation in technical instructions and existing and future articles. A similar test program is being planned for the summer of 1944 which will, in effect, be a continuation of last summer's test and will also include equipment developed since that time.

WATER LANDING CHARACTERISTICS
OF LAND TYPE AIRPLANES

None Expenditure Order No.	Technical Staff Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: This study covers an investigation of (1) general procedure and technique for making satisfactory water landings in land type aircraft, (2) specific water landing characteristics of specific airplanes, (3) improvement of water landing characteristics by (a) improvement of the emergency exits and equipment and (b) improving the actual water landing characteristics by structural reinforcement or modification.

Information and data is being gathered from all available sources including the results of actual experiences by Army, Navy and British personnel, model tests at the N.A.C.A. and examination of existing airplanes for emergency provisions.

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PURPOSE: To determine characteristics and techniques of water landing so that suitable provisions and equipment can be made on aircraft of the present and the future designs.

AUTHORITY: Chief, Engineering Division.

REMARKS: Project officer has initiated a series of ditching tests with dynamic scale models of various A.A.F. airplanes in the Hydrodynamics Laboratory of the N.A.C.A. at Langley Field. Tests of the A-20 and B-26 have been completed and tests of the B-25, B-24 and B-17 are in progress. A model of the B-29 has been completed and tests are scheduled to start about 20 January 1944. Contracts have been negotiated with several model contractors for models of A-26, P-38, B-29, B-32, B-35, B-36 and C-54. Tests are being conducted indoors in the low tank and outdoors with a catapult.

Static tests are being conducted at Wright Field and Langley Field on suitable class 26 airplanes to determine the strength of various A.A.F. airplanes when subjected to water landings and to provide means of improving the ditching characteristics. A class 26 B-17 and B-26 are scheduled to arrive at Langley about 15 January 1944.

Tests to date have shown that different airplanes have considerably different ditching characteristics and that with each airplane, landing attitude, speed and structural damage have the greatest influence on the behavior of the airplane. The A-20 was found to have satisfactory characteristics in either a tail down or level attitude landing, although extreme hazard exists for the bombardier in the nose. The B-26 was found to make good landings in a level or slightly nose-up attitude with extreme failures of the under surface hatches, bomb-bay doors, etc., while a tail down attitude resulted in the model diving in after striking the water. The B-17 was found to land very well in a moderate tail down attitude at the slowest possible speeds, with the lower turret tearing off. If the lower turret does not tear loose, the airplane will usually dive in. The B-24 makes dangerous landings in all attitudes. Considerable need has been shown for more adequate upper escape hatches in the B-24, B-25, B-26 and B-17.

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Section 5

NATIONAL DEFENSE RESEARCH COMMITTEE PROJECTS

NDRC PROJECT

(Note)

Listed above are the projects under development by the National Defense Research Committee at the request of the Materiel Command with classification not higher than "Confidential". Projects which have been completed or were requested by AAF activities outside the Materiel Command have not been included. In cases where the N.D.R.C. is furnishing advisory or consulting assistance only, the report has been left in the proper section of the laboratory concerned.

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PHOTOGRAPHIC LENSES & OPTICAL GLASS SUBSTITUTES

AC-11	National Defense Research Committee Photographic Laboratory.
AAF Project No.	Mfg. or Activity Charged With Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This project includes the development of optical plastic materials, methods for hardening plastics and plastic surfaces, and the development of synthetic optical fluorite lens elements. New aerial camera lenses, and methods of measuring lens definition are also included.

PURPOSE: The purpose of this project is to develop substitutes for optical glass, and to improve the performance of existing optical systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: New lenses being developed under this project include the following:

(1) 40 inch F/5 Telephoto
(2) 40 inch F/5 Infrared Lens
(3) 7 inch F/2.5 Lens for K-24 Camera
(4) 4 inch F/2.8 Wide Angle Lens
(5) 6 inch F/3.5 Wide Angle Lens
(6) Wide Angle Projection Lens
(7) 100 inch F/10 Lens
(8) 36 inch F/8 Fluorite Lens
(9) 12 inch F/4.5 Lens
(10) 7 inch F/2.5 Plastic Lens

AIRCRAFT OXYGEN GENERATORS

AC-12	National Defense Research Committee Aero Medical Laboratory
AAF Project No.	
MX-311	W-535 AC-36980 P.O. 45-33105 P.O. 44-135E · P.O. 44-2959
Classified Project No.	Contract Number

DESCRIPTION: A small light weight mechanical oxygen generator weighing approximately 500 lbs. complete, having a production capacity of 150 s.c.f. of 99.5% pure oxygen or 180 s.c.f. of 98% pure

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oxygen per hour. The generator will be powered by a 24 volt D.C. motor and supercharged to 40,000 feet altitude for use aboard an airplane during flight and by a light weight gasoline engine of 10-15 h.p. capacity for use as an airborne ground oxygen generator.

PURPOSE: To provide a small, light weight, compact aircraft oxygen generator for production of oxygen on board aircraft during flight and aircraft oxygen generator, airborne, for generating oxygen on the ground for field use.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Frigidaire Division of General Motors Corporation has practically completed the four experimental generators specified in their contract. These units have been redesigned and modified by Frigidaire in keeping with the results obtained from experimental runs on the first two units. Contracts for the fabrication of the generators have been placed with the E. B. Badger & Sons Co. of Boston, Massachusetts and the Independent Engineering Company of O'Fallon, Illinois (25 to each company). Both companies are progressing satisfactorily on production, and it is expected that the redesign, development and fabrication of a light weight air compressor and a non-lubricated oxygen compressor and the integrating of the compressor units and the generator itself to the power unit was placed with the Sullivan Machinery Company, Michigan City, Indiana. This work is well under way, and it is expected that the first ten integrated units will be ready for shipment by 15 January 1944. It is estimated that the greater number of the ground units will be in service in the several theaters of operation by 1 March 1944. Following the completion of the development and production of the ground units, the supercharger for the units for use on aircraft will be expedited.

TRAIN BOMBING CALCULATOR

AC-27	National Defense Research Committee Armament Laboratory
AAF Project No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This project concerns the development of a train bombing calculator to be used by a bombardier or mission planning officer. The calculator is to be based upon the calculation of probabilities for the optimum spacing of bombs released under various conditions

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involving variables such as altitude, number of bombs, target dimensions, etc. It is also desired that the calculator furnish the number of mils trial necessary to place the center of a "stick" of bombs on the target.

PURPOSE: To increase bombing accuracy by using the best values for bomb spacing as calculated from mathematical probabilities.

AUTHORITY: Chief, Engineering Division.

REMARKS: A preliminary model of a bomb spacing calculator was constructed in September 1943 based upon a target of rectangular shape. Also a preliminary model for calculation of the optimum number of planes to be used on a mission, was constructed. It is expected that redesigned models of the two calculators mentioned will be submitted to the Armament Laboratory soon for evaluation.

RESEARCH ON PHOTOGRAPHIC EQUIPMENT

AC-29	National Defense Research Committee Photographic Laboratory
AAF Project No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This project includes:

a. Lens design - The following types are included:
   (1) 40 inch F/5.0 telephoto lens
   (2) 7 inch F/2.5 lens for K-24 camera
   (3) 40 inch F/5.0 infra-red telephoto lens
   (4) 6 inch F/3.0 wide angle lens
   (5) Wide angle projection lens
   (6) 100 inch F/10 lens
   (7) 24 inch F/6.0 fluorite lens system

b. Lens definition - Effects on aerial camera lenses of air turbulence during high speed flight are being examined in a tunnel and in flight.

c. Schmidt cameras - The possibility of using Schmidt type high aperture cameras, especially for night photography, is being examined.

d. Anti-oscillation mounting - An anti-oscillation mount for high aerial cameras has been developed by N.D.R.C.

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e. Shutters - N.D.R.C. is conducting research on various kinds of high speed shutters of both the between-the-lens and the focal plane types.

f. Aerial photographic flash powders - Experiments are being carried out to discover the best possible chemical combinations and containers for night photoflash bombs.

COMBUSTIBLE NATURE OF LUBRICANTS

AC-32	National Defense Research Committee Aero Medical Laboratory
AAF Project No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: A non combustible and chemically inert mechanical lubricant for use with oxygen specifically at a minimum pressure of 450 p.s.i. and desirably at pressures up to 2200 p.s.i. The lubricant will satisfy the high and low temperature requirements for lubricants for use with AAF equipment, non-corrosive when used with fervous or non-fervous metals and alloys; non-toxic and free from objectionable odors under all conditions of usage; will not support fungus and bacterial growth.

PURPOSE: To develop a lubricant primarily for use with movable surfaces of mechanisms.

AUTHORITY: Chief, Engineering Division

REMARKS: The project was initinted in October 1941 for the purpose of developing a non-inflammable pipe sealing compound. The pipe sealing problem has since been solved and the project has been revised to develop an inorganic lubricant suitable for use primarily in oxygen compressors. No recent progress reports have been received from the NDRC on this project.

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HEAT RESPONSIVE, TARGET SEEKING BOMB

AC-34	National Defense Research Committee Equipment Laboratory
AAF Project No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This target-seeking device accomplishes detection of and direction to a target by means of heat sensitive instruments. The most advanced equipment consists of a rotating parabolic mirror which scans a 20° field with a bolometer at the focal point of the mirror. Any discontinuity within the field of view caused by the infra red radiation emitted by a distant target in contrast to its background will result in a change of resistance in the bolometer. This change is magnified to provide operation of bomb control relays.

PURPOSE: To develop a heat responsive device to control target-seeking bombs.

AUTHORITY: Chief, Engineering Division.

REMARKS: Work by the National Defense Research Committee on this project began in December 1941 at Massachusetts Institute of Technology. Since then, Bell Telephone Inc., New York, N.Y. and Harvard University have contracted for development studies. This program is twofold: (a) Development of a control system and (b) fundamental research on the physical problems involved in detecting military targets and on the development of more sensitive receivers and optical systems. Preliminary tests have been made in flight of the detection device in which steamships were satisfactorily followed. Improvements in design are being carried out to reduce the size and assure sufficient sensitivity for operation on high angle bomb project (See AC-36).

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HIGH ANGLE BOMB

AAF Project No.	Mfg. or Activity Charged with Development
AC-36	National Defense Research Committee Equipment Laboratory

Classified Project No.	Contract Number
	None

DESCRIPTION: This high angle bomb consists of a standard G.P. 1000 pound bomb with a special tail cone containing stabilizing equipment and movable fins which replace the standard fins. The bomb is carried in the bomb bay of standard airplanes and is controllable through a radio link from the airplane from which it is dropped. The present bomb can be controlled in azimuth by direct sighting with the aid of a flare on the bomb. More elaborate variations of this bomb will incorporate television or a target-seeking device and control in two axes.

PURPOSE: To develop a controllable bomb which will not require modification of standard bombardment airplanes.

AUTHORITY: C.T.I. 1350 dated 5 June 1943, subject "High Angle Controllable Bomb in Azimuth".

REMARKS: This project was initiated 13 April 1942. The National Defense Research Committee at Massachusetts Institute of Technology is developing and conducting the experimental work. Tests of the subject equipment at Eglin Field, Florida are being conducted at present. Following the final type test, the Production Division of the Materiel Command will negotiate procurement of 10,600 of these units for tactical use.

FULL-FACE OXYGEN MASK

AAF Project No.	Mfg. or Activity Charged with Development
AC-38	National Defense Research Committee Aero Medical Laboratory

Classified Project No.	Contract Number
None	NDRC Contract OEM-sr-320

DESCRIPTION: The full-face oxygen mask was developed by the National Defense Research Committee on NDRC Contract OEM-sr-320. The full-face oxygen mask is designed to completely cover the face and head when used in conjunction with the Army Air Forces helmet.

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PURPOSE: To develop a full-face coverage for use by Army Air Forces personnel during flight.

AUTHORITY: Chief, Engineering Division.

REMARKS: The principle has been developed by N.D.R.C. The oxygen passes across the goggles which are double lensed to include an air space and from the goggle cavity the oxygen or gas mixture passes into a face cavity. The goggle cavity is designed to be of such dimensions that vapor from the face and eyes is completely removed with each breath, thereby keeping the goggles clear. The inner surface of the goggle is especially treated to prevent fog formation. Tests on the masks have shown the principle to be adequate but sizing of the mask has not been adequately made. Other minor changes are being made at present.

TELEMETERING EQUIPMENT

AC-40 AAF Project No.	National Defense Research Committee Equipment Laboratory Aircraft Radio Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Telemetering equipment for use in the remote reading of instruments in an airplane. The following groups are involved:

a. Wurlitzer - autosyn units with precision potentiometers are attached to each instrument. These control the modulation of an FM transmitter.

b. NBC - Uses low quality television for direct imaging of the faces of instrument dials on a 7", long-persistence screen located in the receiver.

c. Hazeltine - Uses line scanning. Unit operates by scanning the various instruments. The deflection of the indicating needle is indicated by the separation of two dots on a cathode ray tube.

d. Princeton University, employs electronic commutator. Input is standard a.c. strain gage; output (ground indicators) are multi-element oscillographs. Transmits 18 channels at approximately 1100 times per second.

e. C.G.Conn - Phonic wheel system, employing a motor driven phonic wheel generator, connected to the standard A.C. strain gages.

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PURPOSE: To manufacture equipment for telemetering instruments.

AUTHORITY: Chief, Engineering Division.

REMARKS: Systems have been tested with the following results:

a. Wurlitzer System indicates satisfactory operation. Instability due to complexity has been observed.

b. NBC System gives satisfactory test results. Accurate instrument readings have been obtained.

c. Hazeltine System gives relatively accurate results. Mechanical features involve limitations.

d. Princeton System - Only non-television equipment which gives indication of equipment failure.

e. C.G.Conn System - Good progress being made. Small and light weight.

TOW TARGET HIT INDICATION EQUIPMENT

AC-46	National Defense Research Committee Equipment Laboratory
AAF Project No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This equipment consists of a F.M. pickup transmitter and a F.M. receiver which transforms the intensity of the shock wave caused by the bullet to indicating devices at the gunner.

PURPOSE: To develop an indicator that will instantly inform the gunner as to the accuracy of his fire.

AUTHORITY: Inter-Office Memorandum from M.M.&D. dated 7 April 1942.

REMARKS: Accuracy of latest model is 50%. Further investigation is being made regarding the behavior of the shock wave.

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TESTING MACHINE FOR FIRE CONTROL DEVICES AND SYSTEMS

AC-47	National Defense Research Committee Armament Laboratory
AAF Project No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Machine is to be developed to receive turret or sight which will be capable of reproducing the yaw, roll and pitch usually encountered in military aircraft. This machine will consist of a Scoresby assembly, target projector and recording devices.

PURPOSE: To develop methods and equipment for testing airborne gunnery systems.

AUTHORITY: Chief of Engineering Division.

REMARKS: Machine is being built by N.D.R.C. at University of Texas and first demonstration is scheduled for 12 January 1944.

PLANE-TO-PLANE BOMBING

AC-62	National Defense Research Committee Armament Laboratory
AAF Project No.	Mfg. or Activity Charged with Development
MX-385	None
Classified Project No.	Contract Number

DESCRIPTION: Plane-to-plane bombing consists of:

a. Toss bombing technique
b. Spiral glide bombing
c. Minimum altitude bombing
d. Combinations of the above technique
e. Automatic predicting pilot's bombsight, (E.C. No. 556-292)

Toss bombing is based upon the use of an acceleration integrator and the collision course. The integrator is adjusted to a certain number of seconds which is the time interval necessary to fly from the point of initiation of the integrator to the target. At any time after initiation the pilot is at liberty to

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pull up into a climb. The integrator correctly integrates the vertical component of acceleration and releases the bomb automatically so that the bomb will cross the original sight line at the correct time interval.

Spiral glide bombing is based upon the use of a depressed sight angle and the collision course. The flight path of the attack plane will be a mathematical spiral caused by the depressed sight. The bomb is released at a point dependent upon the previous choice of variables such as relative altitude, sight depressant angle, bomb ballistics, etc.

Minimum altitude bombing is based upon the use of standard bombing practices reapplied to planes as targets.

PURPOSE: To cover all work in connection with the preparation of tactics and technique and the development of special equipment for plane-to-plane bombing.

AUTHORITY: The authority for this project is based upon a letter from Brigadier General F. W. Evans, Director, War Organization and Movement, to Commanding General, Materiel Command, and also to AAF Proving Ground, Eglin Field, dated 15 February 1942 on the subject, "Bombing Attack on Airplanes in Formation".

REMARKS: This project was initiated in March 1943. The mathematics of the spiral glide method was completed by April 1943. Three types of acceleration integrators were completed by May 1943 and were tested at Eglin Field. A special combination sight was tested at Eglin Field in June 1943. A special instrument, incorporating a reversing time clock, was tested at Eglin Field in June 1943. The same instrument with further modifications to extend the range and also compensate for dive angle was tested at Wright Field during August, September and October 1943. The results indicated that the basic assumptions of the required values of the acceleration time integral need modifying for the longer ranges to obtain reasonable accuracy in tossing. The method of compensating for dive angle showed average expected accuracy.

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AIRCRAFT HYDROBOMB

AC-70 AAF Project No.	United Shoe Mach. Co., Beverly, Mass. Calif. Inst. of Tech., Pasadena, Cal. A.O.Smith Corp., Milwaukee, Wis. Westinghouse Elec. & Mfg. Co., East Pittsburg, Penna. Mfg. or Activity Charged with Development
MX-363 Classified Project No.	W-535 AC-20260 - Suppl. 5 W-535 AC-40146 (535) 43-25875-E Contract Number

DESCRIPTION: The Hydrobomb is a jet propelled bomb capable of driving itself through the water at seventy m.p.h. over 1500 yards after being released from aircraft traveling at speeds in excess of 350 m.p.h. Altitudes of release will vary from 50 to 6000 feet. The Hydrobomb will carry a minimum of 600 lbs. of explosives with the detonator of both the contact and proximity types. It will run along a straight course, at any present and controlled depth from 0 to 30 feet.

PURPOSE: To develop a simple, self-propelled, under-water bomb capable of traveling at high speeds and capable of being released at high airplane speeds.

AUTHORITY: Authorization was contained in C.T.I. 1128 dated 22 January 1943 from Headquarters, Materiel Command, Washington, D. C., subject "Development and Design of Aircraft Hydrobombs".

REMARKS: In January 1943, the development problem was presented to California Institute of Technology, United Shoe Machinery Corp., Westinghouse Electric and Mfg. Co. and the A. O. Smith Corp. Work was immediately started by all four concerns and in addition, engineers of the Materiel Command began development on a design of their own. In July 1943 the General Electric Company was consulted on the problem of controls for Hydrobombs being fabricated by the A. O. Smith Company, and in September a proposal was submitted. The N.D.R.C. was consulted in September, and a test program on jet propellants was started at the Monsanto Chemical Co.

Launching models of the Hydrobomb designed by Materiel Command engineers and fabricated by the A. O. Smith Company were delivered in December and preliminary drop tests were completed at Eglin Field.

A full sized wooden model of the United Shoe Machinery Corp. Hydrobomb and full size and half size wooden models of the Materiel Command Hydrobomb are now being built. Upon completion, these models will be tested in the recently completed towing channel at California Institute of Technology.

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EXTENSION OF EFFECTIVE RANGE OF
COMPENSATED SIGHTING EQUIPMENT

Pending	National Defense Research Committee Armament Laboratory
AAF Project No.	Mfg. or Activity Charged with Development
MX-433	None
Classified Project No.	Contract Number

DESCRIPTION: An investigation is to be conducted to determine the possibilities of extending the effective range of compensated sighting equipment which can be supplied in the near future.

PURPOSE: To make it possible to protect formations of bombardment airplanes from enemy fighter aircraft by means of projectiles fired accurately from our own aircraft.

AUTHORITY: Commanding General, Army Air Forces.

REMARKS: According to present plans, this project is to include separate investigations of the errors of (a) guns and ammunition, turrets and mounts, (b) harmonization, (c) aim, (d) sight and computer, including lag, (e) transmission system between gun and sight, static and dynamic, and (f) possible avoiding action of target. After the combined effect of all these factors had been determined, the probability of a hit can be computed and the value of increasing or decreasing the dispersion of various components can be investigated. If the relative destructability or lethal index of a hit is known, the probability of destruction by gun fire from various combinations of gun arrangements can be studied to determine what type of defense should be expected to provide optimum results.

Various commercial and government organizations have been requested to study the possibility of supplying an optical magnifier which can be used in combination with present sighting equipment to investigate the possibility of recognizing enemy fighter aircraft and firing at longer range.

The Ordnance Department is expected to aid in obtaining dispersion data on various guns, ammunition, turrets, and mounts. The N.D.R.C. is expected to aid in the mathematical computations involved in the program.

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CHAFF DISPENSER

Pending	National Defense Research Committee Equipment Laboratory
AAF Project No.	Hdq. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: The chaff dispenser is a device for distributing from operational airplanes at various intervals small strips of aluminum foil, named "chaff" for use against enemy radar. The principle of operation is the simulation of an aircraft by reflection of the radar beam against the masses of chaff as it floats slowly downward through the air, thus confusing enemy radar detection or gun laying equipment.

PURPOSE: To develop a device for distributing "chaff" at desired intervals without the necessity of an additional crew member for this purpose.

AUTHORITY: Asst. Chief of Air Staff, M.M.&D., Materiel Division.

REMARKS: Request for the establishment of the project was initiated 13 December 1943.

The Materiel Command has been in negotiation with the Frigidaire Corporation concerning the construction of such a dispenser. This equipment is at present nearing completion.

The N.D.R.C. project was initiated for the purpose of establishing an additional and perhaps more satisfactory development.

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Aircraft
Lab. Projects

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SECTION I

AERODYNAMICS PROJECTS

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NACA LOW-DRAG WING

458-1-348, Add.2
Expenditure Order No.

Republic Aviation Corp.,
Farmingdale, L.I., New York, N. Y.
Mfg. or Activity Charged
with Development

MX-116
Classified Project No.

AC-19378
P.O. 42-11147
P.O. 42-3042
Contract No,

DESCRIPTION: An NACA low-drag wing has been purchased and installed on a Government furnished XP-47F airplane in order to obtain flight test data for NACA low-drag airfoils on high-performance aircraft. The data obtained on the airplane with NACA low-drag wing should have the advantage of being directly comparable with data on the same type of airplane with a conventional airfoil section.

PURPOSE: To obtain comparative flight test data on airplanes with NACA low-drag and conventional airfoil sections.

AUTHORITY: Chief, Engineering Division.

REMARKS: Contract AC-19378, dated June 27, 1941, covered construction and installation of the full scale laminar-flow wing on the Government furnished XP-47F airplane. This contract also called for an 80-inch chord wing model of 36-inch span. A second wing model with an 80-inch chord and 36-inch span was obtained under P.O. 42-1147 to determine the effects of surface irregularities. Engineering data on a 1/6-scale powered windtunnel model of the XP-47F with low-drag wing and on a 24-inch pressure distribution model were obtained under P.O. 42-3042 to assure satisfactory stability and control characteristics.

The full scale laminar flow wing installation was accepted by the Army Air Forces and preliminary flight tests and profile drag measurements in flight were carried out at Wright Field. The airplane was then sent to the N.A.C.A. Laboratories for further testing. The first portion of the tests at the N.A.C.A. Laboratories were completed and the airplane was flown to a modification center to have the horizontal tail surfaces metal covered. The airplane crashed and was completely destroyed during the return flight to Langley Field. The advisability of obtaining another test airplane is now being considered.

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BOUNDARY LAYER CONTROL WING

458-358 Expenditure Order No.	Dow Chemical Company Midland, Michigan Mfg. or Activity Charged with Development
MX-207 Classified Project No.	AC-27336 Contract No.

DESCRIPTION: An experimental high lift wing utilizing boundary layer control is being procured as a test installation on an L-1 airplane. The Contractor has designed, built, installed, and will flight test the wing and its associated equipment. The experimental wing is of double-flapped type, provided with spanwise slots for induction of boundary layer air. Ducts connect the interior of the wing to a blower situated in the fuselage. Power for the air induction is supplied by an auxiliary light aircraft engine driving the blower. It is expected that removal of the wing boundary layer air, by delaying the separation of the air flow, will permit operation of the double-flapped wing at lift coefficients considerable higher than those attained with conventional airfoil sections.

PURPOSE: To investigate the feasibility of using boundary layer control as a means for providing higher lift coefficients for military aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Negotiations regarding the performance of the subject experimental work were begun in December, 1941, with a proposal submitted by the Dow Chemical Company. As specified in the contract, L-1 airplane No. 40-255 has been supplied to the Contractor for use in the design, installation and test of the Articles called for. Design, construction and installation of the test wing and the associated equipment are complete. Contractor's flight tests are expected to begin in January 1944.

Development of a practical boundary layer control system of this nature would have particular application to bomber type airplanes, making possible the design of load carrying aircraft of appreciably higher efficiency than currently available. Application might also be made to observation aircraft, and to other military types.

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BELLOWS FLAPS

458-367	Aircraft Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-294	None
Classified Project No.	Contract No.

DESCRIPTION: An experimental set of bellows-operated flaps have been installed on an XTG-3 glider and are currently being flight tested.

The bellows flap is a device utilizing for motive power some of the energy in the air flowing past an aircraft in flight. In essence, the device consists of a conventional split-type flap, hinged to the wing structure, and joined thereto by means of gas-impervious material to form an air-tight bellows. Deflection of the flap in flight is achieved by taking air into the bellows under dynamic pressure, derived from the motion of the aircraft through the air. Retraction is obtained by venting the bellows to a region of negative pressure, similarly derived.

PURPOSE: To develop landing and glide control flaps, such flaps to be operable without hydraulic or electrical power.

AUTHORITY: Chief, Engineering Division.

REMARKS: The current development began on January 12, 1942, under Project MX-114, a general glider development project. A working model, submitted to the Materiel Command in 1933 by a private concern was used as a starting point in the development. Although unsuccessful in the attainment of satisfactory operation, this model presented the first known application of the basic bellows flap principle.

A new working model was designed, built and performed successfully under test, whereupon design was started of a full-scale experimental installation of similar flaps on an XTG-3 glider. This installation is complete and flight tests were begun in November 1943. The current phases of this development are covered by Expenditure Order No. 458-367, dated August 12, 1942, calling for the "Development and flight test of an experimental bellows flap installation on a two-place glider."

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FLIGHT MEASUREMENT OF COMPRESSIBILITY EFFECTS

458-370 Expenditure Order No.	Langley Memorial Aeronautical Laboratory Mfg. or Activity Charged with Development
MX-335 Classified Project No.	None Contract No.

DESCRIPTION: Study of compressibility effects at high speeds by means of measurements taken during high-speed dives. Airplane has been furnished by the Materiel Command for flight tests now being conducted by the Langley Memorial Aeronautical Laboratory. The L.M.A.L. has installed the necessary instruments and will conduct the tests. The Materiel Command will cooperate with the L.M.A.L. in the analysis of the results. Data to be obtained from Ames Aeronautical Laboratory high-speed wind-tunnel tests on a model of the test airplane will be correlated with the flight results, to indicate the degree of correlation existing between flight and wind-tunnel compressibility phenomena.

PURPOSE: To determine compressibility effects upon an airplane in high-speed flight.

AUTHORITY: Chief, Engineering Division.

REMARKS: N.A.C.A. participation in the Project was requested in a letter from the Materiel Center to the N.A.C.A., November 27, 1942 and was agreed to in a letter from the N.A.C.A. to the Materiel Center, December 11, 1942.

An XP-51 airplane has been sent to Langley Field. The airplane has been completely instrumented by the L.M.A.L. The flight tests are 15 percent completed. Dive-recovery flaps are being installed for the terminal-velocity dives.

Because of constriction effects in a wind tunnel, greatly magnified at high Mach numbers, it is possible that the undesirable compressibility effects exhibited in wind tunnels may be much more than those obtained in free flight. This question is of fundamental importance in airplane design, since the design loads on an airplane may be greatly affected by compressibility effects. The flight test program will aid in establishing the necessary correlation between wind-tunnel and free-flight compressibility effects.

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INVESTIGATION OF ANTI-SPIN CHUTES

458-366 Expenditure Order No.	Langley Memorial Aeronautical Laboratory Aircraft Laboratory Mfg. or Activity Charged with Development
MX-306 Classified Project No.	None Contract No.

DESCRIPTION: The Materiel Command and the Langley Memorial Aeronautical Laboratory are participating in a joint study to provide more reliable safeguards for airplanes undergoing spin tests. The program includes a study of parachute forms to provide effective anti-spin moments with stable chutes. It also includes spin model tests at Langley Memorial Aeronautical Laboratory to determine types of spin chute installations required to effect recovery. By correlation of model tests with flight tests on airplanes with comparable anti-spin chute installations at the Materiel Command, it is hoped to arrive at design criteria for determining effective anti-spin installations for use in tests of prototype airplanes.

PURPOSE: To provide more reliable emergency recovery means for airplanes undergoing spin tests.

AUTHORITY: Chief, Engineering Division.

REMARKS: During the past year, the N.A.C.A. has conducted tests of various spin chute installations on models in the free spinning tunnel. The effect of the following configurations on recovery has been determined from model tests: bridle line length, chute diameter, and location of chutes on both tail and wing tips. Full scale tests at Wright Field included a series of tests on an AT-6C airplane in which chute diameter, bridle line length, and chute porosity were varied. A wing tip chute installation has been installed on a P-39K and is being flight tested. A tail chute installation has also been made on this same airplane. Successful recovery has been effected with a 3-1/2 foot diameter wing tip chute on this airplane.

Work in progress at present is:

a. Continuation of wing tip chute tests on P-39K.
b. Tail chute tests on P-39K.
c. Tail chute tests on P-51B.
d. Wing tip chute installation on AT-6C.
e. Tests in Wright Field 20-Foot Wind Tunnel to determine relationships between airspeed, diameter, drag, porosity, and "squidding" for spin chutes.

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Swept-Forward Wing Tailless Airplane

458-363 & 430-143	Aircraft Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
M81-40	None
Classified Project No.	Contract No.

DESCRIPTION: The development work under this project has entailed the study of a new tailless airplane configuration with swept-forward wings instead of the usual swept-back wings. Greatly improved aerodynamic characteristics over previous tailless airplanes have been realized. Wind tunnel study models MCD 379, 384, and 387 have been tested in the Wright Field Five-Foot Wind Tunnel. Three preliminary designs have been completed by the Aircraft Laboratory. The results of these design studies are presented in Memorandum Reports ENG-51-4308-3-2, ENG-51-4308-3-1, and ENG-51-4308-4-3, Addendum 2.

PURPOSE: To develop a tailless airplane configuration which will give satisfactory stability and control characteristics as well as improved performance.

AUTHORITY: Chief, Engineering Division.

REMARKS: The tailless airplane has enjoyed considerable attention from airplane designers due to its possibilities of lower weight and drag. Unfortunately, in all designs made thus far, the poor stability and control characteristics of these airplanes as well as the very low trim maximum lift coefficient obtainable have counteracted the above advantages. The tailless airplane with a swept-forward wing as developed in this project gives indications that normal airplane stability and control may be realized as well as higher trimmed maximum lift coefficients than previous tailless designs. Wind tunnel tests of MCD 379 and 384 have been published in AAF Technical Report 4068. The results of a wind-tunnel test of MCD 387 is to be published in the near future.

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FLYING QUALITIES INVESTIGATIONS

Aircraft Laboratory
National Advisory Committee
for Aeronautics
Mfg. or Activity Charged
with Development

458-363
Expenditure Order No.

None
Classified Project No.

None
Contract No.

DESCRIPTION: The flying qualities of various AAF airplanes are being investigated by the N.A.C.A. Laboratories at Langley and Moffett Fields. These investigations include the measurement of airplane stability, control forces, trim, maneuverability, and stall characteristics. The investigation also includes the determination of acceptable characteristics from the service pilot's viewpoint.

PURPOSE: To establish standards for evaluating the flying qualities of airplanes and ot obtain information on specific airplanes for setting center of gravity limits and as a basis for further improvement in handling qualities.

AUTHORITY: Chief, Engineering Division

REMARKS: The flying qualities test program at AAL started in January, 1943, is well under way at present. To date, tests have been completed on one medium bomber, one fighter, two attack airplanes, and one cargo airplane. Tests are in progress on one medium bomber, one heavy bomber, four single engine fighters, one attack airplane. Proposed tests on several airplanes in each of the above categories are awaiting completion of present tests.

The AAF flying qualities specification has been completed and published. All tests are now being conducted in accordance with this specification. The official designation of this specification is "Stability and Control Requirements for Airplanes," AAF Specification No. C-1815, dated 31 August 1943.

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P-51B COOLING DRAG TESTS

430-156	Aircraft Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Total head and static tubes are being installed in the radiator duct of a P-51B airplane to measure the velocity and quantity of airflow through the system. Air temperatures are also being recorded by means of resistance bulbs located forward and aft of the radiator to evaluate the jet thrust produced by this system. Total head pressures will be measured by means of sensitive airspeed indicators and static pressures by means of altimeters. These instruments along with the temperature gauge will be installed in a photorecorder panel. Tests will be run at various air speeds and for several radiator and oil cooler flap settings.

PURPOSE: To obtain information with which to check the theory of cooling drag for application to future designs.

AUTHORITY: Chief, Engineering Division.

REMARKS: Due to the large number of pressures to be measured and the limited space for instruments, a pressure selector valve had to be designed and built in order that these pressures might be recorded on a small number of instruments. This valve has been completed. A temperature selector switch has been purchased which will eliminate the need for a large number of temperature indicating instruments. The pressure valve and temperature selector switch will be mounted as a unit and will be driven by an electric motor geared down to approximately .5 RPM.

High speed of latest fighter airplanes brings up the possibility of obtaining an appreciable amount of jet thrust from an efficient radiator installation. Informationobtained from this test will be checked against the present theory of cooling drag and jet thrust.

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DY-
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SECTION 2

DYNAMICS PROJECTS

VIBRATION PROJECTS

FLUTTER PROJECTS

SOUND PROJECTS

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VIBRATION IN AIRCRAFT DUE TO PROPELLERS

455-29	Aircraft Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This project deals with an experimental investigation of the vibration response of airplanes to propeller generated forcing functions.

PURPOSE: To investigate the effect of propeller generated vibration forcing functions on the vibration response of airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: The subject project was set up jointly between the Aircraft Laboratory and Propeller Laboratory to study the contribution of propeller generated forcing functions to vibration response of aircraft structures. It has long been known that propeller unbalance can be a serious source of airplane vibration but no specific information has been available regarding the relative importance of static, dynamic, and aerodynamic unbalance of the propeller. The importance of reducing the number of rejections of finished airplanes for unsatisfactory vibration characteristics and the importance of reducing the number of propeller blade rejections and subsequent delays in production resulted in initiating test work to determine: (1) the relative importances of the different propeller forcing functions; (2) the unbalance tolerances which must be maintained to provide a satisfactory installation of the propeller in the airplane from a vibration standpoint; (3) the kind and amount of unbalance which characterize installations of production propellers in airplanes.

The work thus far completed, has shown that the important propeller forcing functions are due to unbalance and also to bending vibrations of the propeller blades. It has been found that these forcing functions are intimately associated with the propeller blade design, the vibration characteristics of the crankshaft system of the power plant; the elastic characteristics of the power plant mounting system and the position of the power plant installation in the airplane. Tests to date on a P-39 and a P-47 airplane have shown that the airplanes are not particularly sensitive to propeller static or dynamic unbalance; aerodynamic unbalance of very small amounts, however, (measured in terms of inequality of blade angles) has been shown to be the principal contributor, from a propeller unbalance standpoint, to vibration in the airplane. These results have initiated an investigation by the Propeller Laboratory into aerodynamic unbalance toler-

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ances defined in terms of equivalent blade angle inequality. This factor is being used as a parameter to obtain equal aerodynamic characteristics of propeller blades so that distributed errors in blade angle and profile may be compensated. Vibration measurements on airplanes in flight equipped with many production propellers of different manufacture has shown propeller blade bending vibration and aerodynamic unbalance to be the cause of vibration in the airplane severe enough to result in rejection of the airplane by acceptance pilots. This work is being extended in order to determine the most effective method of minimizing vibration from these sources. In particular, the investigations include the effects caused by providing engine mounts that are flexible in the fore and aft direction as well as mounts without friction dampers.

PREVENTION OF ENGINE COWLING
FAILURES DUE TO VIBRATION FATIGUE

711-6013 Expenditure Order No.	Aircraft Laboratory Mfg. or Activity Charged With Development
None Classified Project No.	None Contract No.

DESCRIPTION: This project concerns engineering work in connection with the problem of mounting ring cowls in radial engine installations to avoid service failures induced by vibration.

PURPOSE: To study the vibration characteristics of engine ring cowls and to formulate design criteria which may be applied to future designs in order to eliminate unsatisfactory service conditions.

AUTHORITY: Chief, Engineering Division.

REMARKS: The numerous unsatisfactory reports regarding vibration fatigue failures have been studied and the action described below has been taken.

Vibration test programs were initiated to determine the vibration difficulties involved in particular engine cowl designs. Ground and flight tests were conducted on the B-26 airplane to determine the vibration characteristics of the engine cowls as supported by three types of cowl attachments. It was found that a tangential arrangement

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of rubber vibration isolators about the cowl former rings reduced the severity of the vibration response in this installation. Vibration tests were also conducted on the B-24, A-20 and C-47 airplanes in order to obtain additional information on the vibration characteristics of engine cowl installations. As a result of the above tests, it is proposed to carry out a design study as to the practicability of incorporating improved vibration isolators for attaching engine cowls in service airplanes and to formulate specific design criteria to be applied to future airplanes for the purpose of preventing vibration failures.

SYNTHETIC RUBBER VIBRATION ISOLATORS FOR MOUNTING AIRCRAFT POWER PLANTS

44-1-24 Expenditrue Order No.	Aircraft Laboratory Mfg. or Activity Charged with Development
None Classified Project No..	None Contract Number

DESCRIPTION: This investigation covers a study of the elastic, fatigue and service life properties of power plant vibration isolators manufactured from synthetic rubber.

PURPOSE: To develop and service test power plant vibration isolators fabricated from synthetic rubber.

AUTHORITY: Chief, Engineering Division and Requests of the War Production Board.

REMARKS: This project was initiated February 1942. Considerable progress has been made recently in obtaining the cooperation of the industry in developing synthetic compounds to replace the natural rubber employed in these items. Memorandum Report No. ENG-51-VF41, Addendum 5, entitled "Power Plant Vibration Isolators Rubber Conversion Program," was prepared and forwarded to the manufacturers of this equipment. The industry is now cooperating with the Materiel Command in supplying synthetic rubber bushings for service tests. One set of bushings, fabricated from Neoprene for the R-1820 power plant is expected to undergo cold weather tests this winter in a B-17 airplane in Alaska. Another set of similar bushings is undergoing service tests in the torque stand at Wright Field. Action has been initiated to procure

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additional synthetic bushings for service tests in the B-24, B-17 and P-40 type airplanes. Load Deflection Tests of Neoprene bushings tested to date indicate that the elasticity of natural rubber bushings can be duplicated. However, little is known of the service life that can be expected from bushings fabricated from this material especially under extreme temperatures. A testing fixture and testing methods are being developed to obtain this information in the laboratory. Drawings and design details for this machine are 95% complete.

PREVENTION OF EXCESSIVE OSCILLATIONS IN ROTARY WING AIRCRAFT

455-18 Expenditure Order No.	Aircraft Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: The development of theoretical methods, experimental procedures, and practical corrective measures for application to vibration problems in rotary wing aircraft.

PURPOSE: To eliminate dangerous and/or objectionable oscillations in rotary wing aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: The theory of mechanical instability of rotors, recently developed at the NACA and at the Materiel Command, has successfully been applied to several autogiros and helicopters. A simple test procedure has been set up so that the critical range of instability may be predicted and if it exists within the operating range of rotor rpm, it may be eliminated by proper blade and landing gear damping. The quantity of damping necessary to remove the instable range may be calculated with at least fair accuracy according to the theory. The G&A XO-61 autogiro and the Sikorsky XR-6 helicopter which were formerly unstable during rev-up on the ground have been made safe by means of damping.

Flight tests of the Sikorsky XR-5 and XR-6 helicopters are now being carried out to determine the nature and cause of the excessive vibrations of these aircraft observed during flight. In addition,

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it is intended to carry out flight tests of a XR-4B helicopter, in cooperation with the Propeller Laboratory, to measure the motions of the blades about their hinges as well as the horizontal and vertical oscillations during various conditions of flight. As soon as practicable a helicopter rotor will be tested in the NACA full-scale wind tunnel at Langley Field in order to secure test data under a greater number of test conditions than is possible in flight.

GOODYEAR FLEXIBLE
SUSPENSION UNITS

None	North American, Inglewood, Calif. Goodyear, Akron, Ohio
Expenditure Order No.	Mfg. or Activity Charged with Development
None	43-24062-E
Classified Project No.	Contract Number

DESCRIPTION: This development covers the procurement and vibration test of the Goodyear flexible suspension installed in an AT-6C airplane.

PURPOSE: To test on an AT-6C airplane in flight the effectiveness of a flexible suspension developed for the purpose of isolating engine vibration and to create for the Aircraft industry additional sources of supply for such items of equipment.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Contractor completed the installation of this mounting 29 July 1943.. Vibration tests were then conducted in flight and were completed 5 August 1943. The results of the tests showed that the new mounting reduced to a considerable extent the vibration response of the power plant and appreciabley reduced the vibration level throughout the airplane structure. A report covering the test results is being prepared. The success of this development to date has encouraged the Goodyear Tire and Rubber Company to embark on a program to develop vibration isolators for all current types of aircraft power plants, thus creating for the aircraft industry an alternate source of supply for these items of equipment. The suspensions developed by this company show possibilities of saving weight as well as reducing the cost and number of parts as compared to other types of flexible engine mountings for radial engines.

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FLUTTER TESTS IN FLIGHT

459-1-14, 459-1-16
Expenditure Order No.

Aircraft Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: This project covers flight tests to obtain experimental data regarding airplane flutter characteristics. This will include tests with and without forced vibration in flight of the following;

a. Actual airplanes (with test personnel on board) at speeds below the critical flutter speed.
b. Radio controlled airplanes at speeds up to and including the critical flutter speed.
c. Towed glider with remote control at speeds up to and including the critical flutter speed.
d. Modified airplane model tow targets at speeds up to and including the critical flutter speed. It is intended to record the amplitude frequency, and phase relationships of the oscillations in flight for each of the above programs.

PURPOSE: a. To obtain experimental data in full-scale flight for checking the accuracy of modern flutter theory.
b. To develop test equipment and necessary technique for carrying out flight tests to determine the safety of airplanes against flutter.

AUTHORITY: Chief, Engineering Division.

REMARKS: a. Flutter tests have been conducted on a CG-3A glider in the fuselage lateral bending vs. rudder mode of flutter. The tests involved the measurement of the rate of decay of fuselage and rudder vibrations up to the limit diving speed. The tests indicated a close approach to flutter but additional mass unbalance of the rudder will be necessary before an actual flutter point can be obtained in the allowable speed range of the glider. A device for changing the unbalance of the rudder in flight has been designed and it is expected that additional flutter tests of the glider will be made in the near future.

b. Flight tests to determine safety against flutter have been conducted on the XP-61 and XP-51 airplanes and the rate of decay of the transient oscillations were measured at various air speeds. No approach to flutter was noted in either of these airplanes under the test conditions.

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c. Flight flutter tests of the original C-54A rudder spring tab combination (without tab mass balance) showed that flutter could be excited at speeds as low as 160 m.p.h. I.A.S. and that the speed had to be reduced to 140 m.p.h. I.A.S. before the oscillations could be stopped. Measurements were made of the fuselage, rudder and tab oscillations during these tests so that flight data is now available for checking spring tab flutter theory. Further flight tests were conducted on a C-54A rudder spring tab that was completely statically balanced. The results of these tests showad that mass balancing the tab eliminated its flutter tendencies. Theoretical flutter calculations made to correlate the flutter speeds and measurements obtained on the original unbalanced C-54A rudder showed considerable quantitative discrepancies between computed and measured data. These discrepancies involve the critical flutter speeds, amplitude ratios and phase angles and appear to be caused by difficulties in evaluating the effect of friction and the equivalent flutter parameters of non-linear systems;

d. The radio-controlled flutter tests of the XTG-1 glider have been completed. The tests were conclusive in showing that the results of two dimensional flutter computations were extremely conservative for the strut braced wing. The flutter speed computed by three-dimensional methods was 120 mph as compared to speed of [illegible]0 mph computed by two-dimensional methods. Tests were conducted up to a speed of 115 mph at 15,000 feet and were terminated when the glider broke loose from the towing plane. Although radio control of the glider was reestablished the glider went into a spin during its landing approach and crashed. A Technical Report covering the subject investigation is practically completed. The valuable experience and technique gained during the instrumentation and testing of the XTG-1 towed glider is being applied towards developing and improving existing remote control, vibration exciting, and transmission equipment. The initiation of a new project using a power aircraft has been recommended.

e. Additional flight flutter tests of the Bristol C-1 tow target will be made when the aerodynamic control difficulties have been eliminated.

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FLUTTER RESEARCH SPONSORED BY THE MATERIEL COMMAND

562-1-20
Expenditure Order No.

Aircraft Laboratory
Mfg. or Activity Charged with Development

Restricted MX-152
Classified Project No.

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Contract Number

DESCRIPTION: a. By the California Institute of Technology (Contract No. 535- AC-27683)

(1) Development of an electrical flutter model consisting of networks for the rapid determination of critical flutter speeds.
(2) Theoretical computations of the effects of various chordwise engine locations and flexible engine suspensions on the wing flutter speeds of multi-engine airplanes.
(3) Development of theoretical methods for considering the effects of aspect ratio on flutter characteristics.

b. By the Massachusetts Institute of Technology (Contract No. 535 AC-16238 and No. 535 AC-29683).

(1) Tests of wind-tunnel flutter models of a wing-aileron system complete from tip to tip.
(2) Theoretical calculations to check the experimental results obtained in b(1) above.

PURPOSE: To utilize available facilities at educational institutions for:

a. Improving available methods for computing airplane flutter tests.

b. Obtaining experimental data to check methods of computing airplane flutter characteristics.

AUTHORITY: Chief, Engineering Division.

REMARKS: a. The electrical flutter predictor for three degrees of freedom has been delivered at Wright Field and is undergoing acceptance tests. It appears to be very satisfactory in principle and results in considerable time savings in solving three degree of freedom flutter problems. However, poor design details such as malfunctioning of switches, etc. have been causing maintenance difficulties.

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b. C.I.T. has submitted a report covering a theoretical study of the effects of aspect ratio on the aerodynamic forces and moments involved in flutter oscillations. This study indicates that the aspect ratio corrections are quite large when the aspect ratio is 3 or less.

c. C.I.T. studies of the effects of chordwise engine locations and engine mount flexibility have been completed and a report covering the studies is being compiled. These studies are expected to reveal important information regarding the flutter characteristics of multi-engine airplanes of the pusher as well as tractor types.

d. The experimental tests on the constant-chord flutter model wings at M.I.T. have been completed and theoretical calculations are being conducted by the Contractor to check the experimental results. The flutter models have been fabricated for the tapered-wing investigation and the wind tunnel tests are about to begin. The construction of the tapered wing models has been greatly improved over previous models as a result of experience obtained in the constant-chord wing project.

METHODS FOR
COMPUTING FLUTTER CHARACTERISTICS

[illegible]-1-15 Expenditure Order No.	Aircraft Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Improved theoretical methods for computing aircraft flutter characteristics are developed and checked against model and flight flutter tests.

PURPOSE: To develop improved methods of flutter analysis so that A.A.F. aircraft will not only be safe from flutter but that the weight penalty for flutter prevention will be a minimum.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project first resulted in the publication of A.A.F. T.R. #4798 subject, "The Application of Three-Dimensional Flutter

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Theory to Aircraft Structures." Work is being carried out to check these methods against experimental data obtained in flight and wind tunnel flutter tests and the results obtained thus far indicate a much closer correlation between theory and experiment than has been the case with the two-dimensional theories previously used. An addendum to this report is now being prepared to extend the method to flutter analysis of all types of tabs including in particular the spring-restrained servo tab. From the results obtained to date with tab flutter theory, it appears that, with proper precautions, spring tabs can be used without danger from flutter. The theoretical results are also being checked against several recently experienced cases of flutter of spring tabs.

IMPROVED SOUNDPROOFING MATERIALS

455-25	Aircraft Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This project concerns the development of materials and methods for soundproofing aircraft which will reduce the necessary weight of the installation.

PURPOSE: To develop methods and materials for soundproofing aircraft which will reduce the weight of present soundproofing materials, improve the efficiency of the installation, reduce fire hazard, and be easily installed or removed.

AUTHORITY: Chief, Engineering Division.

REMARKS: At the time of initiation of this project Kapok was considered the most efficient material known for soundproofing aircraft and from tests conducted at Harvard University a method of installation using a non-porous fabric enclosed between two Kapok blankets covered by a trim cloth had been evolved as the most efficient method of installing Kapok. Due to the shortage of Kapok two vegetable fibers, Typha and milkweed floss, have been investigated and found satisfactory as substitutes. In addition a material made from mineral wool has been found which does not need to be flameproofed and is water resistant. This material is somewhat heavier than

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Knock and efforts have been made in cooperation with manufacturers to evolve a lighter material using a mineral fiber as the basic constituent. As a result a glass wool has evolved which is one third the density of Knock and equally as efficient in reducing the weight of the non-porous fabric and trim cloth used. The tests are being carried on at the University of Michigan and have already indicated methods of reducing the density of the non-porous fabric.

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SECTION 3

STRUCTURES PROJECTS

STRUCTURES

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BC-1 WELDED MAGNESIUM WING PANEL

451-1-257
Expenditure Order No.

Northrop Aircraft, Inc.
Hawthorne, Calif.
Mfg. or Activity Charged with Development

None
Classified Project No.

AC-17234 and AC-18109
Contract No.

DESCRIPTION: An outer wing panel fabricated of magnesium alloy interchangeable with the standard BC-1 panels. These panels are assembled by welding instead of by rivets.

PURPOSE: To further develop the use of magnesium as a structural material; to investigate the possibility of arc welding of magnesium for the assembly of aircraft parts; to determine the suitability of this material and process in service from a structural and corrosion resistance viewpoint.

AUTHORITY: Chief, Engineering Division.

REMARKS: The structural test panel failed to support the required loads and was returned to the contractor for reinforcement. The reinforced panel satisfactorily supported the requir d loads. The service test panels on Contract No. AC-17234 have been completed and were installed at the contractor's plant on a BC-1 airplane from Brocks Field, Texas. Two sets of panels are awaiting installation at Kelly Field. One Set of panels was warped during fabrication. One panel of this set was subjected to gunfire tests under 1g load. The other panel of the set is now undergoing stress corrosion and weathering tests under 1g load.

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BC-1 RIVETED MAGNESIUM WING PANEL

451-1-232	Northrop Aircraft, Inc. Hawthorne, Calif.
Expenditure Order No.	Mfg. or Activity charged with Development
None	W535-AC-14660 & AC-14635
Classified Project No.	Contract No.

DESCRIPTION: An outer wing panel fabricated of magnesium for the BC-1 airplane. This panel was designed in accordance with Specification No. X-40292 and is of riveted construction. In order to facilitate inspection and repair, the panel consists of three detachable spanwise sections.

PURPOSE: To develop the use of magnesium as structural material and to determine its suitability for service from a structural and corrosion resistance viewpoint by utilization of this material in flight as a complete structural unit.

AUTHORITY: Chief, Engineering Division.

REMARKS: The two sets of panels procured on Purchase Order No. 40-7563 were installed on BC-1 airplanes for service test. The left panel of one set was damaged beyond economical repair in a taxiing accident. The right panel of this set was placed in stock. One set was removed after 14-1/2 months of service and 491.5 hours of flying time and disassembled for a thorough inspection. The panels were found to be serviceable and were reinstalled on an airplane at Brooks Field, Texas after minor repairs were made. After 36:05 additional time this airplane was involved in a midair collision and crashed and burned. The tips on the remaining set of panels were damaged in a ground loop. The panels were removed and are being held in stock pending the arrival of new tips from Northrop.

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DESIGN OF AT-6 OUTER WING PANEL ASSEMBLED BY CYCLE-WELD PROCESS

451-279 Expenditure Order No.	Chrysler Corporation Dodge Div.,Cycle-Weld Lab., Detroit, Michigan Mfg. or Activity charged with Development
MX-243 Classified Project No.	W535 AC-39935 Contract No.

DESCRIPTION: Complete program will include the study of a design for an AT-6 outer wing panel to be assembled by the Cycle-Weld Process, outline of tooling and methods of fabrication.

PURPOSE: To determine the feasibility of utilizing the Cycle-Weld method for the production of major structural components of aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Final reports on subject contract are in preparation by Chrysler Corporation.

DEVELOPMENT OF CAST MAGNESIUM ALLOY FOR AIRCRAFT STRUCTURAL PARTS

451-235 Expenditure Order No.	Dow Chemical Company Midland, Michigan Mfg. or Activity charged with Development
None Classified Project No.	P.O.(33-038) 44-3970 Contract No.

DESCRIPTION: Three piece cast magnesium alloy AT-6 wing test section.

PURPOSE: To investigate the possibilities of casting large sections of aircraft primary structure.

AUTHORITY: Chief, Engineering Division

REMARKS: Priliminary drawings of the test section have been received. Dow has experimentally cast a P-40 fin with some success, however, considerable work on the fabricating technique for casting large thin sections is necessary. This work is in progress.

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PROCUREMENT OF MAGNESIUM AIRCRAFT PARTS

451-1-268	Dow Chemical Company, Midland, Michigan
Expenditure Order No.	Mfg. or Activity charged with Development
None	AC-26702
Classified Project No.	Contract No.

DESCRIPTION: a. Fabric covered magnesium aileron for AT-6 airplane, similar in construction to the standard aluminum alloy part.

b. All metal aileron fabricated of magnesium for the AT-6 airplane and similar in construction to the standard aileron.

c. Vertical fin for P-40D airplane. This part is of magnesium construction and is essentially of heavy skinned pure monocoque construction.

d. Wing panel for A-20A airplane. This outer wing panel is to be constructed of magnesium alloy and designed for the same loadings and to be interchangeable with the standard aluminum alloy panel.

PURPOSE: To develop magnesium as a structural material and to investigate the production possibilities of the type of design made possible by the use of this light alloy.

AUTHORITY: Chief, Engineering Division.

REMARKS: a. Each type of aileron was subjected to static and vibration tests. Both types were accepted as satisfactory after changing the balance on the metal covered ailerons and adding gussets to the fabric covered ailerons. Ten sets of each type have been shipped to various stations for service tests. Static and vibration tests have been satisfactorily completed on two P-40D fins. The first of the service test articles are expected by 1 January 1944.

b. In response to the interest shown by the Engineering Division in the development of a monocoque magnesium structure in a heavily loaded wing such as the A-20A outer wing panel, the Dow Chemical Company submitted a proposal for the design and fabrication of one panel for preliminary tests, one panel for final structural tests, and one set (right and left hand) for service tests. Drawings and reports of item 1 have been received. Delivery of the first static test article is expected in April, 1944.

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CONVERSION OF TRAINING AIRPLANES
TO PLYWOOD AND PLASTICS

451-1-261	Aircraft Laboratory Doak Airc., Hermosa Beach, Cal. Fletcher Av., Pasadena, Cal. Duramold Airc., New York, N.Y.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	AC-19371, AC-19197, & AC-20144
Classified Project No.	Contract No.

DESCRIPTION: a. The parts converted into plywood by Doak Aircraft Company are for the AT-6A airplane and consist of outer wing panels, flaps, ailerons aft section fuselage, fuselage side panels, and empennage. These parts are made of Douglas fir plywood assembled by cold setting resin glue.

b. The parts converted into plywood by the Fletcher Aviation Corporation are for the BT-13A and BT-15 airplanes and consist of outer wing panels, flaps, ailerons, aft section fuselage, fuselage side panels, and empennage. These parts are made of spruce plywood assembled by cold setting resin glue.

c. The outer wing panel of the AT-6A airplane is being converted into plywood by the Duramold Aircraft Corporation. This panel is made up principally of mahogany veneers assembled by the Duramold process using thermo-setting adhesive of the phenol-formaldehyde type. The design is a thick shell structure.

PURPOSE: To develop plywood construction in training type airplanes to determine the suitability as a substitute for aluminum alloys by actual use in flight.

AUTHORITY: Authorization was contained in CTI-209, dated 7 March 1941, from Chief, Materiel Division, subject: Conversion of Training Airplanes to Plywood and Plastics.

REMARKS: a. A proposal was received from Doak Aircraft Company in letter dated 26 April 1941, for the conversion of outer wing panels, aileron flaps, aft fuselage section and empennage of the AT-6A airplane into plywood. A proposal was received from the Doak Aircraft Company in letter dated 4 February 1942, for the conversion of the fuselage side panels of AT-6A airplane into plywood. The structural test articles of Contract No. AC-19371

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have been received and tested. All parts were satisfactory except the wing panel which has been returned to the contractor twice for reinforcement. The design and workmanship of these parts were excellent but the weight of the parts was 10 to 25 percent greater than the standard aluminum alloy parts. The wing panel was again submitted to Wright Field for tests and was static tested on 16 March 1943. The wing failed at 95 percent ultimate load. Modifications were made by the contractor at the critical points. Drawings, and an analysis of these modifications were submitted to the Materiel Command. The wing was then approved for 100 percent ultimate load based on these changes. Five sets of fuselage monocoques and empennage, and five sets of fuselage side panels have been installed on service airplanes and service tests are being conducted.

b. As the result of a proposal received from the Fletcher Aviation Corporation in letter dated 25 April 1941, Authority for Purchase No. 158521 was initiated for the procurement of 4 sets (one for structural tests and 3 for service tests) of plywood parts for the BT-13A and BT-15 airplanes. Contract No. AC-19197 was approved 19 May 1941 for this procurement. These parts consist of outer wing panels, aileron, flaps, aft fuselage section, fuselage side panels and empennage. The structural test articles were tested at Wright Field and after reinforcement were released for production. The service test articles were installed on BT-13A airplanes at Montebello Airport, California by the contractor for service tests at Minter Field. This contract is now completed. The weight of these parts was considerably greater than that of the standard aluminum alloy parts. These parts have been removed from service due to deterioration of the plywood.

c. In response to a conference with representatives of the Duramold Aircraft Corporation, a proposal was received from this corporation in letter dated 15 May 1941 for the design and fabrication of an outer wing panel molded of plywood by the Duramold process for the AT-6A airplane. Authority for Purchase No. 183842 was initiated 18 June 1941, for the procurement of one panel for structural tests and three sets (right and left hand) for service tests. The wing panel was successfully static tested at the Materiel Command between 14 January 1943 and 19 January 1943, and approval was given. Since the wing was considerably heavier than the standard metal panel and would have to be redesigned and retested to obtain an efficient structure from weight and production viewpoints, and since no production order was contemplated, the flight test articles of this contract were cancelled on 1 March 1943.

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DEVELOPMENT OF SANDWICH TYPE CONSTRUCTION FOR AIRCRAFT STRUCTURES

451-262	Aircraft Laboratory, Vidal Res., New Rochelle, N. Y. Duramold Div., New York, N. Y. Skydyne Inc., Port Jervis, N. Y.
Expenditure Order No.	Mfg. or Activity charged with development
None	W33-038 AC-1214 W33-038 AC-619 W33-038 AC-1182
Classified Project No.	Contract No.

DESCRIPTION: a. The structure to be fabricated of a sandwich type material by the Vidal Research Corporation is the stabilizer for the AT-10 airplane. The stabilizer is to be made with sufficient internal structure to fully utilize a sandwich type skin consisting of a laminated paper corrugated core with plywood faces. The external skin surface is to be covered with aluminum foil.

b. The Duramold Division of the Fairchild Aircraft Corporation is to manufacture fins, of a sandwich construction, for the PT-19 airplane. These parts are to be made of various low density cores with either laminated paper, laminated fabric or laminated glass cloth faces.

c. The aileron for the AT-6A airplane is being fabricated of a sandwich type construction by Skydyne Inc. This part is to be made with a balsa core and laminated paper faces.

PURPOSE: To develop sandwich construction as a structural material and to determine the optimum facing and core material for these sandwiches.

AUTHORITY: Chief, Engineering Division.

REMARKS: a. A proposal was received from the Vidal Research Corporation in letter dated 5 August 1943, for the fabrication of the stabilizer for the Beech AT-10 airplane. Authority for Purchase No. 320838 was initiated on 10 September 1943 for one static test article, one vibration test article and five service test articles. Contract W33-038 AC-1214 was approved for this procurement.

b. A proposal was received from the Duramold Division of Fairchild Aircraft Corporation in letter 29 June 1943, for the

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fabrication of fins for the PT-19 airplane. Authority for Purchase No. 224141 was initiated on 24 July 1943 for three of PT-19 fins, seven fins per set, each set having different face material. Contract W33-038 AC-619 was approved 14 August 1943 for this procurement.

c. A proposal was received from Skydyne Inc., in letter dated 17 May 1943 for the fabrication of ailerons for the AT-6A airplanes. Authority for Purchase No. 224140 was initiated on 23 July 1943 for one static test aileron, one vibration test aileron and five sets of service test articles. Contract W33-038 AC-1182 was approved 29 November 1943 for this procurement.

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SECTION 4

MECHANICAL PROJECTS

WHEEL & BRAKE PROJECTS

LANDING GEAR PROJECTS

MECH-
ANICAL

MECHANICAL OPERATION PROJECTS

HYDRAULIC OPERATION PROJECTS

SPECIAL PROJECTS

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110-INCH SMOOTH CONTOUR WHEEL, BRAKE, TIRE, AND TUBE ASSEMBLY

452-24
Expenditure Order No.

Goodyear Tire & Rubber Co.
Akron, Ohio
Mfg. or Activity charged with Development

None
Classified Project No.

W-535-AC-40892
(535) 43-219-E
Contract No.

DESCRIPTION: This assembly will have a rated static load of 140,000 pounds and braking capacity of 55,000,000 foot pounds. The tire has 34 plies of rayon cord and natural rubber. The weight of the complete assembly should not exceed 4,000 pounds.

PURPOSE: To provide main wheel, brake, tire and tube equipment for the main landing gear on the XB-36 airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: One wheel, tire and inner tube were received about 1 October 1943, and preliminary side load tests have been made. The weights of parts received were considered satisfactory. Side and radial load tests of the wheel, tire, and tube will probably be made in January 1944.

Preliminary tests of the brake discs are being made at the Goodyear plant. Final tests will be made at the Materiel Command on the 16-foot diameter inertia brake testing machine, installation of which will begin in January 1944.

FABRICATED MAGNESIUM ALLOY WHEEL

452-188
Expenditure Order No.

Bendix Products Division
South Bend, Indiana.
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: This wheel is being manufactured to accommodate a 65-inch smooth contour tire. It will be similar to 65-inch wheels now being

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used by the Army Air Forces except that it will be fabricated of welded magnesium alloy sheet instead of the usual cast type. It will be built to accommodate the standard 24-inch three rotor disc brake now used by the Army Air Forces.

PURPOSE: To determine if a fabricated wheel is lighter in weight, easier to manufacture, or is a more efficient wheel design than the conventional cast type.

AUTHORITY: Chief, Engineering Division.

REMARKS: Design work is completed. Sample sections of the wheel have been tested. The wheel assembly is expected to be completed early in January 1944.

WHEEL, BRAKE, AND TIRE TESTING MACHINE

903-1407	Adamson Machine Company, Akron, Ohio.
Expenditure Order No.	Mfg. or Activity charged with Development
None	W-535-AC-32706
Classified Project No.	Contract No.

DESCRIPTION: This test machine is essentially a flywheel, 16 feet in diameter having 28 removable side plates to permit variation of its mass. The inertia wheel is driven by a variable speed motor and is capable of 200 miles per hour peripheral speed at which the maximum energy stored with all side plates is 210,000,000 foot-pounds. Provision is made for landing wheel, brake and tire assemblies against the flywheel under loads up to 300,000 pounds. Suitable instruments are provided to record flywheel speed, brake line pressure, brake torque, deceleration and stopping time.

PURPOSE: To provide laboratory brake testing equipment which will accommodate wheel, brake and tire equipment for airplanes now in construction with suitable allowance for larger future airplane equipment.

AUTHORITY: Chief, Engineering Division.

[redacted]

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REMARKS: Engineering and design work is practically complete. Most of the electrical equipment has been delivered. The air compressor has been delivered. Several flywheel plates have been delivered. Other major machine parts have been completed. The excavation for the foundation has started and installation of the machine should be completed by May 1944.

EQUIPMENT FOR LANDING GEAR DROP TESTS

903-1550 Expenditure Order No.	The Wellman Engineering Company Cleveland, Ohio. Mfg. or Activity charged with Development
None Classified Project No.	W-535-AC-40030 43-32094E Contract No.

DESCRIPTION: Equipment is being constructed to adequately permit the testing of landing gear for aircraft. The drop test equipment allows for laboratory and acceptance tests for weights on the gear of 250 - 150,000# for one landing gear leg. This range is accomplished by the use of 4 drop test rigs of various weight range increments. In the operation of the jigs the weight is dropped from a specific height with controlled load application. The corresponding stresses are then measured and the shock strut action plotted to prove proper shock absorber operation.

PURPOSE: The equipment is used to test landing gear for proper operation and develop new type gear through simulated operational tests.

AUTHORITY: Chief, Engineering Division.

REMARKS: The largest jig is being expedited to allow for test of the XB-36 airplane landing gear. Delivery is expected in April, 1944.

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TRACK TYPE LANDING GEAR

452-84
452-190
Expenditure Order No.

Hub Industries, Inc.
Long Island City, New York
Firestone Tire and Rubber Co.
Akron, Ohio
Mfg. or Activity charged with Development

None
Classified Project No.

W-535-AC-28785
Contract No.

DESCRIPTION: The track type gear is a caterpillar arrangement for use on aircraft which will replace the wheel type landing gear. This wheel substitute is basically designed like the caterpillar tread used on tanks and trucks currently; however, it is designed for minimum weight, high speed operation, and high acceleration loads.

PURPOSE: To reduce ground pressures and avoid sinking in soft ground and facilitate operation on rough terrain.

AUTHORITY: Chief, Engineering Division.

REMARKS: Installations of track type wheels have been made for the A-20 and P-40 airplanes. The A-20 installation, being the first made for aircraft, is quite heavy. This condition is attributable in part to lack of design experience, the low ground pressures incorporated, and the nature of the design. Flight tests have been conducted and the take-off distance found greater by about 15 percent. A later design for the P-40 airplane still indicates greater weight but a much smaller increase than was experienced on the A-20 design. Flight tests on the P-40 are now being arranged.

CASTING LANDING GEAR COMPONENTS

452-197
Expenditure Order No.

Menasco Manufacturing Co.
Burbank, California
Mfg. or Activity charged with Development

None
Classified Project No.

W04-235-AC-163
44-10265
Contract Number

DESCRIPTION: Manufacture of landing gear components from ferrous castings for the P-36 airplane. The investigation involves the

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manufacture of three landing gear legs; one for drop test and two for service test on an operating airplane. These landing gears will be equal in weight and strength to the existing landing gears.

PURPOSE: To prove that with proper casting design it is possible to substitute cast material for forged or drawn material in the manufacture of landing gear components.

AUTHORITY: Chief, Engineering Division.

REMARKS: The independent portions of the landing gear will be given structural failure tests to determine the strength of the cast material. Detail changes in design have been incorporated but only to facilitate the casting process and not affect interchangeability of the landing gear parts. The design work is complete and tests are proceeding on the cast material. Delivery of the service test articles is anticipated in April.

LEVERED SUSPENSION LANDING GEAR

452-157	[illegible] Industries, Incorporated Long Island City, New York.
Expenditure Order No.	Mfg. or Activity charged with Development
None	W-535-AC-28733
Classified Project No.	Contract No.

DESCRIPTION: The Levered suspension landing gear comprises three major parts; the upper structural leg pinned to a lever permitting rotation of the lever through a confined arc, which lever is restrained in movement by the shock absorber universally mounted between the structural leg and the lever. The wheel is then attached to the free end of the lever.

PURPOSE: This design will increase shock absorber efficiency, decrease shock absorber maintenance, facilitate manufacture on larger gears.

AUTHORITY: Chief, Engineering Division.

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REMARKS: The landing gears have been manufactured and delivered. The gear is in general satisfactory, although some taxiing peculiarities have been noted which are being studied and corrected. A complete test program is currently being conducted to obtain more engineering data on this new type gear. This design shows promise of reducing the structural weight of the gear attachment structure.

ELECTRO-MECHANICAL BALL BEARING THREAD

452-161	Delco Products, Dayton, Ohio
Expenditure Order No.	Mfg. or Activity charged with Development
None	W(33-038) AC 445
Classified Project No.	Contract Number

DESCRIPTION: Research development, and standardization of the electro-mechanical ball bearing thread actuating mechanism for application to retractable landing gear flaps, bomb bay doors, gun turrets, etc.

PURPOSE: The development of an efficient alternate method other than hydraulics for linear actuation of airplane mechanisms, that is, a substitute for linearly acting hydraulic jack struts.

AUTHORITY: Chief, Engineering Division.

REMARKS: The electro-mechanical ball bearing jack is satisfactory for installation in aircraft as a linear actuator for the following reasons:

a. Definite weight saving because of low power requirements.

b. Shorter time of actuation because of low power requirements

c. Reliability.

(1) Operation at -65°F shows only a 5% decrease of efficiency.

(2) Endurance run shows no sign of material fatigue, failure, or loss of efficiency.

Program is approximately 50 percent completed.

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INSTALLATION OF 3 DIFFERENT METHODS OF LANDING GEAR RETRACTION AND FLAP OPERATION

452-180	Delco Products, Dayton, Ohio
Expenditure Order No.	Mfg. or Activity charged with Development
None	(535) 43-26134
Classified Project No.	Contract No.

DESCRIPTION: To design, install, and test 3 different methods of landing gear retraction and flap operation for use in light aircraft. The methods to be used are as follows:

1. Mechanical operation, pilot operated.
2. Mechanical operation, aerodynamically operated.
3. Electrical operation.

The above installations are to be designed for installation on the AT-6 airplane.

PURPOSE: To ascertain comparative data for above methods of landing gear and flap actuation.

AUTHORITY: Chief, Engineering Division.

REMARKS: Mechanical operation by pilot of landing gear retraction mechanism has been installed and will be flight tested in near future.

V-RING HYDRAULIC PACKING

452-1-121	Goshen Rubber & Mfg. Co. Goshen, Indiana
Expenditure Order No.	Mfg. or Activity charged with Development
None	W-33-038 AC-1687 (11561)
Classified Project No.	Contract Number

DESCRIPTION: Development of a V-ring hydraulic packing compound suitable for use throughout the temperature range of -65°F to +160°F.

PURPOSE: To eliminate leaks in hydraulic systems and shock absorber struts at cold temperatures.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Present packings to Specification AN-HH-P-114 are not satisfactory at operating temperatures below -40°F. It is the purpose of this contract to produce a suitable packing compound, the formula of which can be transmitted to all packing manufacturers making this type of equipment.

CYLINDRICAL HYDRAULIC PRESSURE ACCUMULATOR

452-176 Expenditure Order No.	Hydro-Power Systems, Inc. Mt. Gilead, Ohio. Mfg. or Activity charged with Development
None Classified Project No.	P.O.# 43-21655-E Contract No.

DESCRIPTION: Development of a cylindrical pressure accumulator to augment the spherical type. The cylindrical accumulator is to be standardized under AN6202 and Specification AN-A-3.

PURPOSE: To standardize on a cylindrical accumulator design of the lightest weight and allowing the best production methods possible.

AUTHORITY: Chief, Engineering Division.

REMARKS: Work under the contract is progressing satisfactorily.

P-63 SKIS

452-190 Expenditure Order No.	Luscombe Engineering Company North Wales, Pennsylvania. Mfg. or Activity charged With Development
None Classified Project No.	(535) 43-25527E Contract No.

DESCRIPTION: Retractable skis for P-63 airplane.

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PURPOSE: To equip P-63 airplanes with skis so they can operate in advanced Northern bases where snow clearing equipment is not available.

AUTHORITY: T.I. 1031 dated 14 November 1942.

REMARKS: First set will be completed by 15 January 1944. Contract complete approximately 15 February 1944.

RETRACTABLE SKIS

Federal Aircraft Works
Minneapolis, Minnesota
Luscombe Engineering Company
North Wales, Pennsylvania
Mfg. or Activity charged with Development

452-194
Expenditure Order No.

(33-038) 44-1794
(33-038) 44-1795-E
Contract No.

None
Classified Project No.

DESCRIPTION: Retractable skis for the P-51 airplane and P-38 airplane.

PURPOSE: To equip P-51 and P-38 airplanes so they can operate on advanced Northern bases where snow clearing equipment is not available.

AUTHORITY: Directive WPD dated 12 June 1943.

REMARKS: One set complete, awaiting tests.
Contract complete approximately 15 February 1944.

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AT-7 WHEEL SKIS

452-194
Expenditure Order No.

Federal Aircraft Works,
Minneapolis, Minnesota.
Mfg. or Activity charged with Development

None
Classified Project No.

C-33794
Contract No.

DESCRIPTION: Combination wheel and ski for AT-7 airplane. Skis retract and extend about present wheels. Wheels cannot be retracted when equipped with these skis.

PURPOSE: To be used as a rescue ship in Northern bases where snow clearing equipment is not available.

AUTHORITY: C.T.I. 614, Addendum 1 dated 9 September 1942.

REMARKS: 20 sets ordered
7 sets delivered
Awaiting tests of last redesigned model.

L-5 SKIS

452-194
Expenditure Order No.

Heath Company,
Benton Harbor, Michigan.
Mfg. or Activity charged with Development

None
Classified Project No.

(33-096) 44-2635-E
Contract No.

DESCRIPTION: Straight skis for the L-5 airplane.

PURPOSE: To equip these airplanes with skis to be used for liaison and rescue work at Northern bases where snow clearing equipment is not available.

AUTHORITY: C.T.I. 1433 dated 1 September 1943.

REMARKS: Three sets complete. Thirty sets in production.

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L-5 WOOD FLOAT

452-140
Expenditure Order No.

Heath Company,
Benton Harbor, Michigan.
Mfg. or Activity charged with Development

None
Classified Project No.

W-535-AC-35659
Contract No.

DESCRIPTION: L-5 airplane equipped with twin plywood floats.

PURPOSE: To provide an airplane for utility and reconnaissance purposes capable of operating off protected waterways.

AUTHORITY: Inter-Office Memorandum from Chief, Production Engineering Sec.

REMARKS: First set unsatisfactory but contractor replaced them with second set. Tests on these will begin after 1 January 1944.

CTI-1433 dated 1 September 1943 authorized 30 additional sets of floats Model 2650 which are slightly larger.

Six sets not yet contracted for.

L-5 AMPHIBIOUS FLOATS

452-149
Expenditure Order No.

Heath Company,
Benton Harbor, Michigan.
Mfg. or Activity charged with Development

None
Classified Project No.

W20 - 017 AC604
Contract No.

DESCRIPTION: L-5 airplane equipped with twin amphibious floats.

PURPOSE: To provide an airplane for rescue, utility, and reconnaissance purposes capable of operating off ground, snow and water.

AUTHORITY: CTI-1433 dated 1 September 1943.

REMARKS: Three amphibious sets of floats contracted to Heath Company pending approval of a mock-up.

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SECTION 5

GLIDER PROJECTS

GLIDERS

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XCG-10A CARGO GLIDER

456-20	Laister-Kauffmann Aircraft Corporation, St. Louis, Mo.
Expenditure Order No.	Mfg. or Activity Charged With Development
None	W535-AC-27357
Classified Project No.	Contract Number

DESCRIPTION: A full cantilever, single-boom transport glider of 25,000 pounds design gross weight, having a design towing speed of 180 mph and a landing speed of 60 mph with flaps. The glider is of all-wood frame construction with plywood and fabric covered wing and tail surfaces and plywood covered fuselage nacelle. Provisions are made for rapid unloading and loading of cargo from the aft end of the fuselage. The design useful load of the glider is 10,000 pounds and provisions are made for carrying various alternate loads of heavy airborne equipment up to 12,000 pounds. Forty-two (42) fully equipped troops (including pilot and co-pilot) may be carried.

PURPOSE: To develop a troop carrying glider which may be used as a cargo carrier or paratroop transport and also be capable of carrying heavier artillery and equipment than has previously been airborne.

REMARKS: Negotiations were started with the Laister-Kauffmann Aircraft Corporation in February 1942. The contract for one static test article and two flight test articles was approved on 27 April 1942. The fuselage mockup was inspected on 10 May 1942, and the wind tunnel model was delivered for testing on 27 June 1942. The first flight article designated as XCG-10 was delivered on 10 October 1943 to the Glider Test Field at Wilmington, Ohio, and successfully flown on 6 November 1943. Static Test article delivered to Wright Field on 25 October 1943 and approved by Structures Branch on 24 December 1943. As a result of flight tests, and new Airborne Command glider requirements the design has been modified and designated as the XCG-10A. The delivery of the second flight article on subject contract is held up pending redesign to new requirements. Delivery of the XCG-10A glider is expected in May 1944.

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XCG-13 CARGO GLIDER

456-20 Expenditure Order No.	Waco Aircraft Company, Troy, Ohio Mfg. or Activity Charged With Development
None Classified Project No.	W535 ac-31734 Contract Number

DESCRIPTION: A high wing strut braced monoplane having a design towing speed 226 I.A.S., and design stalling speed of 59 mph with flaps. The useful load is 10,000 pounds. This load may consist of personnel or cargo. Type of loads the glider will carry are (1) 105 mm howitzer, one jeep, 30 rounds ammunition and 8 men at 240 pounds per man and (2) 6 by 6, 1-1/2 ton truck, driver, and 2500 pounds of equipment. Fuselage is welded steel tube construction, wings and empennage are wood. The glider loads through the nose which is hydraulically opened. The XCG-13 is a tail wheel glider equipped with jettisonable main gear and skids; however, the YCG-13A, now being developed from the original type XCG-13 is being equipped with fixed tricycle gear.

PURPOSE: To investigate the possibilities of a large loading capacity glider with a high wing loading.

AUTHORITY: Chief, Engineering Division.

REMARKS: Negotiations were begun in July 1942 with the Waco Aircraft Company to procure this glider. The first flight test article was delivered to Wright Field 10 March 1943, a second flight test article and a static test article being delivered shortly thereafter. Flight and static tests proved the glider satisfactory and contracts were issued for a service test quantity of 100, the first article of which was delivered 1 December 1943. The second service test article, modified to incorporate a tricycle landing gear, is expected to be ready about 15 January 1944.

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XCG-14 GLIDER

456-15	Chase Aircraft Co., Inc. New York, N. Y.
Expenditure Order No.	Mfg. or Activity Charged With Development
None	33-038 AC-1206 (11468)
Classified Project No.	Contract Number

DESCRIPTION: A glider of good aerodynamic design with a full cantilever high wing, designed to a gross weight of 7600 pounds, having a design towing speed of 170 mph and a landing speed of 60 mph with flaps. The glider is of all wood frame construction with plywood covering on the wing, fuselage, and tail surfaces. Provisions are made for rapid loading and unloading of cargo from the aft end of the fuselage. The design useful load of the glider is 4370 pounds and provisions are made for carrying various alternate loads of airborne equipment, including 1/4-ton 4 x 4 reconnaissance car or 75 mm howitzer.

PURPOSE: To develop a glider which may be used as cargo or personnel carrier, capable of being towed by pursuit type aircraft.

AUTHORITY: Teletype AFDMA-2-420 dated 5 October 1943 and letter indorsement dated 7 October 1943 subject, "Proposal to Manufacture Cargo Glider" recommended negotiation of a contract.

REMARKS: Negotiations were started with the Chase Aircraft Company, Inc., in July 1943. A letter contract for one static test article and two flight articles was approved on 30 October 1943. The fuselage mockup was inspected on 6 December 1943.

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XCG-15 TROOP AND CARGO GLIDER

456-13 Expenditure Order No.	Waco Aircraft Company Troy, Ohio Mfg. or Activity Charged With Development
None Classified Project No.	W535 AC-25851, Change No.25 Contract No.

DESCRIPTION: A high wing single strut monoplane glider with a design gross weight of 7500 pounds and having a design tow speed of 150 mph indicated air speed and carrying fifteen men including pilot and co-pilot, or a Jeep and six men including pilot and co-pilot, or other equivalent pay load. This glider is a clipped-wing version of the CG-4A glider incorporating a new nose design for aerodynamic cleanliness and slotted flap to maintain a slow landing speed. The glider is the same type of construction as the CG-4A.

PURPOSE: To improve the present CG-4A glider, by reducing drag in tow, improving flight characteristics but maintaining the same landing characteristics.

AUTHORITY: Chief, Engineering Division.

REMARKS: Initial negotiations were carried on with the Waco Aircraft Company during September 1943. The Authority for Purchase was initiated on 22 September 1943 and work was started early in October. The nose section and cockpit mock-up inspection was held on 25 November 1943. Delivery of the flight article is expected in January 1944.

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XCG-16 TRANSPORT GLIDER

456-36 ~~Expenditure Order No.~~	General Airborne Trans. Co. San Fernando, Calif. Mfg. or Activity Charged With Development
None Classified Project No.	W33-038 AC-1666 Contract No.

DESCRIPTION: A full cantilever, twin-boom tail transport glider of 19,580 pounds design gross weight having a design towing speed of 220 mph and a stalling speed (with flaps) of 58 mph. A special feature of the glider is that the fuselage is an NACA 0025 airfoil. The design useful load is 10,000 pounds and provisions are made for carrying 42 fully equipped troops (including pilot and co-pilot) or 1/4-ton liaison trucks, 75mm howitzers, 105 howitzers, ammunition and cargo.

PURPOSE: To develop a transport glider having a very thick center section between the booms; it may be used either as a personnel or cargo carrier.

AUTHORITY: Materiel Command Technical Instructions Serial No. TI-1567 dated 10 November 1943.

REMARKS: Negotiations were started with General Airborne Transport Company in November 1943. A letter Contract was issued on 13 November 1943. This letter calls for one structural test article, two flight articles, wind tunnel model, and necessary engineering data. The Contractor has promised delivery of the static test article on 30 March 1944, and second flight article on 15 April 1944.

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XFG-1 FUEL GLIDER

456-35
Expenditure Order No.

The Cornelius Aircraft Corp
Dayton, Ohio
Mfg. or Activity Charged
With Development

MX-41
Classified Project No.

W33-038 ac-107
Contract Number

DESCRIPTION: A high wing cantilever glider with a design gross weight of 8000 pounds and having a design towing speed of 250 mph indicated tow speed. This glider is of a swept forward wing design such as to incorporate inherent stability. The glider is designed to carry a maximum of 764 gallons of gasoline without the pilot or 704 gallons with the pilot. Provision is made for pumping the fuel to the towing airplane. The wings, vertical tail and fuselage center section are of all wood construction. The fuselage nose and tail sections are of welded steel tubing.

PURPOSE: To develop a fuel trailer incorporating inherent stability for extending the range of the towing airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project originally was intended as a bomb glider but was changed to a fuel glider on 16 June 1943. Authority for Purchase was initiated 17 June 1943 and Contract signed 6 October 1943. Cockpit mockup inspection was held on 17 and 18 November 1943 at the plant of the subcontractor, Spartan Aircraft Company, Tulsa, Oklahoma. The static test article is due for delivery 20 March 1944, the first flight article 19 April 1944 and second flight article 18 June 1944.

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BOMB-CARRYING GLIDER

453-1-142	Aircraft Laboratory
Expenditure Order No.	Mfg. or Activity Charged With Development
MX-166	None
Classified Project No.	Contract Number

DESCRIPTION: A pilotless glider capable of carrying and discharging bombs of the 10,000-pound class. These gliders to be towed by present service aircraft of the twin and four-engine class.

PURPOSE: To develop a pilotless glider capable of carrying bombs of the 10,000-pound class, space for which is not now available in present service aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Because present service aircraft do not have bomb bays large enough to contain 10,000-pound bombs, it has been necessary to develop other means of transporting these bombs to the target. Because of the size involved, the glider capable of carrying a 2,000-pound bomb is being built in the Engineering Shops and will be tested upon completion at Muroc Lake. Wind tunnel tests as well as small scale flying tests have been completed.

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D-1 AUTOMATIC PILOT FOR GLIDERS

456-19
Expenditure Order No.

Jack & Heintz, Inc.
Cleveland, Ohio
Mfg. or Activity Charged
With Development

MX-296
Classified Project No.

W-33-038 AC-1233
Contract Number

DESCRIPTION: The D-1 automatic pilot consists of an adaption of the A-3 airplane pilot to glider use. This automatic pilot makes possible automatic control of the glider, maintaining the position on tow, fixed by the human pilot. Visual indication of the attitude of the glider as a reference for manual or automatic flight control is provided by the gyroscopic flight instrument and the tow rope position indicator which form an integral part of the D-1 automatic pilot. Besides providing automatic flight control on or off tow the D-1 pilot presents a means for accomplishing blind flight. A special wind driven oil and vacuum pump mounted in the nose of the glider provides the power for the servos and gyro. The weight of the complete installation is approximately 90 pounds.

PURPOSE: To provide a means for accomplishing glider flight under instrument conditions and at night and also to relieve pilot fatigue on long tows.

AUTHORITY: Chief, Engineering Division.

REMARKS: Development of the D-1 automatic pilot was started approximately December 1942. This automatic pilot was designed and made with a view toward simplicity, therefore the major units were taken from the A-3A airplane automatic pilot. The automatic tow mechanism takes indication of the tow rope movement and feeds signal to the automatic pilot follow-up system by a method developed by the Glider Branch, Aircraft Laboratory. This pilot is now ready for production in Kit form for installations in CG-4A gliders and will be installed in larger gliders of the 30 place type as standard equipment by the glider manufacturer.

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SECTION 6

JET PROPULSION PROJECTS

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JET PROPULSION FOR AIRCRAFT LIQUID-FUEL MOTORS

462-30	California Institute of Technology Aerojet Eng. Corp., Pasadena, Calif.
Expenditure Order No	Mfg. or Activity Charged with Development
MX-121	AC-20260 AC-31254
Classified Project No.	Contract No.

DESCRIPTION: Jet Propulsion Motors utilizing two liquids which, in most cases, are spontaneously combustible; in other cases ignition is effected by means of an external power source. These motors vary in size from 50 to 12,000 pounds thrust and in duration upwards from 25 seconds. "Aerotojet" and "Centrojet" motors now under design and procurement will have fuel-cooled combustion chambers and are to produce 2000 poun s thrust for periods upwards of about 50 minutes.

PURPOSE: To develop jet propulsion equipment capable of increasing performance of aircraft, particularly the take-off of heavily loaded aircraft.

AUTHORITY: C.T.I. No. 1512 entitled Jet Assisted Take-Off Program dated 10 December 1943.

REMARKS: The service test program using model 25AL-1000 motors on A-20 type airplanes has been discontinued except for tests at Wright Field.

The contract with Aerojet for 100 model 25ALD-1000 droppable motors is nearly completed. Action has been recently initiated for the procurement of an additional 100 motors.

Four model XCAL-200 motors were manufactured and delivered to Northrop Aircraft Company for installation and test. These motors produce 200 pounds thrust for a period of five minutes.

Motors capable of producing 3000 pounds thrust for a period of 40 seconds (model X40ALD-3000) are being designed and sixteen such motors are under contract for construction.

Take-off tests with a P-36G and an XC-47A amphibious airplane each using two model 25ALD-1000 motors have been completed and reports are forthcoming. Other tests are about to start on a B-24D and B-26B airplane and are continuing on an A-20B.

Investigations are constantly being made to develop larger

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and lighter motors having longer duration, propellant feed systems employing methods other than gas pressure, fuels having lower freezing temperatures and involving less handling and airplane hazards, better methods and materials for construction;utilizing, wherever possible, non-critical materials, satisfactory portable equipment for servicing such motors, and better testing methods and equipment.

JET PROPULSION FOR AIRCRAFT SOLID-FUEL MOTORS

462-30 Expenditure Order No.	California Institute of Technology Aerojet Eng. Corp.,Pasadena, Calif. Mfg. or Activity charged with Development
MX-121 Classified Project No.	AC-20260 AC-31254 Contract No.

DESCRIPTION: Jet propulsion motors utilizing a solid fuel which is charged into a cylindrically-shaped steel container having an exhaust nozzle and safety blow-out disc on one end. These motors vary in size from 200 to 2000 pounds thrust and in duration from 5 to 25 seconds. Corresponding weights of these motors vary from 41 to 1000 pounds when fully charged with fuel.

PURPOSE: To develop jet propulsion equipment capable of increasing performance of aircraft particularly during take-off.

AUTHORITY: C.T.I. No. 1512 entitled Jet Propulsion Assisted Take-Off Program dated 10 December 1943.

REMARKS: Delivery has been completed on 600 model 8AS-200, 500 model 8AS-500 and 100 model 8AS-1000 motors. Action has been recently initiated for procurement of 400 model 8AS-1000, 600 model 10AS-1000 motors and for the design and procurement of 120 model X30AS-1000 motors.

It is anticipated that work will be undertaken relative to the use of this type motor as a power unit for jet-driven missiles of various types.

The model X30AS-1000 motors are being procured for a specific use which requires an expendable motor of far smaller diameter than the 25ALD-1000 liquid-fuel droppable motor and slightly longer duration namely, 30 seconds.

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SPECIAL PROJECTS

SPECIAL PROJECTS

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PLASTIC DEVELOPMENT

453-214	Aircraft Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development
MX-286	See Remarks
Classified Project No.	Contract Number

DESCRIPTION: The development of plastics for structural, secondary structural, and non-structural aircraft parts, including the investigation of both the plastic resins and all possible filler materials for added strength.

PURPOSE: To develop plastic materials leading to better performance, greater production rates, and lowered production costs, and assisting in the program of conservation of strategical materials.

AUTHORITY: Chief, Engineering Division.

REMARKS: Service tests conducted on laminated cloth base phenolic plastic parts have proven that this material is satisfactory under the exposure conditions to be encountered in service.

Numerous service test parts of MR-1 laminated plastic have been received on Contract No. AC-37443. Tests have been completed on structural items to investigate the behavior of this material under load and a report is in preparation.

Development of glass fiber plastic laminate for structural aircraft parts is being continued by Owens-Corning Fiberglas Corporation on Contract No. AC-37069. This work has led to the finding of numerous means to increase the strength properties of laminates which are now being used by the plastics industry. The test program is nearing completion after an investigation of combinations of available low pressure resins and various weaves of glass cloth.

A rear fuselage section for the BT-13 airplane has been built at Wright Field using laminated glass cloth and balsa wood sandwich skin. This fuselage was lighter than the present wooden structure and was proven to be over strength in the static tests. A second section is being prepared for flight tests.

The use of high strength paper base laminates is being investigated through P.O. No. 44-3563-E with Consolidated Water Power and Paper Company for the design of a PT-19 outer wing panel.

AN AT-6 fin made by Virginia-Lincoln Corporation using glass cloth and urea formaldehyde was static tested to failure at 170 percent ultimate load, but the assembly was 38 percent over the weight of

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the present fin. Static tests of an AT-6 rear fuselage section designed from the same material were terminated with failure at 90 percent load under a tail wheel loading condition.

CYCLE-WELD PROJECT

453-215, 451-279
Expenditure Order No.

See remarks
Mfg. or Activity Charged with development.

MX-243
Classified Project No.

See remarks
Contract Number

DESCRIPTION: A new assembly method referred to as the Cycle-Weld process, developed by the Chrysler Corporation for bonding steel, wood, thermo-setting plastics, glass, Plexiglas, aluminum, aluminum alloys, magnesium, and magnesium alloys in any combination. This process requires heat and pressure with an adhesive glue for the bonding agent.

PURPOSE: To develop a method of aircraft assembly that will result in a lower fabrication cost, increased production rate, and more efficient aircraft, both structurally and aerodynamically.

AUTHORITY: Chief, Engineering Division.

REMARKS: In March 1941, the Materiel Command initiated a program with the Chrysler Corporation to expedite and assist in the development of a new method for joining materials. This development, known as the Cycle-Weld process, showed promise as a possible method of assembling aircraft with cement, rather than with rivets, spotwelds, bolts or any other method employed heretofore.

In October 1941, the Goodyear Tire and Rubber Company and the Goodyear Airc. Co., Akron, Ohio entered into the development of the Cycle-Weld process in cooperation with the Chrysler Corporation, Detroit.

As a result of continuous research, the Cycle-Weld process was sufficiently developed in November 1941 to warrant its application on aircraft test structures. Accordingly, Chrysler Corporation, Goodyear Aircraft Corporation, and Dow Chemical Co, Midland, Michigan were contracted to assemble three P-49D stabilizers, ten B-26 inboard flaps, and ten P-40D vertical fins, respectively, The stabilizers and flaps were successfully tested at Wright Field. The fins have not been completed.

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When in April 1942 difficulty was anticipated in designing the C-62 bolted outer wing fitting with a reasonable strength/weight ratio, the Chrysler Corporation and Waco Aircraft Company were given the opportunity to design this fitting for attachment by Cycle-Weld. Both companies designed and built test spar sections which were more efficient than the conventional type and withstood the required loads. Ultimate failure in all tests was in the spar.

The Chrysler Corporation under Contract No. AC-32724 has investigated the use of Cycle-Weld in wood to metal joints. This work has led to the addition of a low temperature process known as Cycle-Bonding which permits easier assembly procedures and joints which have shown better weathering properties. Cycle-Bonding is now under investigation through another contract.

The use of Cycle-Weld for the assembly of the AT-6A outer wing panel is under investigation with the Chrysler Corporation under Purchase Order No. 43-31621-E. This project will involve the redesign of the wing structure to permit more rapid assembly.

Cycle-Bonding is being used to good advantage in the investigation of aluminum alloy faced sandwiches which will permit the more efficient use of the metal in thin gages. In this investigation the faces are Cycle-Bonded to balsa cores.

The use of Cycle-Weld has encouraged other manufacturers to develop adhesives for metal joints. The investigations now in progress have therefore been extended to include adhesives from the B.B. Chemical Company, U.S. Stoneware Company, Resinous Products Company, E.I. DuPont de Nemours & Company, and Consolidated Vultee Aircraft Corporation.

COWLING FASTENERS

453-124 Expenditure Order No.	Cowling Fastener Industry Newark, Ohio Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: It has been decided to standardize on two types of cowling fasteners: the cross-pin and the Dzus type. The new specification is now being prepared by the Aircraft Laboratory and will be released as soon as the tests, now in progress on the Dzus type to

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determine strength values, are completed. This specification requires that all cross-pin type fasteners be interchangeable, in their size, with any other manufacturer's fastener of that type. The same interchangeability is requested of the Dzus type fastener. Three strength sizes are specified: the -7 size, capable of carrying a tensile load of 700 pounds, for use on critical cowling areas; the -5 or 500 pound size for cowling access doors and inspection panels; and the 200 pound, or -2 size, for internal applications. Stud lengths are provided in each size to take care of all commonly used sheet thicknesses.

PURPOSE: To establish requirements that will control the procurement of cowling fasteners suitable for high speed aircraft and capable of interchangeability.

AUTHORITY: Chief, Engineering Division.

REMARKS: The enforcement of these requirements will bring about a standardization need that has been felt since the start of the manufacture of military aircraft on a mass production basis. The standardization is intended to provide interchangeability by part without preventing the possibility of improvements in receptacle design.

DEVELOPMENT OF ANTIFRICTION AND PLAIN BEARINGS FOR AIRCRAFT USE

L53-213 Expenditure Order No.	Aircraft Laboratory Bearing Industry Mfg. or Activity Charged with development
None Classified Project No.	None Contract Number

DESCRIPTION: Antifriction bearings fabricated from low-carbon and low-alloy steels are being developed for aircraft use. These contain unground races and have capacities below existing standard Army-Navy antifriction bearings. Plain bearings made with inner and outer races running in direct contact and having no balls are also being developed as substitutes for AN bearings.

PURPOSE: To develop and make available unground antifriction and plain bearings to be used to supplement the existing supply of standard Army-Navy antifriction bearings.

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AUTHORITY: Chief, Engineering Division

REMARKS: Unground antifriction bearings fabricated of low-carbon steel can be manufactured on equipment not required for the manufacture of precision bearings. Their use in aircraft can be permitted in locations where the loads are low and the increase in play will not affect the performance. Plain bearings, dimensionally interchangeable with the AN bearings, are being developed in order to prevent a decrease in production of airplanes because of lack of bearings.

MILITARY CONTROL WHEELS

453-201
Expenditure Order No.

Guardian Elec. Co., Chicago, Ill.
American Hard Rubber Company
Akron, Ohio
Mfg. or Activity Charged with development.

None
Classified Project No.

P.O. 43-4872-E
Contract Number

DESCRIPTION: A figure-eight military control wheel containing recesses for fire control triggers and buttons is being designed for standardization. The shape of the wheel is of the figure-eight so that a maximum of instrument panel visibility can be maintained. The wheel has two removable upper ends to provide for installation of switches, triggers, and buttons. Dummies may be substituted for the buttons and triggers when same are not required. The under side of the wheel rim is thumb-marked to permit an efficient and comfortable grip.

PURPOSE: To obtain a standard control wheel of satisfactory shape and design for use in all AAF airplanes requiring control wheels.

AUTHORITY: Chief, Engineering Division.

REMARKS: A survey was conducted at the start of this project to establish the shape, size, and control switch locations. The data obtained from this survey were considered in the design of a wheel being fabricated by the American Hard Rubber Company under Purchase Order 43-4872-E. This is a smooth contoured wheel capable of being positively gripped by the average size hand with the ends housing the switches being an integral part of the wheel.

The wheels on Order are being fabricated of aluminum and magnesium cores in combination with Tenite II and Ethocell cases. A number

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of these control wheels have been received and are being service tested.

In a recent conference the wheel was proposed for standardization. The shape and size were considered satisfactory but it was the general opinion that a removable end should be used to facilitate the installation of switches. As a result the Guardian Electric Company has undertaken to design and fabricate a wheel basically the same as the previous one but incorporating a removable type of end.

PACKAGING OF BEARINGS FOR STORAGE AND SHIPMENT

Firestone Tire & Rubber Co.
Akron, Ohio
Dearborn Chem., Chicago, Ill.
Bearing Manufacturers
Mfg. or Activity Charged with development

453-207
Expenditure Order No.

None
Classified Project No.

None
Contract Number

DESCRIPTION: Development of a moisture-proof package for sealing individual bearings. The sealed package thereby protects the bearing against adverse conditions during storage and shipping for a period of one to two years, thus preventing loss of bearings due to corrosion.

PURPOSE: To obtain data on which to base the preparation of a specification for packaging and sealing of antifriction bearings for aircraft use.

AUTHORITY: Chief, Engineering Division.

REMARKS: Several methods of protection of antifriction bearings have been tested. A specification is being prepared covering the moisture-proofing on the wrappings or coverings for bearings. Changes will be made to specifications for bearings to include this method of wrapping on bearings which are being furnished to the Army Air Forces for storage and supply.

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LOW CARBON AND LOW ALLOY STEELS
FOR AIRCRAFT STRUCTURES

453-208	See Remarks
Expenditure Order No.	Mfg. or Activity Charged with development
None	AFF-329152
Classified Project No.	Contract Number

DESCRIPTION: The development of low carbon and low alloy steels for use in aircraft.

PURPOSE: To investigate and develop possible applications of low carbon and low alloy steels for use in aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: In May 1942 a program was initiated for the development of low carbon and low alloy steels for use in aircraft structures. At that time it was deemed necessary to undertake this investigation primarily because of the shortage of aluminum and high alloy steels. However, the criticalness of aluminum has gradually been relieved until substitution is no longer necessary unless the non-critical steels show sufficient superior characteristics to warrant it. Non-critical steels in this category have not been developed to date.

Considerable work on low alloy steel of the SAE 4600 series has been conducted by North American Aviation, Incorporated and Consolidated Vultee Aircraft Corporation. This series of steels contains nickel which would limit the use of the steel in production. However, the development work accomplished provides a good background for low carbon and low alloy steel design in aircraft.

Low carbon steels containing no critical elements and with tensile yield strengths in excess of 10,000 psi have been developed by the Carnegie-Illinois Steel Corporation and Republic Steel Corporation. The low ductility of these steels prohibit their use where considerable forming is required.

In collaboration with the Materiel Command, American Rolling Mills Company has developed an aluminum coated low alloy steel which has a tensile yield strength of 130,000 psi. This material has insufficient ductility for extensive forming but its high tensile strength and good corrosion resistance warrant its further investigation. Action has been taken to have Kellett Aircraft Corporation fabricate a number of P-40 flaps of this material for static and service test.

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PASSIVE DEFENSE MEASURES FOR PERSONNEL AND VITAL INSTALLATIONS IN AIRCRAFT

453-117 Expenditure Order No.	Aircraft Laboratory Mfg. or Activity Charged with development
MX-233 Classified Project No.	None Contract Number

DESCRIPTION: This project is composed of the following essential features; the development of new and more efficient method of protecting airplane and crew from enemy gunfire, including investigation of the strength and types of armor plate mountings; procuring new equipment and materials for study and testing; assisting airplane manufacturers by establishing design criteria and by commenting on drawings and proposals submitted; and studying the effect of direct gunfire and splash from projectiles on airplane structure, equipment, and accessories.

PURPOSE: To increase the effectiveness, dependability and safety of the airplane and crew by protecting personnel and vital installations against enemy gunfire.

AUTHORITY: Chief, Engineering Division.

REMARKS: Most important of the investigations completed includes gunfire tests of the B-25 and P-63 airplanes to determine the efficiency of armor protection and the effect of various projectiles on the airplane structure, engine and vital equipment. More efficient protection for the pilot and co-pilot of bombardment airplanes has also been developed in the form of armored seats which afford increased protection from enemy aircraft projectiles and anti-aircraft shell fragments. Damage to airplane fuselages due to the blast effect of their own guns was investigated and design criteria inserted in the Handbook of Instructions for Airplane Designers. Welding of aircraft armor was investigated and an AAF specification was prepared to insure good welds on armor used as structure and attachment brackets. Extensive tests were conducted to ascertain the effect of gunfire on non-strategic materials such as magnesium alloy and plastic laminates.

Armor plate modification for the B-29 airplane was accomplished at Marietta, Georgia, under this project. Complete details are contained in Engineering Division Memorandum Report ENG-51-AD877, Add. 49, dated 9 December 1943.

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PRESSURIZED CABIN SEALING

453-231	Aircraft Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development
None	None
Classified Project No.	Contract Number

DESCRIPTION: The investigation and development of compounds and methods for the air tight sealing of the seams and of the joints around installations in supercharged cabins. This also includes the development of a lining material for pressurized cabins which will seal when punctured by projectile fire.

PURPOSE: To develop improved means and methods for sealing pressurized cabin aircraft. To provide a material which will prevent instantaneous loss of pressure in supercharged cabins punctured by gunfire.

AUTHORITY: Chief, Engineering Division.

REMARKS: On 16 February 1943, this project was authorized under E.O. 453-231. Results of research have been received from aircraft companies involved in pressure cabin work. Information and data have been requested from chemical companies concerning sealing compounds. Data received are being checked.

Pressure test equipment has been procured. High and low temperature testing units have been constructed. A specification covering cabin sealing compounds will be written.

Pressurized cabin aircraft have been inspected and ground pressure checked for leakage.

Materials designed to bullet seal are being tested under air pressure and gunfire. Results of tests to determine the feasability of using rubber sheets incorporated in sound proofing are contained in Engineering Division Report No. ENG-51-45321-1-1, 22 May 1943. Development of a material using uncured rubber inclosed in plastic sheets is in progress. Progress reports will be prepared and released covering these developments.

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Power Plant
Lab. Projects

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ENGINE TEST

SECTION I

ENGINE TEST PROJECTS

ALLISON ENGINES

WRIGHT ENGINE

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SECTION I

ENGINE TEST PROJECTS
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SECTION I

ENGINE TEST PROJECTS
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V-1710-75 WITH WATER INJECTION

503-619
Expenditure Order No.

Allison Division, G.M.C.
Indianapolis, Indiana
Mfg. or Activity Charged with Development

None
Classified Project No.

P.O. (535) 44-3966-E
Contract Number

DESCRIPTION: The V-1710-75 is a standard Allison "F" series (F15R) engine with a 2.36:1 integral reduction gear, but the engines covered herein have been modified for war emergency rating of 1850 to 2000 BHP at 3200 RPM by incorporation of a new fully counterweighted crankshaft, 8.8:1 supercharger gear and complete water injection system.

PURPOSE: To obtain increased war emergency ratings by means of water injection.

AUTHORITY: Chief, Engineering Division.

REMARKS: The above described V-1710-75 engines were suggested by the Allison Division as a means of increasing war emergency ratings at the instigation of the Materiel Command. Authority for Purchase 309341, dated 16 October 1943, resulted in Purchase Order (535) 44-3966-E, dated 24 November 1943. Three engines are to be delivered for testing at Wright Field at the above powers. Specified delivery dates are:

First engine	60 days from date of contract
Second engine	75 days from date of contract
Third engine	90 days from date of contract

MODEL TEST OF V-1710-89 ENGINE

503-625
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: The V-1710-89 is a standard production F17R Allison engine. The model test engine herein was modified to incorporate cam machined Allison Keystone ring pistons.

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PURPOSE: To determine whether cam machined pistons will provide increased engine reliability of the V-1710-89 engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: The model test of the above described engine was started on 29 September 1943, and terminated 5 November 1943, due to failure of No. 7 right exhaust cylinder holddown stud at the completion of 75:15 hours accredited model test endurance time. The No. 1 ring on 6R piston had slight scuffing. It appeared that scuffing may have originated at the sharp lines of demarcation where the undercut in the piston at the piston pin surface runs into the original diameter. These pistons are being reworked to obtain an improved profile and it is contemplated that further tests will be conducted.

ALLISON V-1710-95 ENGINE

503-572 Expenditure Order No.	Allison Division, G.M.C., Indianapolis, Indiana. Mfg. or Activity Charged with Development
None Classified Project No.	P.O. (535) 43-24557 Contract Number

DESCRIPTION: The V-1710-95 engine is a basic "F" series engine (F-23R) equipped with 9.6:1 supercharger gear ratio, 2:1 reduction gear ratio and having a special propeller shaft, including features to enable jettisoning of the propeller. This engine is intended for use as a left-hand pusher engine. The ratings of this engine are as follows:

	BHP	RPM	ALTITUDE
Take-off	1275	3000	Sea level
Military	1125	3000	15,500 feet
Normal	1000	2600	14,000 feet

PURPOSE: To conduct tests on the propeller jettisoning feature of the Allison V-1710-95 engine in connection with its use in the Curtiss XP-55 airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: The original plans for testing of the propeller jettisoning feature of the Allison V-1710-95 engine contemplated tests of only the mechanical details of the new features to enable jettisoning to be conducted at Wright Field. These tests were to be conducted at Wright Field in view of the understanding with the Allison Division that the latter would proceed with the development of this engine,

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provided necessary tests of the new features were conducted by the Materiel Command. However, in conference with Curtiss-Wright representatives in April 1943, it was determined that there were many additional airplane items associated with the propeller jettisoning which required proof testing. These include determination of size and functioning of the nitrogen bottle and connecting pipe line to the reduction gear assembly and the forces necessary to shear the controllable cooling flaps used in conjunction with a cooling fan comprising an integral part of the spinner of the propeller. The cooling flaps are automatically controlled and so located that when the propeller is jettisoned the spinner cooling fan can possibly shear the flaps. Inasmuch as Curtiss-Wright also contemplated running some tests at their plant, to avoid duplication of effort, it was decided to conduct all tests at Wright Field. However, in a subsequent conference between Curtiss-Wright, Allison and Materiel Command personnel on 16 June 1943, it was decided to conduct the static tests of the propeller jettisoning device at the Curtiss plant and to conduct jettisoning tests with the propeller rotating at Wright Field.

The static tests of the propeller jettisoning features were satisfactorily completed at the Curtiss plant in St. Louis. Following these tests the rotating ground test of the propeller jettisoning feature was conducted on 28 June 1943 on the propeller whirl test stand at Wright Field. Memorandum Report ENG-57-503-996, dated 30 September 1943, covers the results of this jettisoning test.

V-1710-97 ENGINES

503-539 Expenditure Order No.	Allison Division, G.M.C. Indianapolis, Indiana Mfg. or Activity Charged with Development
MX-351 Classified Project No.	P.O. (535) 43-21965-E Contract Number

DESCRIPTION: The Allison V-1710-97 (G-1) is the first of the Allison "G" series engines. This engine has a take-off and military rating of 1725 BHP and 3400 RPM at sea level and a normal rating of 1200 BHP and 2750 RPM. To obtain this increased output, new design features consisting of twelve counter weights on crankshafts, strengthened rocker arm studs, large carburetor, increased diameter supercharger impeller, reinforced castings and improved torsional dampening features have been incorporated. The engine is equipped with a 2.36:1 reduction gear ratio and 7.48:1 supercharger impeller gear ratio.

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PURPOSE: To develop an increased output V-1710 model engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: A Materiel Command letter suggested the development of an engine in the 2000 to 2500 cu. in displacement range of greatly increased output, comparable to foreign or other American liquid cooled high output engines. Upon consideration of this suggestion, Allison recommended a development program on the present V-1710 type engine to provide greatly increased output rating, in lieu of the development of the completely new type of engine on the basis of this proposal being the most expeditious and efficient means of developing a high output military aircraft engine. On the basis of the Allison proposal, Authority for Purchase Order (535) 43-21965-E (Contract No. W-535-AC-37355). This Purchase Order covers first, a report on 50 Hour Military Approval Test in accordance with Specification XC-28598 on a V-1710 engine incorporating all the presently available redesigned features proposed for the "G-1" model V-1710 engine; secondly, a report covering the characteristics, detailed design studies, stress analyses and design recommendations to provide a "G" engine having a rating of 1725 BHP and 3400 RPM; and thirdly, three V-1710-97 engines incorporating all features found necessary as a result of the 50 Hour Military Tests and design studies covered by the above reports. Allison has completed approximately 60 hours of testing on the "G" engine in connection with the contract requirement of the item calling for a 50 hour military approval test. A V-1710-97 engine, based on the results of this 50 hour test and the redesign studies also called for in the contract, is being presently assembled. It is proposed to assemble one of these engines and continue testing of this engine at the Allison plant and furnish the remaining two engines for test at Wright Field.

ALLISON V-1710-103 ENGINE

503-580 Expenditure Order No.	Allison Division, G.M.C. Indianapolis, Indiana Mfg. or Activity Charged with Development
MX-410 Classified Project No.	(535) 43-33303-E Contract Number

DESCRIPTION: The Allison V-1710-103 (E23) is a twin V-1710 engine driving a common remote reduction gear. The complete engine includes one right-hand and one left-hand rotation basic V-1710-93 engine, each containing its respective auxiliary stage supercharger, driving two 24-foot extension shafts connected to a V-3420 type remote reduction gear assembly having dual oppositely rotating

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concentric propeller shafts. The two V-1710-93 basic power assemblies are mounted with their normal vertical axis tilted approximately 20° sidewise, and the engines are likewise tilted approximately 1° upward and 1° inward toward the reduction gear assembly. Each engine can be operated separately and independently. Each V-1710 basic power assembly is rated at 1150 BHP at 3000 RPM at 22,400 feet military rating and 1000 BHP at 2600 RPM at 20,000 feet.

PURPOSE: To develop a V-1710-103 engine suitable for application and use in the XA-42 airplane.

AUTHORITY: Inter-Office Memorandum from Chief of Technical Staff.

REMARKS: Inter-Office Memorandum from Chief of Technical Staff advised that action has been initiated to procure two Douglas XA-42 airplanes and requested that action be initiated to procure suitable Allison engines as proposed by Douglas and Allison Division.

P. O. 43-33303E covers procurement of a Development Test Report, a 50 hour military approval test report and five complete V-1710-103 engines. Two engines are intended for installation in each of two XA-42 airplanes, two engines are required for spares for these airplanes and a fifth is to be delivered to the engine manufacturer for use in conducting the 50 hour military approval rating test. The Development Test Report covers tests to determine the torsional, cooling, scavenging and general performance characteristics and durability problems associated with the novel features of the V-1710-103 engine.

The 50 Hour Military Approval Test was to provide required performance and endurance testing of the engine prior to flight use of the engine in the XA-42 airplane.

The first stage in development of this engine consisted of a development test of 1/2 of the complete power plant assembly. For this test, therefore, a V-1710, E type engine was mounted on a tilted stand corresponding to the angles of mounting of the engine in the airplane. The power section of the engine was connected to a remote V-1710-E type reduction gear through six lengths of standard E engine shafting. On 22 November 1943, the contractor had completed approximately 280 hours of testing on this arrangement to determine torsional, carburetion, scavenging and general operating characteristics. Several engines and auxiliary stages were employed for this testing. Allison Report No. A2-109 covers the testing and a description of the required 50 hour development test required by the contract. The complete V-1710-103 engine, which comprises two basic power sections and their respective auxiliary stage superchargers and the remote V-3420 type gear box, is presently being prepared for the 50 hour military approval test.

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V-3420-5 AND -7 ENGINES

503-302
Expenditure Order No.

Allison Division, G.M.C.
Indianapolis, Indiana.
Mfg. or Activity Charged with Development

None
Classified Project No.

W-535-AC-11328
Contract No.

DESCRIPTION: The Allison V-3420-5 engine is a 24 cylinder double "V" liquid-cooled engine. The power section of this engine is similar to the previous V-3420-3 model, but incorporates a special propeller drive consisting of two extended crankshafts. connected to a remote reduction gear equipped with dual oppositely rotating concentric propeller shafts. The engine is intended for use with the turbine supercharger at a military and take-off rating of 2600 b.h.p. Also in lieu of the four V-3420-7 engines called for, Allison agreed to furnish a total of eight engines, consisting of five V-3420-11 engines and three V-3420-13 engines. These eight engines and an additional nine engines being procured under separate contract, covered a total of seventeen V-3420 engines required for the B-19 and MX-230 airplanes, an additional model test engine and three engines required by the British.

PURPOSE: To further develop the basic V-3420 engine and special propeller drive systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: A change in reduction gear ratio to 2.46:1 has been authorized since the V-3420-5 engine is now being considered for use in a fighter airplane, whereas it has previously been considered mainly in connection with bombardment airplanes.

Contract W-535-AC-11328 covers the procurement of a 50-hour Military Approval Test on both the V-3420-5 and -7 engines, these tests to be conducted at the contractor's plants on Government furnished engines. Engineering Order X-3841, Reference No. 6, on Contract W-535-AC-11328, dated 15 September 1943, specified a change in the shaft size for the V-3420-5 engine from a 60-80 combination to a 50-70. This change was made on all similar model V-3420-19 engines as the propellers with the 60-80 hub would not be available in time.

The 50-hour Military Approval Test on the V-3420-5 engine, in accordance with Specification XC-28398 was started at the Allison Division on 6 July 1943. This test was successfully completed on 15 July 1943, based on a normal rating of 2100 b.h.p. at 2600 r.p.m. and 2600 b.h.p. at 3000 r.p.m. take-off and military rating. A subsequent unofficial 7-1/2 hour war emergency rating approval test was conducted on this engine on 4 and 5 August 1943 at 57 In. Hg. manifold pressure at 3000 r.p.m. This corresponds to 3050 b.h.p. at 80°F carburetor air temperature.

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The 50 hour Military Approval Test on the V-3420-7 engine has been delayed in view of the lack of an airplane for this engine and to higher priority ratings of other projects at Allison Division.

ALLISON V-3420-19 ENGINE

503-541 Expenditure Order No.	Allison Division, G.M.C. Indianapolis, Indiana Mfg. or Activity Charged with Development
None Classified Project No.	P.O. (535) 43-27600-E Contract Number

DESCRIPTION: The Allison V-3420-19 (B-8) is a further development of the Allison V-3420-5 engine. This is a 24 cylinder, upright, double "V" liquid-cooled engine. This engine includes dual oppositely rotating crankshaft extension shafts connected to a remote reduction gear with dual oppositely rotating concentric propeller shafts. A two-stage gear driven supercharger is included in the accessory section of the engine. The auxiliary or first stage is driven through a hydraulic coupling and the carburetor is located at the entrance to the second stage supercharger. The auxiliary stage supercharger has a 6.92:1 gear ratio and 10" diameter impeller. The engine is rated as follows:

	BHP	RPM	ALTITUDE
Take-off	2600	3000	Sea level
Military	2300	3000	20,000 feet
Normal	2100	2600	17,000 feet
Sea level	2100	2600	Sea level

PURPOSE: To develop a two-stage high altitude, high output V-3420 engine suitable for installation in a fighter type airplane.

AUTHORITY: Inter-Office Memorandum from Chief, Engineering Division, dated 19 November 1942, requesting engine be obtained for XP-75 airplane.

REMARKS: Development of a V-3420 engine as described above is required for installation in the XP-75 airplane. Inter-Office Memorandum from Chief, Engineering Division dated 19 November 1942, requested that necessary action be taken to obtain the required engines. Accordingly, Authority for Purchase No. 345202 dated 7 January 1943, was initiated and a short form contract was issued in Materiel Command letter of 18 February 1943, under Purchase Order No. (535) 43-27600-E (Contract No. W-535-AC-37891). This Purchase Order provided for a total of five V-3420-19 engines. Two engines were required for installation in each of two airplanes, two engines for spares and a fifth engine was procured for test at Wright Field.

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To expedite delivery and airplane installation of these engines the Purchase Order provided for delivery of the first two engines as single-stage engines equipped with a 7.8:1 supercharger gear ratio with provision for modification to two-stage integrally geared supercharged engines at a later date by the contractor.

In view of the procurement of 6 additional XP-75 airplanes, Authority for Purchase 322453, dated 21 August 1943, was initiated covering procurement of 9 V-3420-19 engines for installation and spares in the 6 additional airplanes. This Authority for Purchase led subsequently to the formulation of Amendment 3307 to Purchase Order (535) 43-27600-E. The following deliveries apply to the V-3420-19 engines for the XP-75 airplane:

First engine - 4 December 1943
Second engine - 8 December 1943
Third engine - 14 December 1943
Fourth engine - 18 December 1943
Fifth engine -22 December 1943
Sixth engine - 29 December 1943
Subsequent engines at intervals of one week.

The sixth engine will be delivered to Wright Field for tests.

Of the 14 engines included in this procurement, 2 engines are included for calibration and test purposes at Wright Field. E. O. 503-541 covers one engine and the second engine is covered by E. O. 503-604

DESIGN AND DRAWINGS OF COMBINED PACKARD ROLLS-ALLISON V-1710 ENGINE

503-606
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: The combined Packard Rolls-Allison V-1710 engine consists of the basic power section and reduction gear from a V-1710-91 engine and a two-speed Packard Rolls supercharger and aftercooler connected to the induction system of the V-1710 engine. The Packard Rolls supercharger is driven by means of a special adapter and drive shaft from the starter shaft of the V-1710 accessory housing.

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PURPOSE: To fabricate special engine and test parts required for altitude calibration and testing of the above described engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: Inter-Office Memorandum was initiated on 10 September 1943 requesting priority on the fabrication of these parts in view of the interest in this project by the Assistant Chief Air Staff, Materiel Division. The final and complete drawings were furnished to Engineering Shops on 18 September 1943. On 29 November 1943, all parts were completed except two ducts required for the induction system. A check of the fit and arrangements of these parts was made in the Engineering Shops on 6 December 1943. Testing of this engine is being held in abeyance pending availability of test facilities.

PISTON AND RING TESTS OF V-1710 ENGINE

503-624	Power Plant Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: The piston and ring combinations tested herein consisted of Allison previous standard square rings and current production Keystone ring pistons, cam machined to prevent scuffing and seizure along the piston pin axis. Low tension and high tension top 15° Keystone rings are included. A new combination consisted of a Pratt & Whitney R-1830 piston and rings suitably modified to fit the Allison V-1710 engine.

PURPOSE: To obtain improved reliability and performance of the Allison V-1710 engine by improved piston and ring performance which is presently the limiting critical factor of the engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: Considerable difficulty has been experienced during model tests of the Allison V-1710-93 and -89 engines on production contracts due to excessive ring wear, sticking, and breakage. Tests conducted at Wright Field indicated distortion or unsuitable shape of the pistons which resulted in scuffing along the piston pin axis which is at right angles to the thrust axis. Accordingly the standard square ring and Keystone ring Allison pistons were cam machined by a lathe cut with the piston mounted on an eccentric fixture. Six tests on the altitude dynamometer test stand at 60" manifold pressure and 150°F. manifold temperature and above were

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conducted on the various cam machined Allison pistons. Memorandum Reports ENG-57-1022, ENG-57-503-1059 and ENG-57-503-1074 cover four of the six tests. In general, improved output was possible through the use of cam machined pistons.

Tests on the Pratt & Whitney pistons were started on 22 November 1943 and were delayed due to excessive oil consumption. After 20 hours of run-in the engine was removed and the rings werelapped into the cylinder barrels. 19:40 hours of subsequent running still resulted in high oil consumption and at this time failure of the rear thrust washer of the reduction gear pinion occurred. The reduction gear was repaired and the third compression ring was reworked to provide a 10° tapered ring to reduce oil consumption. 2:40 hours of additional running still produced excessive oil consumption. The engine was disassembled and the pistons were reworked to provide increased oil drainage from the oil control rings through additional holes in the pistons to decrease the oil consumption. This engine will be subjected to a 150 hour model test at 1425 BHP military and take-off at 1100 BHP normal.

DEVELOPMENT OF MAGNETIC RELUCTANCE TORQUEMETER FOR V-1710 ENGINES

503-527
Expenditure Order No.

None
Classified Project No.

Allison Division, G.M.C.
Indianapolis, Indiana
Mfg. or Activity Charged with Development

P.O. (535) 43-16327-E
Contract Number

DESCRIPTION: This development covers a magnetic reluctance type torquemeter for measurement of engine power in flight. The first torquemeter will be specifically suitable for use in the reduction gear assembly of an Allison V-1710-85 or similar model engine. The unit is an electrical device which functions on the principle of a change in magnetic reluctance of an air gap which varies in proportion to the torsional deflection of the propeller shaft. The Allison Division is working cooperatively with the Westinghouse Electric Manufacturing Company on this project.

PURPOSE: To develop a torquemeter specifically for the Allison V-1710-85 engine and to provide for future adaptation of torquemeters to various V-1710 and V-3420 model engines.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Allison Division in their letter of 16 October 1942, suggested formulation of a contract for a magnetic reluctance type torquemeter based on a proposal by the Westinghouse Electric Manufacturing Company and submitted the necessary data and cost quotations.

Authority for Purchase 307587 dated 28 November 1942, resulted in formulation of Purchase Order (535) 43-16327-E (Contract W-535-AC-35881) dated 12 January 1943. This Purchase Order covers procurement of a report on a calibration and 50 hour Development Test of the magnetic-reluctance type torquemeter.

At the request of Allison Division and confirming Materiel Command telegram dated 4 May 1943, Engineering Order Serial No. X-3364, was initiated on the above Purchase Order covering authorization for extension of the development of this type torquemeter to various other types and model engines. The subject Purchase Order specifically covers the development of a torquemeter for use in the V-1710 engine. The Engineering Order enabled extension of this development to V-1710 engines of the "F" series and also to the V-3420 model engines with integral and remote reduction gears.

Some delay was experienced due to development difficulties with this torquemeter. A 90 day extension in delivery date was requested by Allison Division and in Inter-Office Memorandum dated 8 October 1943 to Procurement Division it was agreed that Allison be granted this delay with the understanding that they furnish a preliminary report.

EXAMINATION AND TEST OF GERMAN
J-211F AND DB-601E ENGINES

503-551	Power Plant Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This project covers the examination of the latest available type German liquid-cooled engines. The Junkers J-211F and Daimler Benz DB-601E engines are very similar type engines, differing in constructural details. They are inverted, 12 cylinder "V" liquid-cooled engines incorporating fuel injectors. The Daimler Benz 601 incorporates a hydraulic coupling drive to the integrally geared supercharger, whereas the J-211F has a two-speed drive to the integrally geared supercharger.

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PURPOSE: To study the construction details and obtain performance calibrations of latest available German liquid-cooled engines for comparison with previous similar German engines received at Wright Field and to compare them with American liquid-cooled engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: Three DB-601E engines and one Junkers Jumo J-211F engines were received at Wright Field in February 1943. Two of the DB-601 engines were received from Africa and were Daimler Benz engines, and the third was a Mercedes Benz and was received from Russia. These engines were disassembled for inspection and it was discovered that the two Daimler Benz engine's were in fairly good condition, whereas the Mercedes Benz engine had suffered a main bearing failure which had resulted in damage to the crankshaft and crankcases. A similar DB-601 engine was removed from a Messerschmidt ME-109F airplane and the parts from one of the two Daimler Benz engines above were utilized in building a good engine for use in the airplane. Following the examination of these DB-601 engines, one complete engine is being reassembled for use in calibration tests to obtain performance characteristics. The Junkers J-211F engine has not been disassembled inasmuch as it is contemplated using this engine for performance calibrations prior to detailed inspection of the engine.

Calibration of these German engines is being withheld pending completion of higher priority tests. Memorandum Report, Serial No. ENG-57-503-1001, dated 4 December 1943, covers the disassembly inspections of the DB-601E engines.

STRATOS SUPERCHARGER BY RANGER AIRCRAFT

503-581 Expenditure Order No.	Ranger Aircraft Engines Farmingdale L.I., N.Y. Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: The Stratos supercharger is the present name for the Szydlowsky-Planiol supercharger. This supercharger includes controllable inlet vanes which replace the ordinary inlet throttle, and an impeller, fabricated from four different sections splined together, each unit containing airfoil section vanes displaced relative to each other. The novel features and utilization of aero-dynamic principles in the design are intended to provide a supercharger assembly of high efficiency. The Stratos

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supercharger had previously been adapted for use with the Allison V-1710-65 engine. Reference is made to Expenditure Order No. 503-441, covering the development of the Allison V-1710-65 engine with the Stratos (formerly termed Planiol) supercharger.

PURPOSE: To continue the development of the Stratos supercharger in connection with its application to the Allison V-1710-65 engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: Expenditure Order 503-543 covers the results of testing of the Allison V-1710-65 engine equipped with the Stratos supercharger. Several serious difficulties were experienced during the course of calibration tests on this engine associated with the adaption of the Stratos supercharger to the Allison engine. These consisted of serious surging between the two supercharger stages, damage to the ducting from the outlet of the Stratos supercharger to the engine carburetor due to backfires, impeller blade failures and leakage of oil through the Stratos supercharger oil seal, which resulted in freezing of the inlet vane controls of the supercharger.

On 1 June 1943, Ranger submitted a proposal covering the redesign and overhaul of the two Stratos supercharger assemblies already furnished the Government to eliminate surging and to correct other difficulties experienced during the first calibration tests. Consideration was given in the redesign studies to enable operation of the Stratos supercharger with the Allison hydraulic coupling inasmuch as due to difficulties caused by inadequate oil supply to the hydraulic coupling when used with the Stratos supercharger, a fixed drive coupling was used with the first design.

The first Stratos unit was delivered on 3 December 1943, and the second unit was delivered on 14 December 1943.

In conference discussions with Ranger personnel on 10 December 1943, as reported in Memorandum Report ENG-57-503-1089, it was proposed to utilize the second unit for flight tests in a Bell P-63 airplane, and Ranger is to submit a proposal covering procurement of an additional unit for endurance testing at Wright Field following, or simultaneous with altitude calibration on the first unit.

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PROCUREMENT AND TEST OF R-1820-93 ENGINE

503-453
Expenditure Order No.

Wright Aeronautical Corp., Paterson, New Jersey
Mfg. or Activity Charged with Development

None
Classified Project No.

W-535-AC-27005
Contract No.

DESCRIPTION: The Wright Aeronautical Corporation Model R-1820-93, 9 cylinder air-cooled engine. This engine, rated at 1350 b.h.p. at 2700 r.p.m. for take-off, has forged heads and is in general a redesigned R-1820-65 for higher horsepower output.

PURPOSE: This engine is to be used as an experimental engine for investigating the possibilities of a higher horsepower output in the 1820 series engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: This engine was received at the Materiel Command on 13 March 1943. Results of dynamometer calibration indicate that the engine will not develop its guaranteed ratings as stated in Wright Aeronautical Corporation Engine Specification 794-A, dated 24 October 1942. The engine has been shipped back to the manufacturer for redesign prior to an official model test.

DEVELOPMENT OF THE R-2600 ENGINE

503-304
Expenditure Order No.

Wright Aeronautical Corp., Patterson, New Jersey
Manufacturer or Activity Charged with Development

M-6440
Classified Project No.

W-535-AC-15738
Contract Number

DESCRIPTION: The R-2600-C engine referred to in the original War Reparations Agreement between the Wright Aeronautical Corporation and the United States Government was an engine of 2600 cu. in. displacement having an overall diameter considerably less than 55 in., which has been the standard diameter for R-2600 engines manufactured by the Wright Aeronautical Corporation. Since the War Reparations Agreement was made, it was found that the development of a smaller diameter engine was not feasible nor could much gain in airplane performance be made if a smaller diameter engine were installed. For this reason, the standard diameter of

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55 in. has been adhered to in the development of the 1800 h.p. model of the R-2600 engine. The increased horsepower rating of this engine is obtained by using higher rotational speeds.

PURPOSE: To develop a high output engine of 2600 cu. in. displacement.

AUTHORITY: War Reparations Agreement between the United States Government and the Wright Aeronautical Corporation.

REMARKS: The R-2600-C rating of 1800 h.p. has been superseded by a 1900 h.p. rating. A type test at this power is now being run by Wright Aeronautical Corporation. An R-2600-15 engine rated at 1900 h.p. has been successfully model tested at the Lockland Plant, Wright Aeronautical Corporation.

THE DEVELOPMENT OF AN R-3350 ENGINE OF 2200 H.P.

503-525 Expenditure Order No.	Wright Aeronautical Corp. Paterson, New Jersey Mfg. or Activity Charged with Development
None Classified Project No.	W-535-AC-20296 W-535-AC-18071 Contract Number

DESCRIPTION: This is an 18-cylinder air-cooled engine designed for 2200 horsepower at take-off.

PURPOSE: To develop a 2200 H.P. engine suitable for installation in the XB-29 and XB-32 airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: At the time heavy bombardment aircraft for future use were being designed, the R-3350-5 engine was the most highly developed R-3350 engine available. When it was decided that engines of greater than 2000 h.p. were needed, the R-3350-13 engine rated at 2200 h.p. for take-off was being developed. Considerable difficulty with reduction gears was experienced and over a period of the last two years, considerable development has taken place. Recent model tests of the R-3350-13 and -21 engines indicate that reduction gears are now reasonably satisfactory. Notable changes in the engine made since the first model test which was held in September of 1941 are as follows:

(1) Installation of silver pre-fit master rod bearings.

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(2) Design of a second order balancer which counteracts the second order whirl normally experienced with a two-row radial engine.

(3) Installation of full floating reduction gear pinion bushings.

The latest model test of an R-3350-19 engine, which is similar to the R-3350-13, with the exception that it is equipped with fuel injection, indicated that the engine was suitable for installation in the XB-29 airplanes. The development of this engine has continued at a satisfactory pace, and when nichrome exhaust valves and buttress threaded valve seat inserts are available it is believed that this will be a very satisfactory "combat engine".

DEVELOPMENT OF R-3350 ENGINE OF 2300 H. P.

503-304 Expenditure Order No.	Wright Aeronautical Corp. Paterson, New Jersey Mfg. or Activity Charged with Development
M-6440 Classified Project No.	W-535-AC-15738 Contract Number

DESCRIPTION: The first R-3350 engine to be rated at 2300 h.p for take-off is the R-3350-7 engine. In accordance with the War Reparations Agreement between the United States Government and the Wright Aeronautical Corporation, this engine is to be developed by the contractor at no cost to the Government. The R-3350-7 engine is a conventional 3350 engine that obtains the higher horsepower rating by increased rotational speeds. The prime problem of obtaining the 2300 h.p. rating is that of obtaining master rod bearings.

PURPOSE: To develop a 3350 engine having 2300 h.p. rating for take-off.

AUTHORITY: War Reparations Agreement between United States Government and Wright Aeronautical Corporation.

REMARKS: At the time of the War Reparations Agreement between the United States Government and the Wright Aeronautical Corporation, the R-3350-5 engine was the most highly developed R-3350 engine. The development of a 3350 cu. in displacement engine having take-off rating of 2300 h.p. was necessary to provide higher horsepower ratings for heavy bombardment aircraft of future design. Since the R-3350-7 engine proposed for development in the War Reparations Agreement and contracted for in Contract No. 15738 was not installationally desirable, an Engineering Order was accomplished to

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require that the R-3350-7 engine be replaced with an R-3350-31 engine. This change order was made so that testing of the engine called for in Contract No. 15738 would provide sufficient data for a model test of the R-3350-31 engine which is to be used in the C-69 and C-74 airplanes.

XR-4090 ENGINES

503-439
Expenditure Order No.

Wright Aeronautical Corp.,
Paterson, N. J.

MX-153
Classified Project No.

W-535-AC-30116
Contract Number

DESCRIPTION: Wright Aeronautical Model XR-4090, 22 cylinder, two-row, air-cooled engine. This is a 3000 horsepower engine to be used in the development of heavy bombardment and pursuit types of airplanes.

PURPOSE: To cover all work in connection with procurement of XR-4090 engines.

REMARKS: Original plans called for procurement of two XR-4090-1 engines and three XR-4090-3 engines. Upon the advice of Wright Aeronautical Corporation, who did not wish to work on the development of two-speed superchargers and dual rotation propeller gearing, the original Authority for Purchase was revised to call for four XR-4090-1 engines in place of the above mentioned engines. Of these four engines, one engine shall be designated as an XR-4090-2 engine and shall be assigned a Bureau of Aeronautics serial number. The procurement of these four engines is covered by Authority for Purchase No. 224908. When the Wright Aeronautical Corporation begins development of two-speed superchargers and dual rotation propeller gearing for engines of this horsepower, arrangement shall be made to procure engines with this equipment. Contract W-535-AC-30116 covers the procurement of these engines. To date 280 hours of endurance testing have been accomplished with very satisfactory results.

DEVELOPMENT OF TWO-SPEED DUAL ROTATION GEARS FOR R-3350 ENGINES

503-304
Expenditure Order No.

Wright Aeronautical Corp.,
Paterson, N. J.

M-6440
Classified Project No.

W-535-AC-15738
Contract Number

DESCRIPTION: The two-speed dual rotation reduction gear for the R-3350 engine is a reduction gear having provisions for co-axial counter

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rotating propeller shafts and provisions for gear shifting so that the propeller shaft turns at two speeds with reference to the engine crankshaft speed.

PURPOSE: This project was undertaken to provide for two-speed dual rotation reduction gears which are designed for use with the R-3350 engines when they are used in fighter or bombardment type aircraft where propeller clearance is close and maximum propeller efficiency is desired under take-off and high altitude cruising conditions.

AUTHORITY: War Reparations Agreement between the U. S. Government and Wright Aeronautical Corporation.

REMARKS: As a result of the War Reparations Agreement between the United States Government and Wright Aeronautical Corp., the Wright Aeronautical Corp. is to develop a reduction gear suitable for use with the 2300 h.p. R-3350 engine. Since the R-3350 production problems have necessitated the use of practically all Wright Aeronautical Corp. engineering talent, the experimental development of the two-speed dual rotation reduction gear has not progressed rapidly. At the present time the Experimental Development Department of the Wright Aeronautical Corp. is laying out a two-speed dual rotation reduction gear system that will be suitable for use with both the R-3350 type engines and the R-2160 type engines. Specific details have not as yet been introduced into the design because it has not been determined what gear ratios would provide the maximum efficiency of the propeller under all operating conditions. The gain that can be obtained in airplane performance by using two-speed dual rotation reduction gears is dependent upon the actual airplane installation. Since no specific application of the two-speed dual rotation reduction gear has been proposed, the final details of design cannot be accomplished on this project. Dual rotation gearing has been developed in the past year for the R-3350-17 engine being installed in the XP-62 airplane. It is expected that flight test of this airplane will be conducted in the near future.

PISTON RING DEVELOPMENT FOR WRIGHT ENGINES

503-537 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged With Development
None Classified Project No.	None Contract Number

DESCRIPTION: This project was set up as a means of assisting Wright Aeronautical Corporation in the development of a suitable piston and ring combination for R-1820 and R-2600 engines.

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PURPOSE: To cover all work necessary in connection with the development of a piston and ring combination that will alleviate high oil consumption difficulties now being experienced on Wright engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: A total of twenty-seven 19-hour indicative tests were run to check various piston ring combinations and to indicate whether the combinations run were leading to a successful solution. At the conclusion of these 19-hour tests, resulting piston ring combination decided upon was installed in an R-1820-97 engine and endurance tested for 301-1/2 hours. Although believed that improvement would be made within a short time, because of higher priority of other projects, these tests were not completed. Service tests and further test stand work have resulted in three piston ring configurations that are available and believed suitable for R-1820 and R-2600 engines; Uniflow configuration with a chrome plated top ring which is now in production; single Simplex combination, and Power Plant Phase II configuration which has been recommended for use in .015 oversize R-1820 cylinders. Development work is continuing and it is expected that one of the above combinations will eventually be used in all Wright engines.

XR-2800-37 ENGINES

503-437 Expenditure Order No.	Pratt & Whitney Aircraft Div., East Hartford, Connecticut. Mfg. or Activity Charged With Development
None Classified Project No.	W-535-AC-27184 Contract Number

DESCRIPTION: Four XR-2800-37 engines were procured for the Brewster XA-32 airplane. These engines have 2100 horsepower for take-off and have strengthened crankshaft, forged cylinder heads and a high speed generator drive. One engine will be equipped with a torquemeter for flight testing.

PURPOSE: To develop an R-2800 "C" engine with improvements in design to permit higher horsepower output for improvement of airplane performance.

AUTHORITY: Chief, Engineering Division.

[redacted]

REMARKS: Authority for Purchase No. 190597 was initiated on 17 December 1941 to cover procurement of these four engines. Contract No. W-535-AC-27184 has been negotiated for procurement. Three engines have been delivered to Brewster and one is at present in the Wright Field Power Plant Laboratory awaiting test.

XR-2800-55 ENGINE

430-137 431-137
Expenditure Order No.

Pratt & Whitney Aircraft Div.
East Hartford, Connecticut
Mfg. or Activity Charged With Development

None
Classified Project No.

P. O. (535) 43-31123-E
Contract Number

DESCRIPTION: Two R-2800-55 engines were procured for the Curtiss-Wright XP-60C airplane. These engines are new "C" type engines having higher horsepower ratings two-stage, two-speed superchargers of improved performance and dual rotation .50 reduction gear.

PURPOSE: To develop an air-cooled engine of higher output and altitude performance for fighter aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Authority for Purchase No. 319510 was initiated 8 May 1943 and Purchase Order No. 43-31123-E dated 25 May 1943 has been issued.

R-2800-57 AND -61 ENGINES

430-142
Expenditure Order No.

Pratt & Whitney Aircraft Div.,
East Hartford, Connecticut.
Mfg. or Activity Charged With Development

None
Classified Project No.

NOA (S) 567
Contract Number

DESCRIPTION: One each R-2800-57 and -61 engines were procured for the Republic P-47J airplane. These engines are new type "C" engines having higher horsepower ratings than the present production R-2800's. The R-2800-61 engine has dual rotation.

PURPOSE: To develop an air-cooled engine of higher output and altitude performance for fighter aircraft.

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AUTHORITY: Chief, Engineering Division

REMARKS: Authority for Purchase No. 319510 was initiated 8 May 1943. An R-2800 "C" type engine has completed a 7-1/2 hour War Emergency Rating Test at 2800 b.h.p.

R-4360 ENGINES

425-56 503-486
Expenditure Order No.

Pratt & Whitney Airc. Div.
East Hartford, Conn.
Mfg. or Activity charged with Development

MX-164
Classified Project No.

NOA (S) 1524
Contract No.

DESCRIPTION: The R-4360 engine is a 28 cylinder, air-cooled, 4 row radial engine and can be used in a submerged installation and with pusher propellers, extension shaft, cooling fan, dual rotation, two-speed propeller gear or it can be also used in a conventional tractor installation. These engines have single-speed, single-stage, variable speed single stage, and variable speed two-stage supercharger characteristics and dual rotation single-speed, single-rotation two-speed, and single rotation single-speed reduction gearing.

PURPOSE: To develop engines suitable for more advanced designs of bombardment type aircraft and engines having more horsepower which will be suitable for new types of fighter aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Authority for Purchase No. 236388 was initiated 8 June 1942, and Purchase Order No. 43-852-E dated 14 July 1942 has been issued, Navy Contract No N 93651 was issued to cover procurement of experimental R-4360 engines for the Army and Navy. Contract N-93651 was superseded by Contract No. A (S) 1524 to permit changes in quantities and characteristics of the R-4360 engines being procured. Delivery of engines was begun in October 1943. As of 15 December 1943, the following is the shipping schedule of experimental R-4360 engines.

R-4360	Nov.(43)	Dec.(43)	Jan.	Feb.	Mar.	Apr.	May	June
-5	1				3	4		
-7	1		1	1	2	1		
-9	1				1			
-9T		1						
-11			1	1	1	2		

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R-4360	Nov.(43)	Dec.(43)	Jan.	Feb.	Mar.	Apr.	May	June
-13	1		1	1				
-15		1						
-17							2	
-21								2
-25						3	7	10
-27						2	1	
-29			1	3	1			3

The R-4360-9T engine listed above as being delivered in December, 1943, is now at Wright Field and will be prepared for miscellaneous calibration and other tests as soon as a carburetor and mounts are furnished by the engine manufacturer.

V-1650-9 and -11 ENGINES

503-609
Expenditure Order No.

Packard Motor Car. Co.
Detroit, Michigan
Mfg. or Activity charged with Development.

MX-438
Classified Project No.

W 535 AC-15678
Contract No.

DESCRIPTION: These engines are similar to the V-1650-7 engine except that main bearings will be strengthened and other changes made so that the engine will withstand higher War Emergency Ratings comparable to those of the British RM14Sm engine. The engines would still be interchangeable with the V-1650-3 engines. The V-1650-11 engine differs from the V-1650-9 engine in that it incorporates a Rolls-Royce type fuel injection pump instead of a carburetor which should increase the altitude rating.

PURPOSE: To develop an engine comparable to the British RM14SM engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: During August 1943, an Authority for Purchase was initiated for five V-1650-9 engines and the necessary parts to convert two V-1650-9 engines to V-1650-11 engines Also preliminary steps were taken to provide Packard Motor Car Company with additional experimental facilities for the development of these engines. At the present, preliminary design of the engine has been completed. Fabrication of parts will start as soon as additional shop facilities can be obtained. This development program is not supposed to interfere with production.

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V-1650-5 ENGINE

503-446 Expenditure Order No.	Packard Motor Car Co. Detroit, Michigan Mfg. or Activity charged with Development
None Classified Project No.	W 535 AC-28854 Contract No.

DESCRIPTION: This drive is similar to that used by the Allison engine in the P-39 airplane. The nose of the V-1650-3 was modified to drive the propeller through an extension shaft. This was accomplished by merely making an adapter which fits on the front of the V-1650-3 engine and will take a standard Allison reduction gear and extension shaft drive.

PURPOSE: To adapt the V-1650-3 engine to airplanes of the P-39 type.

AUTHORITY: Chief, Engineering Division.

REMARKS: In April, 1942, a contract was made with the Packard Motor Car Company for an engine propeller drive with a torsiometer pick-up which would be adaptable for use with an Allison reduction gear and extension shaft as used in the P-39 airplane. The purpose of the torsiometer pick-up was to make it possible to determine if the V-1650-3 engine would operate satisfactorily with this type of drive. During March 1943, the engine was tested in combination with Allison reduction gear and extension drive to determine torsional characteristics. Subsequent disassembly inspection revealed that the spring drive to the supercharger had broken, indicating the possibility of torsional difficulties even though a torsional pick-up on the front of the crankshaft indicated no trouble. Additional torsional runs will be made in January, 1944 with a torsional pick-up on the rear of the crankshaft.

AUTOMATIC ENGINE CONTROLS FOR TURBOSUPERCHARGED ENGINES

525-288 525-309 Expenditure Order No.	See "Remarks" Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: Automatic engine controls for turbosupercharged engines are

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quite similar to those used for geared supercharged engines. However, an additional control has to be incorporated to control the turbosupercharger and link this control in with the throttle control and propeller governor control in such a manner as to obtain a single lever control from the entire power plant.

PURPOSE: To develop an automatic control for turbosupercharged engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: Bendix Aviation Corporation, Bendix, New Jersey, proposed to develop a control by incorporating a turbo control with their control for geared supercharged engines. The Army Air Forces have no contract with Bendix, but this control is being flight tested under Expenditure Order No. 525-288.

Fairchild Aviation Corporation, Jamaica, Long Island, New York, is doing preliminary research for a control which will handle either geared supercharged engines or turbosupercharged engines. This project is described under Automatic Engine Controls for Geared Supercharged Engines.

General Electric Company, West Lynn, Massachusetts, has developed a turbosupercharger control which can be incorporated with any type of engine control as used for geared supercharged engines. Flight tests are now being conducted by the Power Plant Laboratory under Expenditure Order No. 525-309.

AUTOMATIC ENGINE CONTROLS FOR GEARED SUPERCHARGED ENGINES

427-64 503-585
518-223 525-291
Expenditure Order No.

See Remarks
Mfg. or Activity charged with Development

None
Classified Project No.

W-535-AC-40173
W-535-AC-34906
Contract No.

DESCRIPTION: There has been a demand for various degrees of automatic engine control. The simplest form is one which maintains constant manifold pressure for a given setting of the pilot's control lever regardless of changes in altitude. The next step is to incorporate the automatic regulation of manifold pressure with a speed control,

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which merely entails hooking up the propeller governor with a datum selector on the automatic boost control. Other variations of automatic engine controls include automatic supercharger shift for two-speed engines and readjustment of manifold pressures for use of water injection and the incorporation of automatic spark advance.

PURPOSE: To develop automatic engine controls for geared supercharged engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: Several companies are working on the development of the above types of controls.

Bendix Aviation Corporation, South Bend, Indiana, has under development a variable datum manifold pressure regulator, a variable datum supercharger shift control, and engine speed control. Flight tests so far conducted under Expenditure Order No. 518-223 have indicated that modification is necessary before this control will be satisfactory.

Eclipse Aviation, Bendix, New Jersey, is building an automatic control incorporating engine speed and manifold pressure. They have been given a contract for six controls which are expected about 1 January 1944. The contract number is W-535-AC-34906, and was authorized under Expenditure Order No. 427-64.

Delco-Remy Corporation, Anderson, Indiana, and Simmonds Aerocessories, Inc., New York, New York, have also developed a control for manifold pressure and engine speed. These two companies are subcontractors to engine companies; however, the Power Plant Laboratory is conducting the flight tests which are being conducted under Expenditure Order No. 503-585.

Fairchild Aviation Corporation, Jamaica, Long Island, New York, has been given a contract, No. W-535-AC-40173, authorized under Expenditure Order No. 525-291, to conduct research work preliminary to the development of a complete automatic engine control. This engine control is to control carburetion in addition to speed, manifold pressure, and automatic spark advance. This has been about completed, and it is intended to give another contract to proceed with the development of a bread-board model of an automatic control which can be used either for turbo-supercharged engines or for geared supercharged engines.

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TYPE TEST OF R-250 ENGINES

504-142	Research Laboratories Div., General Motors Corporation, Detroit, Michigan.
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The General Motors R-250 engines are two-stroke cycle, supercharged, direct drive, liquid cooled engines having four cylinder blocks radially arranged. Each cylinder block contains a ported intake cylinder and a ported exhaust cylinder connected by a common combustion chamber. The XR-250-1 engine uses 8.37:1 blower gears. It is rated at 200 b.h.p. at 2500 r.p.m. at sea level. The XR-250-3 engine uses 9.7:1 blower gears. It is rated at 200 b.h.p. at 2275 r.p.m. for take-off at sea level and 200 b.h.p. at 2500 r.p.m. for normal rating at sea level to 3700 feet altitude.

PURPOSE: To type test the XR-250-1 engine and the XR-250-3 engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: The test program in progress includes obtaining a torsional vibration survey and an endurance test of the XR-250-3 engine. Sea level and altitude calibrations of the XR-250-3 have been obtained.

The last previous test was a complete endurance test of the XR-250-1 engine. Memorandum Report No. ENG-57-504-25 covers this test. The testing of the XR-250-3 engine will serve as a penalty test for the parts which failed the XR-250-1 engine endurance test. Memorandum Report No. ENG-M-57-673-16 covers the first attempted type test of the XR-250-1 engine. Memorandum Report No. EXP-M-57-504-12 covers an altitude calibration of an R-250 engine first with 7.82:1 supercharger gears and then 10.48:1 supercharger gears installed.

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XO-240-1 ENGINE

503-573	Stout Research Div. of Consolidated Aircraft, Dearborn, Michigan.
Expenditure Order No.	Mfg. or Activity charged with Development
None	W-535-AC-40659
Classified Project No.	Contract No.

DESCRIPTION: The XO-240-1 engine is a four cylinder, flat opposed, aircooled, direct drive, unsupercharged engine with a normal rating of 125 h.p. at 3200 r.p.m. This engine is arranged to operate in a vertical position with the nose end uppermost and includes a complete integral engine cylinder and oil cooling system.

PURPOSE: To develop an extremely light, small engine for small helicopter use.

AUTHORITY: Chief, Engineering Division.

REMARKS: The XO-240-1 engine should be type test approved by December 1944, if contract dates are met. The contract provides for a cost plus a fixed fee phase development, which may terminate at the end of any phase if so desired by the Material Command. Stout Research has completed about 50% of the single cylinder work.

XO-300-9 ENGINE

503-452	Aircooled Motors Corp., Syracuse, New York
Expenditure Order No.	Mfg. or Activity charged with Development
None	P.O. No. (535) 42-14812
Classified Project No.	Contract No.

DESCRIPTION: The XO-300-9 engine is a six-cylinder, flat-opposed, geared, unsupercharged and air-cooled engine rated at 165 h.p. at 3500 r.p.m.

PURPOSE: To develop a light, air-cooled and geared engine for target aircraft application.

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AUTHORITY: Chief, Engineering Division.

REMARKS: The engine was delivered to the Materiel Command 18 January 1943 but was returned to the manufacturer, where it is now located, for incorporation of changes indicated as necessary by the XO-200-5 type and model tests. In addition, other improvements are to be incorporated to allow the engine to be interchangeable with the O-300-11 engines.

XO-405-7 ENGINE

665-57 Expenditure Order No.	Aircooled Motors Corp., Syracuse, New York. Mfg. or Activity charged with Development
None Classified Project No.	P.O. No. (535) 41-11565 Contract No.

DESCRIPTION: XO-405-7 engine is a six-cylinder, flat-opposed, air-cooled, geared and supercharged engine rated as follows:

Take-off - 250 h.p. at 3200 r.p.m.
Normal - 230 b.h.p. at 3200 r.p.m. at sea level
Normal - 225 b.h.p. at 3200 r.p.m. at 17,000 feet, normal rated altitude.

PURPOSE: To develop a small supercharged, air-cooled, geared engine for application in the MX-53 aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: The XO-405-7 engine was originally designated as the XO-405-1 engine. Changes from automotive to aeronautical types of drives and pads, from unsupercharged to supercharged and from direct drive to geared, have resulted in the present designation of XO-405-7. This engine is intended for use, at present, in remote control bombardment type aircraft. The XO-405-7 type test engine is now at the Materiel Command being calibrated. Endurance type test running will commence after the calibration.

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XO-435-7 ENGINE

420-28
Expenditure Order No.

Lycoming Division, Williamsport, Pa.
Mfg. or Activity Charged with Development

None
Classified Project No.

W-535 AC-31740
Contract Number

DESCRIPTION: The XO-435-7 engine is a six-cylinder, air-cooled, flat-opposed, unsupercharged, direct drive engine rated at 225 h.p. at 3000 r.p.m. is designed to operate with the crankshaft vertical, the nose end uppermost, and is equipped with an integral engine cylinder and oil cooling system and air cleaner.

PURPOSE: To develop a light, air-cooled engine capable of operating in a vertical position and suitable for operation in the XR-6 helicopter.

AUTHORITY: Chief, Engineering Division.

REMARKS: Three XO-435-7 engines and a model test at the manufacturer's plant are being procured. One engine is to be used for the model test, one is to be installed in an XR-6 helicopter, and the third is to be used as a spare for the helicopter. The model test of the XO-435-7 engine is expected to be satisfactorily completed by 1 February 1944.

XO-540-5 ENGINE

665-57
Expenditure Order No.

Aircooled Motors Corp., Syracuse, N.Y.
Mfg. or Activity Charged with Development

None
Classified Project No.

P.O. No. 41-11[illegible]
Contract Number

DESCRIPTION: The XO-540-5 engine is an eight-cylinder flat-opposed, air-cooled, supercharged and geared engine rated as follows:

Take-off - 330 h.p. at 3200 r.p.m.
Normal - 300 h.p. at 3200 r.p.m. at sea level to 17,000 feet, normal rated altitude.

PURPOSE: To develop a supercharged, air-cooled and geared engine for miscellaneous small aircraft use.

AUTHORITY: Chief, Engineering Division.

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REMARKS: The XO-540-5 engine was originally designated as XO-540-1. Due to the changes requested by the Equipment Laboratory in the changing from unsupercharged to supercharged and from non-standard to some standard drives, the designation is now XO-540-5. This engine was originally intended for use in target and remote control bombardment type aircraft. However, preliminary steps are now under way to produce six of these engines, prior to type tests, for use in a flying model of the Northrop flying wing. It is expected that this engine will be delivered for type test at the Materiel Command about 1 February 1944.

XO-805-5 ENGINE

665-57 Expenditure Order No.	Aircooled Motors Corp., Syracuse, N.Y. Mfg. or Activity Charged with Development
None Classified Project No.	P.O. (535) 41-11565 Contract Number

DESCRIPTION: The XO-805-5 engine is a twelve cylinder, flat-opposed, air-cooled, supercharged and geared engine rated as follows:
Take-off - 500 h.p. at 3200 r.p.m.
Normal - 450 h.p. at 3200 r.p.m. at sea level to 17,000 feet, normal rated altitude.

PURPOSE: To develop a supercharged, air-cooled, and geared engine for use in small aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: The XO-805-5 engine was originally designed as the XO-805-1 engine; however, at the request of the Equipment Laboratory, the engine was changed from an unsupercharged to a supercharged, and from non-standard to some standard pads and drives, resulting in redesignation to XO-805-5. This engine was originally intended for use in target and remote control bombardment aircraft. The XO-850-5 engine is expected for type test at the Materiel Command about 1 February 1944. Delivery of the engine is now dependent upon development of an automatically compensated carburetor.

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XV-770-5 ENGINE

522-378
Expenditure Order No.

Ranger Aircraft Engines,
Farmingdale, Long Island, N.Y.
Mfg. or Activity Charged
with Development

None
Classified Project No.

P.O. No. (535) 42-7363
Contract Number

DESCRIPTION: The XV-770-5 engine is a twelve cylinder, air-cooled, inverted "V", in-line, supercharged, geared engine rated as follows:
- Take-off - 575 h.p. at 3400 r.p.m.
- Normal Altitude Ratings - 465 h.p. at 3200 r.p.m. at 12,000 feet, first normal rated altitude.
- Normal Altitude Ratings - 450 h.p. at 3200 r.p.m. at 20,000 feet, second normal rated altitude.
- Military Ratings - 515 h.p. at 3400 r.p.m. at 12,000 feet.
- Military Ratings - 500 h.p. at 3400 r.p.m. at 20,000 feet.

PURPOSE: To develop an engine suitable for use with a Planiol-Szydlowski supercharger to allow development test of the supercharger.

AUTHORITY: Chief, Engineering Division.

REMARKS: Purchase Order 42-7363 covers the procurement of two XV-770-5 engines. This engine incorporates a single-stage Planiol-Szydlowski, two-speed supercharger. It is planned to altitude test the engine-supercharger combination on delivery to the Materiel Command, which is expected by approximately March 1944.

XV-770-9 ENGINE

503-497
Expenditure Order No.

Ranger Aircraft Engines,
Farmingdale, Long Island, N.Y.
Mfg. or Activity Charged
with Development

MX-346
Classified Project No.

W-535 AC-31759
Contract Number

DESCRIPTION: The XV-770-9 engine is a 12 cylinder, air-cooled, inverted "V", supercharged and geared engine designed for a cannon firing through the propeller shaft. Ratings of this engine

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are as follows:

- Take-off - 575 h.p. at 3400 r.p.m.
- Normal - 465 h.p. at 3200 r.p.m. at 12,000 feet.
- Normal - 450 h.p. at 3200 r.p.m. at 27,000 feet.
- Military - 515 h.p. at 3400 r.p.m. at 12,000 feet.
- Military - 500 h.p. at 3400 r.p.m. at 27,000 feet.

PURPOSE: To develop an engine for the XP-77 airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: Contract W-535 AC-31759 covers the development of the XV-770-9 engine and delivery of four engines. Since the commencement of this development the XP-77 airplane with the XV-770-9 engine has been cancelled. This engine is similar to the XV-770-5 engine except for the reduction gear, accessory drives, and provisions for nose firing cannon on the XV-770-9. Altitude ratings for the XV-770-9 are guaranteed to 27,000 feet, while those of the XV-770-5 are guaranteed only to 20,000 feet. The final report covering the completion of type test by Ranger is expected by October 1944.

TEST OF BMW801-D2 ENGINE

503-517 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: The BMW801-D2 engine is a 14 cylinder two-row radial, two-speed, single-stage, supercharged, geared, fuel injector-equipped German engine provided with an integral unit which controls engine manifold pressure, spark advance, mixture strength, supercharger gear change, and propeller pitch through a single pilot control. An overriding propeller control is also provided. An integral cooling fan is provided. As installed in German aircraft, the accessories, cooler, oil tank, piping, mount, exhaust stacks, etc., and cowl form an integral "power egg". The ratings of this engine are as follows:

BMW801-D (Full Rating)

Take-off	- 1695 h.p. at 2700 r.p.m. at S.L.	Low Blower
Maximum	- 1755 h.p. at 2700 r.p.m. at 3250 ft.	Low Blower
Normal	- 1590 h.p. at 2450 r.p.m. at 2500 ft.	Low Blower
Maximum	- 1530 h.p. at 2700 r.p.m. at 20,000 ft.	High Blower
Normal	- 1450 h.p. at 2450 r.p.m. at 18,000 ft.	High Blower

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PURPOSE: To test the BMW801-D2 engine to ascertain its performance characteristics, especially the operation of the automatic controls.

AUTHORITY: Chief, Engineering Division.

REMARKS: The BMW801-D 2 is now under test at the Power Plant Laboratory. The BMW801A engine test was discontinued because of very high oil consumption and poor compression due to unsatisfactory piston rings. Several BMW801-D2 engines are now available for investigation, one is now installed on a dynamometer for complete sea level and altitude calibration, with the automatic control in operation. Another engine was completely disassembled and sent to the Materials Laboratory for metallurgical analysis. Two engines have been overhauled and one was sent to Bell Aircraft Corp. for installation in a Focke Wulf 190 airplane being rebuilt for the AAF and the other is awaiting a test stand for a check run before being installed. A bench test was set up on the control box and complete setting data was obtained on several boxes. One box was disassembled for inspection.

XIV-2220 ENGINE

503-344 Expenditure Order No.	Chrysler Corp., Detroit Mich. Mfg. or Activity Charged with Development
MX-103 Classified Project No.	W-535 AC-18195 Contract Number

DESCRIPTION: This engine is a 16 cylinder, inverted, liquid-cooled, "V" type rated at approximately 2000 H.P. for take-off. This engine is being developed both for carburetion and fuel injection, and the program includes the development of an axial flow geared type supercharger for a critical altitude of 20,000 feet and construction of an engine specifically for use with a low altitude radial type supercharger as an integral part of the engine. A particular feature of this engine is the small frontal area which is 34" diameter at the nose. To avoid the problems of a 16 cylinder crankshaft the propeller drive is taken from the center of the crankshaft forward through an independent propeller lay shaft.

PURPOSE: To develop an inverted, liquid-cooled engine of approximately 2000 horsepower specifically for pursuit type aircraft.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Three XI-2220 engines have been built and put on test. However, with the exception of 25 minutes at 1950 to 2000 H.P. and 2-1/2 hours at 1800 to 1950 H.P., very little high output running has been conducted because of crankcase failures. A new designed crankcase has just been installed on one engine but there is yet no assurance of its success.

The twin and single cylinder test program has made good progress. The twins regularly run at 300 to 350 p.s.i. i.m.e.p. and 3600 r.p.m. and have completed 50 hour tests at 300 and 325 i.m.e.p. Parts for a new two-stage, two-speed supercharger have been ordered and are expected in March 1944.

Since the inception of this engine other engine powers have increased to such an extent to make a 200 H.P. Chrysler XI-2220 engine unattractive. Also certain mechanical problems have raised some doubt of the engine's success without major re-design. Chrysler has been given a six month's period in which to show satisfactory progress with the project. Satisfactory passing of a 50 hour military approval test at 2500 H.P. take-off and military rating is planned as a requirement to measure satisfactory progress.

X-6 ENGINE

503-602	Lycoming Division, Williamsport, Penn.
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-434	W-33-038-AC-564
Classified Project No.	Contract No.

DESCRIPTION: The latest preliminary layout of the engine which Lycoming now designates as the X-7 engine has 9 rows of 4 cylinders in a block, the blocks being dispersed radially around the crankcase. The preliminary installation drawing shows an overall diameter of 65 to 67" and an overall length of 120 inches including dual rotation propeller shaft and starter. The engine will be liquid cooled, use fuel injection or carburetion, a two-speed coaxial propeller system, and will obtain altitude performance by means of a turbosupercharger. The engine is rated at 4000 H.P. at 2500 RPM with 5000 H.P. at 2800 RPM for take-off. Every effort will be made in this development to obtain low fuel consumption.

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PURPOSE: To initiate the development of a 5000 H.P. engine specifically for long range bombardment aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: As early as 1935 studies made by the Engineering Division indicated the desirability or recommending two separate and distinct classes of engines instead of an all-purpose engine. The first class was the engine for all applications except long range bombardment. The second class would be an engine specifically for long range with fuel consumption of maximum importance. Durability under cruising conditions would be important, as well as sufficient take-off power to place the long range bomber in the air without excessive ground run. Obviously the second class of engine would be heavier per horsepower than an engine of the first class because the only known practical means of obtaining the required fuel consumption is by means of higher compression ratios and to simultaneously obtain the high take-off power on engine of large piston displacement would be indicated. Early in 1940 Request for Data R40-D for a 4000-5000 horsepower engine was submitted to the industry but a recommendation was made by the Materiel Command on 25 July 1940 that this Request for Data be held in abeyance until the aircraft engine industry is in a better position to judge the effects of the expansion program and can undertake new developments with less risk of interference with production. In December 1941 the importance of this project was realized again. A contract was negotiated with Studebaker (Project MX-232) involving the early phases of such a development. Since a second source for such an engine was desirable, since Lycoming had engineering personnel available because of the dropping of the XH-2470 engine (Project MX-211), and since they were desirous of entering this development, an Authority for Purchase was issued in August 1943 to cover tests to determine design and endurance characteristics of multi-cylinder components, multi-cylinder engine parts, and blueprints of power section design and options for continuing through the building and testing of multi-cylinder engines. To avoid complete tie-up to Lycoming of necessary facilities, action is be considered to limit the contract to single cylinder work only with option for the remaining items now on contract. Single cylinder parts are being fabricated.

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XH ENGINE

503-464
Expenditure Order No.

Studebaker Corporation,
South Bend, Indiana.
Mfg. or Activity Charged
with Development

1X-232
Classified Project No.

W-535-AC-28386
Contract No.

DESCRIPTION: A description of the engine covered by this project cannot be made at this time because the work to date involves exploratory investigations of cylinder sizes to evolve the most suitable arrangement for long range bombardment applications. To date engines have been designed for all purpose applications; this is the first attempt to develop an engine specifically for the maximum economy required by long range bombardment airplanes. This engine will possibly be an H type and will develop 5000 h.p. for take-off and military power. A contract has been entered into for study of four sizes of cylinders and performance and durability tests of the cylinders finally selected as well as component parts of the multi-cylinder engine. The engine will be liquid cooled, use fuel injection, a two-speed co-axial propeller system with the altitude performance obtained by means of a turbosupercharger. Every effort will be made to obtain low fuel consumption.

PURPOSE: To initiate the development of a 5000 h.p. engine specifically for long range bombardment aircraft.

AUTHORITY: Chief Engineering Division.

REMARKS: As early as 1935 studies made by the Engineering Division indicated the desirability of recommending two separate and distinct classes of engines instead of an all-purpose engine. The first class was the engine for all applications except long range bombardment. The second class would be an engine specifically for long range with fuel consumption of maximum importance. Durability under cruising conditions would be important, as well as sufficient take-off power to place the long range bomber in the air without excessive ground run. Obviously the second class of engine would be heavier per horsepower than an engine of the first class because the only known practical means of obtaining the required fuel consumption is by means of high compression ratios and to simultaneously obtain the high take-off power on engine of large piston displacement would be indicated. Early in 1940, Request for Data R40-D for a 4000 - 5500 h.p. engine was submitted to the industry but a recommendation was made by the Materiel Command, 25 July 1940 that this Request for Data held in abeyance until the aircraft engine industry is in a better position to judge the effects of the expansion program and can under-

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take new developments with less risk of interference with production. In December 1941 the importance of this project was realized again, and through various negotiations an Authority for Purchase was issued involving the early phases of this development and options for continuing through the building and testing of multi-cylinder engines.

Tests on the 6-1/2", 7", 7-1/2" and 8" bore single cylinders have been run and improved design 6-1/2" and 8" cylinders are now becoming available. Calibrations have been conducted, and to date the 8" cylinder shows promise of excellent performance. An output of 289 I.M.E.P. has been reached on this cylinder with 45" Hg absolute manifold pressure at 2400 r.p.m. This same cylinder shows a maximum economy fuel consumption of .34 lbs. per i.h.p. - hr. with 6.8:1 compression ratio over a wide range of speed and output. The first tests at 8:1 compression ratio have just been run and a maximum economy fuel consumption of .305 lbs. per i.h.p. - hr. has been obtained at 1200 r.p.m. The old design 8" cylinders have completed 226 hours of running time, the 6-1/2" cylinder has completed 225 hours, the 7" cylinder has completed 108 hours and the 7-1/2" cylinder has completed 45 hours.

JUNKERS JUMO 205-C ENGINE

505-83	Power Plant Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This is a six cylinder, twelve piston, opposed, Diesel, liquid cooled, in-lined engine which works on the two stroke cycle. Each cylinder contains two pistons which drive separate crankshafts at the top and bottom of the crankcase, these crankshafts being geared together at the front of the engine. The bore, stroke, and displacement are 4.13", 2 x 6.30", and 1104 cu. in., respectively. The weight is 1257 lbs., the rated power and take-off power are 510 h.p. at 2000 r.p.m. and 600 h.p. at 2200 r.p.m., respectively, rated minimum specific fuel consumption is .35 lbs. per h.p. hr., and frontal area is 6.5 sq. ft.

PURPOSE: This engine was obtained in order to run performance tests on a well known foreign diesel type to determine its characteristics, expecially with reference to low specific fuel consumption.

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AUTHORITY: Chief, Engineering Division.

REMARKS: This engine is now being set up on the dynamometer for its first performance tests.

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SECTION 2

INSTALLATION PROJECTS

INSTAL-
LATION

FUEL SYSTEMS

ACCESSORIES

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SECTION 2

INSTALLATION PROJECTS
(continued)

ACCESSORIES

INSTALLATIONS

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SECTION 2

INSTALLATION PROJECTS
(continued)

COOLING AND LUBRICATION

TANK DEVELOPMENT UNIT

~~CONFIDENTIAL~~

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FUEL BOOSTER PUMPS FOR HIGH ALTITUDE

524-579 524-172
524-598 524-565
524-573 524-598
524-652 524-689
524-649 524-682
524-638 524-667
524-633 524-640
Expenditure Order No.

See Remarks
Mfg. or Activity charged with Development

MX-360
Classified Project No.

P.O.'s. 43-27397-E, 43-281187-E 43-30813-E, 43-25192, 42-19466, 44-1247-E, 44-1025.
Contract Number

DESCRIPTION: Fuel booster pumps are electrically driven pumps and are mounted on the fuel tank sumps of tactical airplanes to obtain satisfactory fuel system altitude performance. They replace wobble pumps and hence are also used for starting and emergency purposes.

PURPOSE: To develop fuel booster pumps which will provide satisfactory fuel system performance at high altitudes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Manufacturer or activity charged with development:

Pesco Products Company, Cleveland, Ohio.
Thompson Products, Inc., Cleveland, Ohio.
Ingersoll-Rand Company, New York, New York.
Nash Engineering Company, Norwalk, Connecticut.

Service experience has indicated that two types of fuel booster pumps are required for high altitude airplanes, namely, the centrifugal type and positive displacement type. Both pumps are mounted in the bottom of the fuel tanks.

The centrifugal type pump is considered satisfactory for installation in heavy bombers, inasmuch as the rate of climb, installation and fuel capacity of these types of airplanes make for less rigid requirements than in pursuit type and more maneuverable types. The positive displacement type is considered when the centrifugal type is not satisfactory. Specification requirements on centrifugal pumps have been made more rigid to encourage development of better pumps.

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In view of the above, a standardization program is being adopted.

Centrifugal Pumps	Positive Displacement Pumps
Type B-7A	*Type B-11
Type B-5A	*Type B-12 D.C. installation
*B-15	*Type B-14 A.C. 400 cycle installation on D.C.
*Standard AAF design	Type B-10

Note: Type B-10 pump is developed to replace centrifugal pumps in service when the latter are considered unsatisfactory.

Types B-7A and B-11 are interchangeable, Types B-5A and B-12 are interchangeable, and Types B-15 and B-14 are interchangeable.

The development work has been started on 208 volt 400 cycle electric motor driven fuel booster pumps of the centrifugal and positive displacement types. Requirements for experimental positive displacement Type B-14 and centrifugal Type B-15 have been established. Every effort is being made to adapt a single motor design to both types of pumps.

DEVELOPMENT OF STANDARD ENGINE FUEL PUMP

524-645, 524-635, 524-663
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

P. O.'s 43-28146-E, 43-27830-E, 43-28143-E, 43-27950-E
Contract Number

DESCRIPTION: At the present time there are five approved sources of engine driven fuel pumps, all interchangeable. This condition had complicated the problems of maintenance and stocking spare parts for those pumps.

PURPOSE: To develop a standard engine driven fuel pump, made from AAF drawings.

[redacted]

REMARKS: AAF design of standard engine pump for type G-15, G-16 and G-17 have been completed. Drawings are available. The type G-15 and G-16 pumps have been fabricated experimentally and it is expected that test work will start soon.

Type G-14, G-15 and G-16 are standard pumps for replacement of five different makes of each type. A 1200 g.p.h. pump, type G-13 is prepared and AAF design will be made in near future.

The AAF standard design pumps incorporate all the best and proven features devised from service and manufacturing experience.

When pumps are considered satisfactory they will be proposed as Army-Navy standards.

The advantages of standard items for service and supply is obvious, in addition it is estimated that present fuel pump manufacture could be increased approximately 25% without increase in tools or facilities. The cost could be reduced approximately 40%.

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MATERIALS SUBSTITUTION FOR FUEL PUMPS

524-621, 524-619, 524-640 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity charged with Development
None Classified Project No.	P.O.'s. 43-14796 and 43-27830 Contract Number

DESCRIPTION: Fuel System Pumps and equipment has always been made from the highest grade of materials and manufacturing has been that of custom built type. The pumps are expensive due to use of materials and method of fabrication. Materials used are critical.

PURPOSE: To investigate and develop use non-critical materials and production fabrication methods.

AUTHORITY: Chief, Engineering Division.

[redacted]

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REMARKS: Carbon in the form of molded graphite composition has been developed for use as bearings. The bearings are lighter and inexpensive. The use of carbon bearings eliminates ball bearings and lead-bronze bearings. Improvement in bearing life has resulted.

Carbon has also been developed to replace high grade steel alloys for fuel pump blades, fuel valve parts and seal surfaces. Improvement in life and reduction in weight of parts has resulted.

Plastic thermo setting materials for molded parts replaces critical aluminum alloy castings. Reduction in weight, elimination of machinery operation, increase in productive capacity, elimination of protective treatment, and cost decrease are a few of its advantages. The standard Army Air Forces fuel pumps are being made from plastics.

Steel stampings are being considered to save critical materials and increase production. To date all aircraft accessories have been made from aluminum alloy castings and machined. This method is slow and expensive in addition to wasting critical material. Automotive practice of stampings has been considered satisfactory. It is, therefore, considered advisable to investigate that method of fabrication. The type B-11 pump is now being fabricated from stampings. If this proves satisfactory consideration will be given to those items which molding from plastic is not considered feasible. If stamping can be successfully used in aircraft accessories a new field of manufacturing is opened. It is expected to reduce cost approximately 50 to 75%, increase production capacity, save critical materials, no change in weight, and make additional industry facilities available.

SPECIAL PUMP INVESTIGATION

524-657, 524-655, 524-614 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity charged with Development
None Classified Project No.	43-32993-E Contract Number

DESCRIPTION: At the present time there are basically two types of pumps used in the fuel system, namely, a rotary vane position displacement type gear pump and centrifugal type. It is considered advisable to investigate other types of pumping mechanism.

[redacted]

[redacted]

PURPOSE: To develop various types pumping mechanism for consideration as fuel system pumps, and to develop pumps for special fuel system problems.

AUTHORITY: Chief, Engineering Division.

REMARKS: A water injection pump unit has been developed. Drawings are available and experimental sample to be fabricated. A turbine type fuel pump is under design consideration.

Diaphragm type pump is being considered. Type F-2 sample pumps have been made. A diaphragm type booster pump to be designed.

DEVELOPMENT OF HIGH PRESSURE FUEL SYSTEM

None Expenditure Order No.	Power Plant Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This project covers conventional fuel system parts redesigned to provide fuel pressure up to 50 p.s.i.

PURPOSE: To develop a fuel system which will operate satisfactorily at fuel pressures up to 50 p.s.i.

AUTHORITY: Chief, Engineering Division.

REMARKS: Laboratory tests have been conducted on manufacturer's engine driven fuel pumps. Results of tests indicated pumps are satisfactory for 45 p.s.i. systems.

Fuel pump specifications have been recently revised for pump operation at 20 p.s.i. with adjustment to 30 p.s.i. to take care of pressure increase on present carburetors.

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FUEL SYSTEMS FOR PRIMARY TRAINING AIRPLANES

524-624
Expenditure Order No.

Chandler-Hill Corps, Detroit, Mich.
Midwest Aircraft Prod. Company,
Dayton, Ohio
Mfg. or Activity charged with Development

None
Classified Project No.

P.O.'s 43-25968-E and 42-14534
Contract Number

DESCRIPTION: Considerable difficulty has been experiences with the vapor-locking characteristics of several of the primary and basic training fuel systems. This unsatisfactory condition was determined to exist due to the fact that the primary training engine fuel pump mounting pads run extremely hot. This condition causes a rapid vaporization of the fuel at the relief valve in the engine driven pump. To correct this condition, the redesign of the fuel system has been deemed necessary.

PURPOSE: To develop a standard fuel system for installation in all primary training airplanes which will not vapor-lock.

AUTHORITY: Chief, Engineering Division.

REMARKS: The design of the proposed fuel system indicates an engine driven pump incorporating a by-pass valve only, a separate relief valve to be mounted on the fire wall and a type D-2 hand-pump connected in parallel with the engine driven pump are necessary. The relief valve, which is now known as a type E-6 has been tested and approved. An additional design of engine pump type J-2 for this system has been constructed. The pump is a diaphragm type of inexpensive construction. Experimental testing is now in progress.

AIRPLANE DEFUELING SYSTEM

524-681
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Various requirements are presented to the Power Plant Laboratory to rapidly defuel airplanes.

[redacted]

[redacted]

PURPOSE: To develop suitable methods and equipment for rapidly defueling airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Necessary pumps, valves and connection to be developed for required airplane installation in order to rapidly defuel the same.

Rapid defueling is necessary to remove bomb bay tanks. Rapid defueling is necessary when airplane is used as a gasoline tanker.

WATER INJECTION SYSTEM INSTALLATION

524-675 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: A water injection system consists of a water tank, water pump with pressure control valve, water control valve, a metering device and the necessary lines, fittings and controls.

PURPOSE: To determine the necessary Army Air Forces requirements covering the installation of water injection systems in aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Requirements covering the installation of water injection systems have been prepared and will be distributed to the aircraft industry. Development tests are being conducted on positive displacement water pumps which are similar to present standard fuel pumps. Studies are being made preliminary to the installation of water injection systems in various types of service airplanes.

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FUEL VALVES

524-659 524-605 524-602 524-653 Expenditure Order No.	See Remarks Mfg. or Activity charged with Development
None Classified Project No.	44-3721AF, 44-2620E, 44-4444E Contract Number

DESCRIPTION: Fuel selector and shut-off valves presently installed in airplanes are generally unsatisfactory as regards flow area, leakage and torque. Three main types of selector valves are presently being investigated, poppet, plug and disc. Poppet and diaphragm type solenoid valves are being considered to develop suitable valves for fuel systems.

PURPOSE: To develop suitable valves for fuel systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: The following manufacturers are interested in this development:

Erie Meter Company, Erie, Pennsylvania.
Henry Valve Company, Chicago, Illinois.
General Controls Company, Cleveland, Ohio.
Parker Appliance Company, Cleveland, Ohio.

A poppet type selector valve has recently been approved, and the plug type valves are near approval. In addition, two poppet type solenoid valves are approved, and a diaphragm type is presently being tested. Tests are also being conducted on experimental hydraulically operated valves.

LOSS OF FUEL THROUGH EVAPORATION AT HIGH ALTITUDES

524-677, 524-573 Expenditure Order No.	Pesco Products Co., Cleveland, Ohio Ohio State University, Columbus, Ohio Mfg. or Activity charged with Development
None Classified Project No.	W-535-ac-28999, W-535-ac-27060 42-19148, 42-17435 Contract Number

DESCRIPTION: The program was originated to secure information concerning the evaporation characteristics of aircraft fuel at high altitudes.

[redacted]

PURPOSE: To determine the amount of fuel lost through evaporation at high altitudes and at simulated altitude flight conditions, and to determine suitable method to reduce loss.

AUTHORITY: Chief, Engineering Division.

REMARKS: All test reports will be submitted by manufacturers in 1944.

The laboratory tests indicate the loss of fuel at altitude generally occurs during the climb and in just a few minutes of flight as much as 16% is lost. The loss increases when the initial temperature of fuel is increased, when ratio of fuel surface to fuel volume is increased and when the fuel is agitated. External temperature during climb has neglectable effect on fuel loss.

Necessary flight tests are to be conducted to determine accuracy and value of reports submitted by manufacturers, also to test suitable means to reduce loss of fuel.

INVESTIGATION OF TURBO CABIN SUPERCHARGING

522-437 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity charged with Development
MX-75 Classified Project No.	None Contract Number

DESCRIPTION: Consideration is being given at the present time to accomplishing pressurizing of pressure cabin aircraft by means of bleeding air from the engine turbo supercharger compressor rather than by utilizing separate mechanically driven cabin supercharger. With the use of the turbo supercharger compressor, definite quantities of air are metered from the discharge of the turbo compressor into the cabin with provisions included for varying the quantity of air provided.

PURPOSE: To conduct a thorough investigation into the effects, penalties and limitations imposed on an airplane and its engine turbo supercharger combination when various quantities of air are bled from the turbosupercharger compressor into the cabin for cabin pressurization.

AUTHORITY: Chief, Engineering Division.

[redacted]

REMARKS: A three-fold investigation of the effects of turbo cabin supercharging is now underway, consisting of a theoretical investigation based on available engine and supercharger data, a laboratory check of representative aircraft engines and turbo superchargers and a flight investigation being conducted on the XB-28 pressure cabin airplane. Tests have been completed utilizing a Wright R-1820 engine in conjunction with General Electric Type B compressor and a Memorandum Report covering results of this test is now being prepared. Installation of an R-3350-21 engine is now being accomplished to check operating characteristics on this larger displacement engine. The XB-28 airplane has been reworked with provisions for mechanical cabin supercharging from one engine and turbo cabin supercharging on the other engine. Complete instrumentation of the airplane has been accomplished so that precise comparative results can be determined by the use of the two methods of cabin pressurization.

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VARIABLE SPEED DRIVE FOR CENTRIFUGAL CABIN SUPERCHARGERS

522-342, 522-345
522-352, 522-373
522-399, 522-415
522-424
Expenditure Order No.

See Remarks
Mfg. or Activity charged with Development

MX-75
Classified Project No.

P.O. 41-12089 and 42-13368
Contract Number

DESCRIPTION: Variable speed driven capable of external regulation to provide output shaft speeds as required independent of the speed of the input member. These drives permit a regulation of the output member over a range of 4:1 for any input drive shaft speed variation from 2:1.

PURPOSE: To develop a variable speed drive suitable for use in conjunction with centrifugal cabin superchargers so as to regulate the speed of the supercharger impellers independent of the input shaft speed, in this manner limiting the discharge from the supercharger to the desired ventilation air flow to the airplane cabin at the same time effectively limiting the horsepower required by the supercharger and prevent excessive supercharger discharge air temperature.

AUTHORITY: Chief, Engineering Division.

[redacted]

[redacted]

REMARKS: Manufacturer or Activity charged with development:

Sundstrand Machine Tool Company, Rockford, Illinois
Ohio State University, Columbus, Ohio.
Chrysler Corporation, Detroit, Michigan.

The development of a variable speed cabin supercharger transmission, initiated with various interested accessory manufacturers, has at the present time narrowed itself to one successful source, Sundstrand Machine Tool Company. The Sunstrand Machine Tool Company has designed, developed and satisfactorily tested a hydraulic transmission capable of complying with the specified purpose with a suitable high overall transmission efficiency. A cabin supercharger utilizing this transmission has been designed and is now in the process of fabrication. Chrysler Corporation and Ohio State University are both working on a mechanically variable speed drive basically adaptable to the specified requirements. However, the Chrysler Corporation has experienced appreciable difficulties in the design and test of a suitable drive, and Ohio State University's transmission has not as yet been completed for test.

CABIN SUPERCHARGER FOR XB-29 AIRPLANE

522-310 Expenditure Order No.	Eclipse Aviation, Bendix, N.J. Boeing Aircraft Co., Seattle, Washington Mfg. or Activity charged with Development
MX-75 Classified Project No.	P.O. (535) 42-32433-E Contract Number

DESCRIPTION: A cabin supercharger with a flow capacity of 25 pounds per minute at a flight altitude of 30,000 feet and maintaining a cabin pressure of 8,000 feet. The cabin supercharger is of the 2-stage centrifugal type and utilizes a variable speed drive of the hydraulically loaded planetary type. An air flow control is included whereby the supercharger variable speed drive is regulated so as to automatically provide a constant mass flow of air from the supercharger at all flight altitudes. The cabin pressure control is the large capacity control manufactured by the Airesearch Manufacturing Company.

PURPOSE: To develop cabin supercharging equipment suitable for pressurizing the cabin of the XB-29 airplane.

AUTHORITY: Chief, Engineering Division.

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REMARKS: The cabin superchargers were originally procured by the Boeing Aircraft Company, as contractor furnished equipment for the B-29 airplane, from Eclipse Aviation. Prescribed laboratory tests were satisfactorily completed on the engineering samples at both the Boeing Aircraft Company and the Materiel Command. At the present time sixteen of the cabin superchargers have been installed on completed B-29 airplanes and are being flight tested concurrently with the airplane. The method of pressurizing the B-29 cabin has recently been changed to utilize the compressor of the turbo-supercharger for that purpose; the change being made principally to simplify the installation and to make additional nacelle space available. Although all initial contracts for the mechanical units have been cancelled, development work is continuing so that a reliable alternate means of pressurizing the B-29 airplane will be readily available in the event that turbo cabin supercharging proves unsatisfactory. Inasmuch as the above-mentioned change was accomplished on the basis of limited flight test results, a more complete investigation of turbo cabin supercharging is being conducted at the Materiel Command at the present time.

CABIN SUPERCHARGER FOR XB-32 AIRPLANE

582-310 Expenditure Order No.	See Remarks Mfg. or Activity charged with Development
MX-75 Classified Project No.	None Contract Number

DESCRIPTION: A cabin supercharger with a flow capacity of 20 pounds per minute at a flight altitude of 30,000 feet and maintaining a cabin pressure of 8,000 feet. The supercharger is of the 2-stage centrifugal type incorporating a variable speed drive consisting of a variable fill hydraulic coupling. A flow control is included whereby the variable speed drive is automatically regulated to provide any desired constant mass air flow from the supercharger over the flight altitude range of the airplane. The cabin pressure control is the Airesearch large size control.

PURPOSE: To develop cabin supercharging equipment suitable for maintaining air flow and pressure in the cabin of the XB-32 airplane.

AUTHORITY: Chief, Engineering Division.

[redacted]

[redacted]

REMARKS: Manufacturer or Activity charged with development:

Consolidated Aircraft Corporation, San Diego, Calif.
General Electric Company, Schenectady, New York.

Cabin superchargers for the XB-32 airplane were designed and fabricated by the General Electric Company as contractor-furnished equipment to the Consolidated Aircraft Corporation. After extensive laboratory testing cabin superchargers were installed in the XB-32 airplane together with cabin pressure regulators fabricated by the Airesearch Manufacturing Company. Flight tests utilizing pressure cabin have been conducted on the second XB-32 and these results were successful, although operating differential pressures were limited to approximately 3.5 p.s.i. because of weaknesses in portions of the windshield panels. Upon receipt of windshields of improved strength characteristics, flight tests at the designed 6-1/2 p.s.i. differential will be conducted. Duplicate cabin supercharger and cabin pressure regulator assemblies are being tested at the Materiel Command.

CABIN PRESSURE REGULATOR

522-442 Expenditure Order No.	See Remarks Below Mfg. or Activity charged with Development
MX-75 Classified Project No.	W-535-ac-24913 W-535-ac-35735 Contract Number

DESCRIPTION: The cabin pressure regulator is a unit of an airplane cabin pressurizing system, acting to throttle the outflow of cabin air so as to closely maintain the desired air pressure within a pressurized cabin aircraft.

PURPOSE: To develop a regulator with precise control characteristics capable of maintaining within the cabin of a pressurized cabin aircraft a pressure best suited to the physiological needs of the operating personnel consistent with the structural weight limitations and thermodynamic characteristics of the cabin supercharging equipment.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Experimental procurements of cabin pressure regulators have been initiated with numerous accessory manufacturers including AiResearch Manufacturing Company, Sullivan Machinery Company, Schwien Engineering Company, and Alco Valve Company. Cabin pressure regulators have been received from all except the last of the aforementioned companies and thoroughly laboratory tested to ascertain their operating characteristics. Installations in airplanes have been accomplished in the B-29, XB-28 and XB-32. In general, performance characteristics have been satisfactory although further work is required in the improvement of calibration methods. Investigations in this direction are now under way. The manufacturers interested in this development are:

Airesearch Manufacturing Company, Los Angeles, Calif.
Schwien Engineering Company, Los Angeles, Calif.
Alco Valve Company, St. Louis, Missouri.
Sullivan Machinery Company, Michigan City, Indiana.

ECLIPSE AND PESCO ENGINE DRIVEN CABIN SUPERCHARGERS FOR FIGHTER AIRCRAFT

522-372, 522-395 522-396 Expenditure Order No.	Pesco Prod. Co., Cleveland, Ohio Eclipse Aviation, Bendix, N. J. Mfg. or Activity charged with Development
MX-75 Classified Project No.	P.O.'s 43-3178-E, 42-16483 and 42-15302 Contract Number

DESCRIPTION: A cabin supercharger system consisting of a small cabin supercharger suitable for providing adequate air under pressure to the cabin of a pursuit airplane and a pressure control for maintaining pressure within the airplane cabin. The supercharger is of the conventional lobed rotor type designed for installation directly in rear of the engine and is mounted to and driven by the power take-off or generator drive of the engine. This supercharger will weigh not more than 20 pounds and will rperesent a light and comparatively simple means of supplying air under pressure to pursuit airplane cabins. The cabin pressure control is of the self-actuating type maintaining pressure within the airplane cabin by restricting air out flow from the cabin.

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PURPOSE: To develop cabin supercharger systems for pursuit airplanes of minimum weight, maximum simplicity and suitable performance characteristics.

AUTHORITY: Chief, Engineering Division.

REMARKS: Development contracts for such cabin supercharger systems were placed with Eclipse Aviation and Pesco Products Company. Appreciable difficulties have been experienced by both Eclipse Aviation and Pesco Products Company in the design and fabrication of suitable small cabin superchargers. Eclipse Aviation has designed and tested the drive gear section of the cabin supercharger assembly and are now proceeding with fabrication of the complete assembly. Pesco Products has sub-licensed the McCollough Engineering Company for the design and fabrication of the cabin supercharger under the basic contract. Design of this unit has been completed and fabrication is nearing completion. Following laboratory tests by the accessory manufacturers, complete laboratory tests at the Materiel Command have been scheduled following which service tests will be conducted in various new available pressure cabin airplanes.

SULLIVAN ENGINE DRIVEN CABIN SUPERCHARGERS FOR FIGHTER AIRCRAFT

522-372 Expenditure Order No.	Sullivan Machinery Co., Michigan City, Indiana Mfg. or Activity charged with Development
MX-75 Classified Project No.	P.O. 42-2961 Contract Number

DESCRIPTION: Cabin supercharger systems consisting of a small cabin supercharger suitable for providing air in quantities required for ventilation purposes to the cabin of a pursuit airplane and maintaining a pressure control within the airplane cabin such that the operating personnel can function efficiently at high altitudes without the use of oxygen equipment. The supercharger is of a uniquely designed type incorporating spiral lobed-rotors, such that adiabatic compression of the air entrained by the supercharger is accomplished. Supercharger is designed for installation directly in rear of the engine and will be mounted to and driven by the power take-off or generator drive on the engine. The supercharger will, by virtue of its specially designed internal construction, obtain exceptionally high compression efficiencies and will be of an

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exceptionally light weight and bulk. The cabin pressure control is of the self-actuating type maintaining pressure in the airplane cabin by restricting air out flow from the cabin.

PURPOSE: To develop cabin supercharger systems for pursuit airplanes of minimum weight, bulk and performance characteristics.

AUTHORITY: Chief, Engineering Division.

REMARKS: Investigations have been under way at the Materiel Command to determine means of improving the compression cycle for lobed-rotor types of cabin superchargers. Designs for units in two-basic capacity sizes have been completed by Sullivan Machinery Company and fabrication of units is complete on one of the two sizes. Tests are now under way on the completed cabin supercharger, preliminary results of which indicate excellent supercharger efficiency. The smaller of the two units has been completely designed, and fabrication will be undertaken in the immediate future.

ELECTRIC CABIN SUPERCHARGERS FOR FIGHTER AIRCRAFT

522-390 522-398 Expenditure Order No.	Lockheed Airc. Corp., Burbank, Calif. with Kollsman Inst. Co. Eclipse Aviation, Bendix, N.J. General Electric, Company, Schenectady, N.Y. Mfg. or Activity charged with Development
MX-75 Classified Project No.	P.O.'s 42-16483 and 43-3178-E, Cont.W-535-AC-31117 Contract No.

DESCRIPTION: Cabin supercharger systems consisting of a small cabin supercharger suitable for providing air under pressure to the cabin of a pursuit airplane in quantities adequate for maintaining ventilation within the airplane cabin and a pressure control for maintaining pressure within the airplane cabin such that the cabin occupants can operate efficiently at high flight altitudes without the use of oxygen equipment. The supercharger is of the electric motor driven type designed for installation at any convenient location within the airplane and deriving its power either from a special aircraft generator or from the general airplane electrical system. The cabin pressure control is of a self-actuating type maintaining pressure within the airplane cabin by restricting the air outflow from the cabin.

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PURPOSE: To develop cabin supercharger systems for pursuit airplanes in which lack of available power take-off drives or installation considerations necessitate the use of an electric motor driven cabin supercharger.

AUTHORITY: Chief, Engineering Division.

REMARKS: In September, 1941, negotiations were started with the various aircraft accessory manufacturers for the design and fabrication of small electric motor driven cabin superchargers of the type outlined above. Following design studies by the accessory manufacturers, development contracts for such cabin supercharger systems were placed with the Eclipse Aviation and the General Electric Company in June, 1942, and with the Lockheed Aircraft Corporation and Kollsman Instrument Company shortly thereafter. The cabin supercharger designed by the General Electric Company was thoroughly tested at the manufacturer's plant following which it was forwarded to Curtiss-Wright for installation in the XP-62 airplane. Flight tests utilizing the cabin supercharger have revealed some service operational difficulties which are being investigated at the present time. A duplicate of the General Electric supercharger is being installed for test at the Materiel Command at the present time. The cabin supercharger designed by Eclipse Aviation Corporation is now complete and testing will begin immediately. The Lockheed and Kollsman cabin superchargers function satisfactorily in the original condition but are now being redesigned for a material reduction in the weight of the operating assembly.

1000 P.S.I. ENGINE DRIVEN HYDRAULIC PUMP

341-399 341-402	Pesco Products Co.,
341-403 341-404	Cleveland, Ohio.
536-151 536-130	Eclipse Aviation, Bendix, N.J.
Expenditure Order No.	Mfg. or Activity charged with Development
	P.O. No. (535) 40-4392
	P.O. No. (535) 39-5109
None	P.O. No. (535) 37-5204
Classified Project No.	Contract No.

DESCRIPTION: See "Purpose".

PURPOSE: To obtain hydraulic pumps which meet the requirements of specifications for AAF Types B-4, B-5, B-6, B-7, B-8 and B-9 1000 P.S.I. engine driven hydraulic pumps.

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AUTHORITY: Chief, Engineering Division, per Expenditure Order numbers above.

REMARKS: Adequate sources of 1000 P.S.I. engine drive hydraulic pumps conforming to AAF Types B-4, B-5, B-6, B-7, B-8 and B-9 have been established. Since the majority of airplane hydraulic systems require operating pressures of above 1000 P.S.I. experimental development in this line of pumps is being discontinued in favor of pumps capable of developing 1500 P.S.I. and above.

1500 P.S.I. ENGINE DRIVEN HYDRAULIC PUMPS

341-414, 536-148
Expenditure Order No.

Pesco Products Co.
Cleveland, Ohio
Mfg. or Activity charged with Development

None
Classified Project No.

P.O. No. (535) 42-4022
Contract No.

DESCRIPTION: These pumps are designed to take the place of the 1000 P.S.I. pumps and serve the dual purpose of supplying power for both the 1000 P.S.I. and 1500 P.S.I. hydraulic systems.

PURPOSE: To obtain hydraulic pumps which will meet requirements of specifications for AAF Types B-4a, B-5a, B-6a, B-7a, B-8a and B-9a pumps as well as AAF Types B-14, B-15, B-16, B-17 and B-3 hydraulic pumps.

AUTHORITY: Chief, Engineering Division, per Expenditure Order numbers above.

REMARKS: Pesco Products Models 320-HA have been approved as AAF Types B-14 and B-15, respectively, hydraulic pumps and have fulfilled all the requirements of the applicable AAF specifications. Pesco Models 320-P, 320-N, 349-P have also been approved as AAF Types B-4a, B-5a, B-6a, B-7a hydraulic pumps, respectively. Pesco Model 582-E, applying as AAF Type B-8a hydraulic pump was completely type tested at the Materiel Command but was not found satisfactory. Pesco is working on the redesign of this pump as well as the Model 583-B, AAF Type B-9a hydraulic pump. In addition, the Hycon Model

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L-6701 hydraulic pumps which is manufactured by the New York Air Brake Co. is now being tested at the Materiel Command for conformance to AAF Type B-16 requirements. This pump was originally developed for 3000 P.S.I. series but, pending results of the 3000 P.S.I. tests, the pump will be tested at 1500 P.S.I.

3000 P.S.I. ENGINE DRIVEN HYDRAULIC PUMPS

341-415, 341-416
Expenditure Order No.

Pesco Products Co., Cleveland, Ohio
New York Air Brake Co., Watertown, N.Y.
Sundstrand Machine Tool Co., Rockford, Illinois
Mfg. or Activity charged with Development

None
Classified Project No.

P.O. No. (535) 43-11603
Contract No.

DESCRIPTION: Although these pumps are considered, for the most part, experimental, some airplane installations already require 3000 P.S.I. hydraulic pumps, for example, the C-54 airplane, and the following specifications have been set up to cover the expected range:

AAF Type	Specification No.
B-12	X-28455
B-13	X-28456
B-18	X-28461
B-20	X-28485

PURPOSE: To develop a line of 3000 P.S.I. engine driven hydraulic pumps.

AUTHORITY: Chief, Engineering Division, per Expenditure Order numbers above.

REMARKS: The Pesco Model 320-R, AAF Type B-12, hydraulic pump was tested at the Materiel Command but found unsatisfactory. This pump is being redeveloped by Pesco. In addition, Pesco has revised the designs of the B-13 and B-18 hydraulic pumps.

Hycon Model L-6701, AAF Type B-13, manufactured by New York Air Brake Co., has been completely calibrated and model tested

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at the Materiel Command and has completed approximately 80% of the required endurance testing. If the pump successfully completes the remaining 20% of endurance, it will be approved as a standard AAF Type B-13 hydraulic pump. In addition, a minor change in the pump cover will enable this pump to be used as an AAF Type B-8a hydraulic pump.

Development of the Sundstrand Model EX-181, AAF Type B-13, hydraulic pump has been delayed due to necessity of diverting this company's development facilities to cabin supercharger drives. However, this project has been renewed and pumps should be available for test within three months.

HIGH SPEED 3000 P.S.I. ENGINE DRIVEN HYDRAULIC PUMPS

536-153 536-154
Expenditure Order No.

Sundstrand Machine Tool Co.
Rockford, Illinois
New York Air Brake,
Watertown, New York.
Mfg. or Activity Charged with Development

None
Classified Project No.

P.O. No. (535) 43-7885-E
P.O. No. (535) 43-5837-E
Contract Number

DESCRIPTION: The rated speed of these pumps is 8250 r.p.m. Three specifications have been drawn up setting forth requirements for the AAF Types F-4, B-19 and B-20 hydraulic pumps for operation at this speed. The Type F-4 is a variable volume pump whose full stroke capacity is 5 g.p.m. at 3000 r.p.m. according to Specification X-28483. The B-19 and B-20 types are fixed displacement hydraulic pumps rated at 5 g.p.m. and 3 g.p.m. respectively, at 3000 r.p.m. according to Specifications X-28484 and X-28485.

PURPOSE: To develop high speed, high pressure hydraulic pumps for use on the newly developed high speed engine drives.

AUTHORITY: Chief, Engineering Division.

REMARKS: Sundstrand Machine Tool Company has already developed loading pumps to operate in this speed range and have completed approximately 50% of the development work for pumps of the above mentioned types.

These pumps are still in the design stage at New York Air Brake Company.

[redacted]

VARIABLE VOLUME PUMPS

Dowty Equipment Corporation,
Long Island City, New York.
Sundstrand Machine Tool Co.,
Rockford, Illinois.
New York Air Brake Co., Watertown, N.Y.
Mfg. or Activity Charged with Development

536-152 536-153
Expenditure Order No.

P.O. No. (535) 43-11603
P.O. No. (535) 43-5848-E
Contract Number

None
Classified Project No.

DESCRIPTION: Variable volume pumps are generally of the piston type and include means for providing pressure regulation of volume control so that in the event the system is closed on the discharge side of the pump, the pressure reaches a maximum and the flow decreases.

PURPOSE: To develop a group of variable volume pumps for use in hydraulic systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Dowty Equipment Corporation Model 1301-B hydraulic pump, which is similar in operating characteristics to the requirements for the AAF Type F-2 pumps, has been again submitted for test, this time incorporating a vibration damping drive. Testing on this pump is still under way. This pump has been designed for use in the Curtiss P-40 series airplanes at 1500 p.s.i.

Development of the Sundstrand Machine Tool Company hydraulic pumps, Types F-1, F-2 and F-3 (for both 1500 and 3000 p.s.i.) has also been delayed due to the necessity of diverting development facilities to cabin supercharger drives. The development of these pumps, however, has once again been taken up and pumps should be available for test within three months.

Hycon Model L-68, built by New York Air Brake Company to AAF Type F-1 specification, has been calibrated at sea level and altitude at the Materiel Command and has still to undergo cold testing and endurance running. This pump accomplishes its variable volume feature by means of a pressure controlled suction restriction.

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PISTON TYPE LOADING PUMP

522-415
Expenditure Order No.

Sundstrand Machine Tool Co.
Rockford, Illinois
Mfg. or Activity Charged with Development

None
Classified Project No.

P.O. No.(535) 42-7885-E
P.O. No.(535) 43-17229-E
Contract Number

DESCRIPTION: Large piston type high pressure oil pump suitable for operation at high rotative speeds and designed to provide a means of loading aircraft engine power take-off drives and also to become a component part of a hydraulic variable speed transmission.

PURPOSE: To develop and test a large high pressure, high speed pump suitable for absorbing the rated output torque of the large power take-off drives on aircraft engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Sundstrand Machine Tool Co. high speed, high pressure piston type hydraulic load pump which had been redesigned and which had successfully been tested by the Sundstrand Machine Tool Company within available range of the power drive, has been submitted to the Materiel Command. All the necessary equipment for building the test stands for use in conjunction with these pumps has been assembled and one stand has been 90% built up. The pump and stand upon completion will be calibrated for use as an engine drive load device.

FLUID METERING PUMP ASSEMBLIES

536-184 536-185
536-89 536-54
Expenditure Order No.

Weldon Tool Co., Cleveland, Ohio
Adel Precision Products Corp., Burbank, Calif.
Skinner Purifiers, Inc., Detroit, Mich.
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Small aircraft motor driven pumps utilized to pump ice elimination fluid and filters as required for installation in the inlet line to these pumps.

[redacted]

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PURPOSE: To develop and test pumps and filters for propeller, windshield and carburetor ice eliminators.

AUTHORITY: Chief, Engineering Division.

REMARKS: Weldon pump Model 100 was type tested in accordance with the requirements of the AAF. It was found that the pumps operated satisfactorily and approval was given on this pump.

The Adel anti-icing pumps, Model J2.5-24D-4 and Model K2.5-27.5D-5, were type tested in accordance with the AAF requirements and failed to meet the requirements due to insufficient suction and bearing seizure.

OIL DILUTION SYSTEM FOR VACUUM PUMPS

416-12	Aro Equipment Corp., Bryan, O. Eclipse Aviation, Bendix, N.J.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: See Purpose.

PURPOSE: To develop a vacuum pump oil dilution system to dilute lubricating oil for cold starting which will operate as part of the engine oil dilution system.

AUTHORITY: Chief, Engineering Division.

REMARKS: The development accomplished at the Materiel Command is covered in Memorandum Report No. ENG-57-536-394. In this report it was recommended that a tee-check valve incorporating a restricted vent in the branch connection for metering the gasoline to the inlet side of the vacuum pump be designed for use in the oil dilution system. Specifications for such a valve were set up and letters sent to several companies requesting that they submit samples. Tee-check valves manufactured by the Aro Equipment Corporation and Eclipse Aviation have been received and approved. Production Engineering Section has been notified of the availability of these valves so that procurement may be initiated. The present vacuum pump installation drawings have been revised to include the installation of this oil dilution system. Vacuum pumps are currently being delivered in production by vacuum pump manufacturers with 1/8" pipe tapped holes in the vacuum pump ports for connection of the oil dilution lines. The necessary service tests are now under way in the Alaskan theater to determine service usability of this vacuum pump oil dilution system.

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VACUUM PUMP FILTERS

536-127 341-406
Expenditure Order No.

Pesco Prod. Co., Cleveland, Ohio.
Eclipse Aviation, Bendix, N.J.
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: See Purpose.

PURPOSE: To develop and test vacuum pump suction relief valves fitted with nipple connections for the attachment of air filters so that clean air may be drawn into the pump through the filter.

AUTHORITY: Chief, Engineering Division.

REMARKS: Some months ago Army Air Forces vacuum pump specifications were revised to specify conformance with the above mentioned purpose. Revised assemblies were submitted by the various accessory manufacturers, including approved types of wire mesh filters in accordance with AAF Drawings 42B3365-1 and -2. These assemblies from Pesco and Eclipse Avaition were tested and approved for production procurement. However, recent investigations of service operation of aircraft have revealed little or no actual necessity for such filters in the present theaters of operation. Accordingly, Production procurement is being returned to specifications calling for suction relief valves without filters. The filter assemblies and specifications are being retained on active status so as to insure immediate availability of suitable equipment in the event of service demand.

HIGH ALTITUDE AIR PUMPS

536-168 536-142
Expenditure Order No.

See Remarks
Mfg. or Activity Charged with Development

None
Classified Project No.

P.O.'s 43-23043, 43-23163, 43-23447 and 43-25775
Contract Number

DESCRIPTION: Vacuum pumps capable of satisfactory operation at the high altitudes now being attained and to be attained by future high altitude aircraft, particularly those in which cabin superchargers are installed.

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PURPOSE: To develop a vacuum pump capable of providing air under pressure for operating wing ice elimination equipment for high altitude aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Manufacturer or Activity charged with development -
Pesco Products Company, Cleveland, Ohio
Eclipse Aviation, Bendix, New Jersey.
Aro Equipment Corporation, Bryan, Ohio.
Romec Pump Company, Elyria, Ohio.

A specification for the H-1 air pump to provide a vacuum pump in conformance with the required purpose has been prepared and released and production orders for suitable pumps to this specification were issued to Pesco Products Company and Eclipse Aviation, based on designs submitted by these companies. Tests have been conducted on experimental pumps submitted by both manufacturers and the Eclipse H-1 vacuum pump has been approved for production. Pesco Products Company pump failed during endurance testing and revisions in design have been considered necessary, which revisions Pesco Products Company is now accomplishing. A standardization program on the H-1 air pump is under way with Pesco Products Company, Eclipse Aviation, Romec Pump Company and Aro Equipment Corporation for the development of a completely standard interchangeable pump and accessories. Contracts for experimental articles have been awarded to all four companies and the standardized design has been drawn up and agreed upon by representatives of the various companies and the Materiel Command. These companies are now in the process of fabricating pumps to the standardized drawings.

DRY AIR PUMPS

536-120 Expenditure Order No.	See Remarks Mfg. or Activity Charged with Development
None Classified Project No.	P.O.'s 42-3544, 42-7299 Contract Number

DESCRIPTION: Electric motor driven dry air pumps to be used as source of air under pressure for inflation of wing ice elimination equipment. These pumps are to be driven by high speed electric motors and are intended to be a small, light weight unit which can be disposed of within the airplane close to the wing boots or to the central distribution system.

[redacted]

[redacted]

PURPOSE: To develop light weight, high speed electric motor driven dry air pumps.

AUTHORITY: Chief, Engineering Division.

REMARKS: Manufacturer or activity charged with development -
American Gas Accumulator Company, Elizabeth, N. J.
Pesco Products Company, Cleveland, Ohio

Procurement for Type G-1 electric motor driven dry air pumps was placed with the American Gas Accumulator Company and Pesco Products Company. After appreciable difficulty in manufacture, the American Gas Accumulator Company is now perfecting a manufacturing procedure for a small ultra-high speed pump and an experimental pump is being fabricated for test at the present time. Pesco Products Corporation has deferred fabrication of their pump pending further development tests on suitable dry air pump rotors.

POWER TRANSMISSION SHAFTS

522-405, 536-147 522-414 Expenditure Order No.	See Remarks Mfg. or Activity Charged with Development
None Classified Project No.	P.O.'s 42-17695,43-669-E Contract Number

DESCRIPTION: Power transmission shafts are required for remote installation of heavy generators or cabin superchargers.

PURPOSE: To develop power transmission shafts capable of satisfactorily driving engine driven accessories requiring high torque and being large in dimension.

AUTHORITY: Chief, Engineering Division.

REMARKS: Manufacturer or activity charged with development -
Pesco Products Company, Cleveland, Ohio
Eclipse Aviation, Bendix, New Jersey.

Pesco Products Company is in the process of fabrication of a new design of power transmission shaft and active engine tests are under way to determine life expectancies in conjunction with conventional types of universally joined power transmission shafts as fabricated by Spicer Manufacturing Corporation and other interested concerns.

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FLAME SUPPRESSION DEVELOPMENT

539-18 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Installation, modification and testing of various flame damping systems designed for combat airplanes.

PURPOSE: To develop adequate flame damping in accordance with Specification 95-28164 for all combat airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Flame damping installations have been made and tested recently on C-47, C-54 and A-20 airplanes. Those scheduled for near future are P-61, A-26 and B-29. Progress can be reported as considerable although the requirements of Specification 95-28164 have not been met in all cases.

A-20 EXHAUST SYSTEMS

534-427-51 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Testing of exhaust systems designed by the Materiel Command and the contractor to determine the relative service life, airplane performance and flame damping qualities of the various systems.

PURPOSE: To develop a more satisfactory exhaust system for A-20 airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: AAF type short flame damping exhaust stack system has been service tested at great length and found to be unsatisfactory from a service life standpoint. Modifications to this system failed to improve service life sufficiently to justify this system being installed on all A-20 airplanes. A variation on this system,

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designed by the contractor, incorporating a semi-collector ring for the top five cylinders and using a muff for carburetor heat, has been tested at A.S.T.B. with satisfactory results, although some improvements will be required. This system will be incorporated in production in January. To provide a more satisfactory system for service airplanes, flexible hose connections have been tested with a view to substituting these units for the standard ball and socket joints. These will be incorporated on service airplanes upon successful completion of additional service tests.

EXHAUST FLAME DAMPING

354-427-51 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This project covers work in connection with the design, fabrication, and test of short stacks on A-20C airplanes.

PURPOSE: To develop an exhaust stack installation that will give satisfactory flame damping and prove to be structurally sound.

AUTHORITY: F. O. Memo. No. 32 dated 1 June 1942 from Technical Executive, Materiel Command.

REMARKS: The exhaust stacks originally designed for this airplane have since undergone slight modifications in an effort to increase the structural life of these stacks. They have proven satisfactory as flame dampers. Structural tests are still being carried on. Tail buffeting tests with this short exhaust stack installation are being carried on. Extensive tests are being made with the use of porcelain enameled low carbon steel exhaust stacks to be used in the place of stainless steel.

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ENAMEL COATINGS FOR EXHAUST MANIFOLDS

535-22
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This is protection against corrosion on exhaust equipment fabricated of ordinary steel as a substitute material for stainless steel and inconel.

PURPOSE: To develop the best possible protective coating so that non-corrosion resistant steels may be substituted for critical high alloy steels.

AUTHORITY: Chief, Engineering Division.

REMARKS: A number of porcelain enamel coatings have been tested and are on test at the present time. Success has been sufficient that two airplanes, B-25 and A-30, are in production with enameled exhaust stacks. To be employed on A-20 airplanes beginning January 1944. Improved types of enamel coatings being tested and the possibility of employing the enamel on mild steel manifolds is being explored.

HYDRAULIC ENGINE CONTROLS

525-300
Expenditure Order No.

Power Plant Laboratory
Aircraft Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Hydraulic engine controls.

PURPOSE: To develop hydraulic power plant controls for large bombardment aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Tentative specifications have been prepared covering performance requirements for hydraulic control systems. A number of experimental sample hydraulic control systems have been submitted and tests in accordance with the tentative requirements have been initiated.

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QUICK CHANGE POWER PLANTS

525-314
525-310 525-313
Expenditure Order No.

Ford Motor Company, Detroit, Mich.
Ranger Engineering, Farmingdale, N.Y.
Mfg. or Activity Charged with Development

MX-448
Classified Project No.

W-33-038-AC-1181
Sup. AG. 38 - W-535 AC-16528
Sup. Ag. 23 - W-535 AC-16528
Contract Number

DESCRIPTION: This project covers the development of quick change power units for AAF airplanes. These units will be developed for particular airplane installations and will incorporate quick disconnect features and arrangements for improved field maintenance.

PURPOSE: To improve power plant maintenance and power plant change characteristics of Army Air Forces airplanes.

AUTHORITY: TI-1474 dated 19 March 1943.

REMARKS: This problem has been carefully studied and tentative requirements have been prepared for the design of quick change power units. Contracts have been negotiated with Ford Motor Company of Detroit, Michigan covering the development of quick change power units for P-47 and B-24 airplanes and with the Ranger Aircraft and Engine Company of Farmingdale, L. I., New York covering the development of quick change power units for the P-38 airplane. Requests for estimated costs have been made covering the development of quick change power for P-51F, by North American Aviation Inc., and B-17 by Boeing Aircraft Company.

PLASTIC FITTINGS

525-284
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Plastic fittings to replace metallic tube and hose fitting as generally found in the AN standard series of fittings.

PURPOSE: To test various types of plastic tube fittings to determine their usability with, or instead of, metal fittings in power plant installations.

[redacted]

AUTHORITY: TI 1070 dated 8 December 1942.

REMARKS: Fittings have been submitted by various manufacturers for test. Vibration, tightening torque, burst pressure and other tests are being performed to determine whether fittings of this type will be satisfactory for use in aircraft power plant installations.

OIL SYSTEM SURGE PROTECTION VALVES

534-45 — Expenditure Order No.

See Remarks — Mfg. or Activity Charged with Development

None — Classified Project No.

None — Contract Number

DESCRIPTION: A general survey and study and study of various oil system surge protection valves. Surge valves include two types, the combined surge protection and temperature regulating valve, and the line type or separate surge valve.

PURPOSE: To prevent oil cooler failures due to high surge pressures obtained during engine starting.

AUTHORITY: Chief, Engineering Division.

REMARKS: Combined surge valves have been received from Fulton Sylphon, Knoxville, Tenn., Harrison Radiator Division, GMC, Lockport, N.Y., Airesearch Manufacturing Company, Inglewood, Calif., Young Radiator Company, Racine, Wisconsin, and the United Aircraft Products, Inc., Dayton, Ohio.

Separate line type surge valves have also been received from the above companies. All of these valves have been tested and their performance evaluated.

At the present time, a specification including testing procedure is being prepared for the surge valves.

[redacted]

COOLANT VALVE DEVELOPMENT FOR HIGH PRESSURE COOLANT SYSTEM.

523-308 Expenditure Order No.	See Remarks Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This is a special altitude compensated relief valve for use in high pressure coolant systems.

PURPOSE: To develop a satisfactory valve for pressure relief in high pressure coolant systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: Manufacturer or Activity Charged with Development:

AC Spark Plug Division,
General Motors Corporation,
Flint, Michigan.

One experimental unit has been fabricated and submitted to the Materiel Command for tests. Laboratory tests have been completed. Results are apparently satisfactory. Additional pressure-flow tests are contemplated.

ENGINE OPERATION AT ELEVATED OIL TEMPERATURE

523-333 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: A general survey and study to simplify the lubrication system in order to eliminate or reduce the size of the oil coolers.

PURPOSE: To investigate engine performance characteristics when operating with an oil inlet temperature of 140°C.

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AUTHORITY: Letter, W.D., Hq. AAF Washington, From Chief, Development Engineering Branch, M.O. (AFDMA-2E) dated 17 May 1943 to C.G. Mat. Command, Att. Prod. Engineering Section., I.O.M. from Production Section.

REMARKS: A B-25C and B-26B have been operating for approximately 35 hours with an oil inlet temperature of 140°C. The oil and fuel consumption is normal. Slight oil leaks are occurring due to the hot oil escaping past the gaskets and seals.

A P-51B was operated with an oil inlet temperature of 140°C.; however, the engine failed to scavenge properly with oil at this temperature. The test is continuing with the engine oil inlet temperature of 120°C.

A P-40N will be placed on test in the near future. The oil inlet temperature will be maintained at 120°C.

ALUMINUM RADIATORS

523-275
523-291
Expenditure Order No.

Clifford Mfg. Co., Boston, Massachusetts.
McCord Radiator Co., Detroit, Michigan
Mfg. or Activity Charged with Development.

None
Classified Project No.

P.O.'s 43-19819E
43-7922
Contract Number

DESCRIPTION: A general survey and study of any possible methods of constructing radiators of aluminum.

PURPOSE: To save weight in existing airplanes by the use of aluminum, and also to save copper, since copper is more critical than aluminum, at the present time.

AUTHORITY: Chief, Engineering Division.

REMARKS: An aluminum radiator of the fin and tube type is being constructed by the McCord Radiator Company. Aluminum radiators have been procured from Clifford Manufacturing Company and tested, and various methods of bonding aluminum radiators have been studied and discussed

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with different companies. The radiators supplied by Clifford Manufacturing Co. appear to be the most promising construction furnished to date. These radiators for the P-40 weigh less than half that of present radiators and save 64 pounds per airplane. They have approximately 5% less cooling capacity because the method of construction eliminates some of the core tubes around the outer shell. The radiator passed the 8,000 steam cycle test as required by the Handbook without leaking and has been installed in a P-40E airplane at Wright Field for six months without failure of any kind.

Procurement has been made for 1000 radiators for the P-40 by Production Engineering Section with deliveries beginning August 1943. Experimental quantities are on order for P-51, P-39, P-39-H airplanes.

OIL COOLER CORE TUBE INNER FIN INSET

523-298
Expenditure Order No.

Frigidaire Division
General Motors Corp.
Dayton, Ohio
Mfg. or Activity Charged With Development

None
Classified Project No.

P.O.'s 42-16698
44-2255E
Contract Number

DESCRIPTION: The Frigidaire Division was contacted and given the project of investigating the possibility of improving the heat transfer and air consumption on conventional core tubes by using inner fin inserts of the type that can be mechanically inserted into the tube after the oil cooler has been fabricated, and also the type that might have to be soldered into place before cooler fabrication. The dependability of such a construction is indicated by tests at the Materiel Command and the N.A.C.A.

PURPOSE: To increase the cooling capacity of oil coolers, and also to provide a method of augmenting the cooling provided with coolers in existing airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Frigidaire Division investigated eight or ten different types of inner fins for core tubes and prepared a report covering their investigation. These data which they obtained were limited entirely to investigation of a single core tube and have not yet been applied to a complete cooler, but it indicates an increase of approximately 10% heat rejection and a decrease in air consumption

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of approximately 6%. These figures are based on an S-shaped inner fin that can be inserted without soldered bonding in a cooler already constructed. Another investigation is planned to carry this work still further and apply these results to other core tube sizes and lengths.

Six thousand Z-shaped aluminum inner fins have been received by the Power Plant Laboratory. Some oil cooler tests with the inner fins inserted into the core tubes have been conducted and additional tests are contemplated in the near future.

STUDY OF CARBURETOR AIR FILTERS

525-235
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This project covers the development of suitable carburetor air filters for use in military aircraft.

PURPOSE: This project covers the development of suitable carburetor air filters for use in military aircraft.

AUTHORITY: CTI No. 232, dated 10 April 1941.

REMARKS: Since October 1941 filters suitable for use with air velocities up to and including 1000 ft. per minute have been available from three sources. These filters have been installed in many types of aircraft. A formal specification No. R-28466 was prepared to cover detailed performance requirements for carburetor air filters. The filters described above were designed primarily for installation in the ramming intake of an airplane; however, tests conducted subsequently in the laboratory indicated that the amount of dust entering an aircraft engine is greatly reduced if a non-ramming intake system is employed. Accordingly, a specification, No. R-28465, was prepared covering requirements for the installation of filters in aircraft and providing for a non-ramming source of air to the engine. In view of the decreased dust quantities to be obtained with such an installation it was possible to develop filters using higher air velocities. Three types of filters capable of performing satisfactorily in a non-ramming induction system at air velocities up to 1500 ft. per minute have been developed thus far.

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In November 1942, a meeting of the Joint Aircraft Committee resulted in the preparation of Specifications AN-F-30 and AN-I-8 covering carburetor air filters and their installation in aircraft. These specifications are patterned after the original Army Air Forces Specifications but differ from them slightly in that airplane manufacturers are permitted more freedom in designing installations for individual type of aircraft and fuller use is made of the advantages to be gained by employing a non-ramming intake system.

In general, the present aims of this project are to develop a standard filter test procedure that will furnish consistent test results and to develop the most practical types of cleaning devices for use in aircraft. To this end, laboratory investigations are being made in cooperation with the Bureau of Aeronautics to determine the suitability of a proposed "AN Standard" test set-up together with a standard test procedure and standard test dusts. It is hoped that the adoption of such a proposal will permit the duplication of test results on a given filter when the tests are conducted by the Bureau of Aeronautics, the Materiel Command and the filter manufacturers. Considerable difficulty has been encountered in the past in this respect.

With regard to the development of the cleaning devices themselves, a continual effort is being made to reduce the size of these units in order to ease the problems of designing the installation. In June 1943, a 2" thick filter suitable for use with air velocities up to 2000 ft. per minute was made available from one source. Other sources for such a filter are being developed.

Some attention is also being given to the development of centrifugal type air cleaners. While this type of cleaner is generally larger and more difficult to install than filters currently being used, it has a definite advantage in that it is automatic and requires no servicing. The feasability of using such a cleaner in airplanes in which space is not too critical a factor is being investigated.

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DEVELOPMENT OF COLLAPSIBLE EXTERNAL
JETTISON AUXILAIRY FUEL TANKS

524-623
Expenditure Order No.

Eastman Kodak Co., Rochester, N.Y.
St. Clair Rubber Co., Detroit, Michigan
Mfg. or Activity Charged With Development

None
Classified Project No.

P.O. (535) 43-32674-E
P.O. (33-038) 44-3176-E
Contract Number

DESCRIPTION: Collapsible external jettison auxiliary fuel tanks are fuel tanks capable of being collapsed to conserve shipping space and to relieve the critical metal situation from which rigid tanks are fabricated.

PURPOSE: To develop suitable droppable fuel tanks which can be shipped in a collapsed state and can easily be made rigid and usable in the field.

AUTHORITY: Chief, Engineering Division.

REMARKS: Tanks consisting of 24 oz. duck sewed in a tear-drop contour impregnated with plastic materials are under consideration.

Eastman Kodak Company, Purchase Order (535) 43-32674-E - This tank is impregnated with unplasticized gelled cellulose acetate and packaged hermetically sealed.

St. Clair Rubber Company, Purchase Order (33-038) 44-3176-E - This tank employs the use of a plasticized urea formaldehyde polyvinyl alcohol, and Saran. Six to eight hours are required to set up each type of tank. However, only 1/2 man hour labor per tank is required.

These tanks are in experimental state and will be produced in large quantities if results of the experimental program are satisfactory.

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524-671
Expenditure Order No.

MX-445
Classified Project No.

American Aero Supply
Los Angeles, California
Mfg. or Activity Charged with Development

A.F.P. No. 318159
Contract Number

DESCRIPTION: All purpose jettisonable tank is to be adaptable to use on fighter aircraft for carrying paratroopers, cargo, or wounded personnel.

PURPOSE: These tanks are to be utilized to increase the usefulness of fighter aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Fifty tanks being procured in accordance with American Aero Supply Company proposal outlined in Brochure XP-900 and letter dated 21 September 1943. Authority for Purchase No. 318159 initiated.

A wood mock-up was made from a 300 gal. drop tank manufactured by Gillespie Furniture Company. The mock-up was fitted with seats for two men. A quick release mechanism was designed to drop the tail of the tank and so provide an escape hatch.

The wooden mock-up was subjected to accelerated drop tests for structure study.

Drawings are being made for tank and electridal signal system.

DEVELOPMENT OF LEAKPROOF FUEL AND OIL TANKS AND FUEL HOSE.

524-494
Expenditure Order No.

MX-233
Classified Project No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

None
Contract Number

DESCRIPTION: Leakproof fuel and oil tanks and fuel hose are items of equipment used specifically for passive defense to prevent the loss of fuel and oil and to reduce the fire hazard resulting directly from enemy gunfire.

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PURPOSE: To develop satisfactory leakproof fuel and oil tanks and fuel hose for use in combat aircraft. Minimum requirements are satisfactory protection against .50 caliber gunfire with relatively good protection against 20 mm. gunfire.

AUTHORITY: Office Memorandum 41-21 dated 2 January 1941 from Office of Chief, Engineering Division.

REMARKS: Present production tanks utilizing 37.5 parts of Buna S synthetic rubber sealant. Tests being conducted on 100% Buna S sealants.

Study also being conducted to develop an all synthetic rubber oil tank.

Tests being conducted on high volume swell fuel hose with reduced wall gage. Development along these lines being conducted in an attempt to reduce weight, obtain improved sealing characteristics over a broader fuel range, conserve critical Buna N supplies, and obtain improved low temperature performance.

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SECTION 3

FUEL METERING PROJECTS

FUEL METERING

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ALLISON V-1710-69 AND -71 ENGINES

WITH FUEL INJECTION

533-64 Expenditure Order No.	Allison Division, General Motors Corporation Indianapolis, Indiana Mfg. or Activity Charged with Development
MX-228 Classified Project No.	W-535-AC-29292 Contract No.

DESCRIPTION: Included in this procurement are reports on tests of single cylinder engines with both intake port injection and combustion chamber injection; one V-1710-69 engine equipped with intake port fuel injection; report on design, test, and application of an automatic mixture control to this engine; one V-1710-71 engine equipped with cylinder head fuel injection; report on the design, test, and application of automatic mixture control to this engine; report of endurance test of the V-1710-71; reports on acceptance tests of both engines; one fuel injection system complete as used on the -71. All details of design of the engine and the selection of fuel injector are left to the manufacturer. The fuel injection pump to be used is being designed by Detroit Diesel Division of General Motors Corporation. The automatic mixture control is being designed by Allison Division. This control will be of the manifold pressure type and will incorporate several of the operating principles used in automatic mixture controls on contemporary German aircraft engines.

PURPOSE: To develop an engine of the V-1710 type equipped with fuel injection.

AUTHORITY: CTI-382, 17 November 1941, from Commanding General, Army Air Forces.

REMARKS: A report on single-cylinder engine tests with intake port injection was received at the Materiel Command in October 1942. None of the other items of this contract have been completed. Since that time the progress reported on this project has been limited to single-cylinder engine tests using both fuel injection and carburetion type fuel metering systems. Development of the multi-cylinder fuel injection pump by Detroit Diesel Division for the V-1710-69 and -71 engines has been relatively slow. The first sample of this pump was expected to be completed by the end of June, 1943. It has not successfully passed bench tests as yet. The development of the engines and automatic mixture controls is awaiting completion of the single-cylinder engine tests and the development of the fuel injection pump. For this reason very little has been accomplished on the latter mentioned developments.

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R-2800-45 ENGINE WITH FUEL INJECTION

533-63, 533-68, 533-69
Expenditure Order Nos.

Pratt & Whitney Aircraft Division
East Hartford, Conn.
Mfg. or Activity charged with Development

MX-222
Classified Project No.

W 535 AC 28719
Contract No.

DESCRIPTION: This procurement includes two R-2800-45 engines with 50-hour endurance tests, engine calibration, and necessary overhaul; one fuel injection system complete with nozzles, identical to that supplied on the second engine; reports on all tests, inspections, and calibration of the engine; blueprints of the assembly, parts list, all sub-assemblies, and all detail drawings of the second engine and the fuel injection system.

PURPOSE: To develop an R-2800 type engine equipped for fuel injection in the combustion chamber and suitable for operation with a turbo supercharger.

AUTHORITY: CTI 382, 17 November 1941, from Commanding General, Army Air Forces.

REMARKS: This engine is adapted for injection of aviation gasoline into the cylinders and is completely equipped with fuel injector, external fuel feed lines, and a suitable automatic mixture control. All design features of the engine other than those requiring modification due to fuel injection adaptation are to be the same as on R-2800-41 engine. The fuel injection pump used is manufactured by American Bosch Corporation. It is an 18-cylinder unit. The fuel-air control for the R-2800-45 engine is a Bendix Model PT-13-G1 pressure type carburetor which supplies the correct amount of fuel to the injection pump and by the pressure of this fuel controls the position of the capacity control mechanism of the injection pump. This project was initiated following receipt of CTI-382 from Commanding General, Army Air Forces. The first R-2800-45 engine was delivered to the Materiel Command in January, 1943. It was intended to accomplish a 150-hour model test on this engine. Three attempts have been made to calibrate this engine, which have been unsuccessful thus far due to severe engine vibrations and injection line leaks. The engine is now being worked on in an attempt to stop injection line leakage. Delivery of the second R-2800-45 engine to the Materiel Command has not been made. This has been promised at various times, the latest being November, 1943. The fuel injection system of Item 3 of this contract has been delivered to the Materiel Command for tests which are to include a 300-hour endurance test. This fuel injection pump has been returned twice to the manufacturer for repair.

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R-3350 ENGINES WITH FUEL INJECTION

533-65, 533-55, 533-67
Expenditure Order Nos.

Wright Aero. Corporation
Paterson, N. J.
Mfg. or Activity charged with Development

MX-227
Classified Project No.

W 535 AC-19028
Contract No

DESCRIPTION: Contract No. W 535 AC-19028 was originally for two R-3350-19 engines. These engines are to be equipped for cylinder head fuel injection. Except for this, the engines are identical with the -13 and -15 engines. All design features were left to the discretion of the manufacturer. The automatic mixture control unit was a Bendix injection carburetor with modifications necessary for controlling position of fuel injection pump capacity control lever. Due to a change in the development program, additional equipment and tests were desired on this contract. This contract has been amended to include a complete Holley fuel injection system, all prints of the Holley system, and reports on engine tests of the following Government-furnished equipment manufactured by American Bosch Corporation:

2 A.A.F. Type X-2 Fuel Injectors
1 set of injection nozzles
1 hydraulic type automatic mixture control

PURPOSE: To develop three R-3350 type engines equipped with fuel injection.

AUTHORITY: CTI-382, 17 November 1941 from Commanding General, Army Air Forces.

REMARKS: This project was initiated in April, 1941. The original contract was written and approved 27 June 1941. When the directive CTI-382 was received from the Commanding General, Army Air Forces, in November, 1941, it was decided to expand on this original contract to include the development of three fuel injection systems of different manufacture for the R-3350 engines; as a result of this, Supplementary Agreement No. 1 was written and approved. The R-3350-19 engine of this contract which was equipped with a Bendix Model 58-18-A1A fuel injection system was delivered to the Materiel Command in January, 1943. A 150-hour model test of this engine was completed in April and May, 1943. Since that time this engine and fuel injection system has undergone further development at Wright Aeronautical Corporation. The Government-furnished equipment manufactured by American Bosch Corporation has completed a 150-hour model test at Wright Aeronautical Corporation but no official report has been received on this to date. The R-3350-39 engine of this contract is awaiting development by the Holley Carburetor Company of a fuel injection system which is somewhat different in

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design than that originally intended for this engine. This system is undergoing development tests now at Holley Carburetor Company, and is expected to be delivered to Wright Aeronautical Corporation for engine tests early in 1944.

AMERICAN BOSCH TYPE X-2 FUEL INJECTORS

533-61 Expenditure Order No.	American Bosch Corporation Springfield, Mass. Mfg. or Activity charged with Development
MX-227 Classified Project No.	(535) 42-7089 Contract No.

DESCRIPTION: Purchase Order No. 42-7089 requires the delivery of two AAF Type X-2 fuel injection pumps; one in accordance with the American Bosch Corporation Drawing No. EGN-6389-55-R and the other in accordance with Drawing No. EGN-6389-55-L, two throttle bodies and 40 fuel injection nozzles. This equipment is designed for use on the R-3350-41 engine which is being supplied to the Materiel Command by Wright Aeronautical Corporation on Contract No. W 535 AC-19028.

PURPOSE: To develop fuel injection equipment for use on the R-3350-41 engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: Development of this equipment was originally intended for an R-1820 type engine adapted to fuel injection, however, with the receipt of CTI-382 which required the development of the R-3350 engine with fuel injection, these plans were changed. The subject purchase order was modified to furnish this equipment. Engine development tests of these pumps are practically completed, the engine having passed a 150-hour endurance test in October and November, 1943. No official report of this has been received by the Materiel Command.

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BOSCH AUTOMATIC MIXTURE CONTROL

533-60, 533-43	American Bosch Corporation Springfield, Mass.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-227	(535) 42-4050, (535) 40-467
Classified Project No.	Contract Nos.

DESCRIPTION: These projects required the development of two types of automatic mixture controls for fuel injection pumps. These are the electrical and hydraulic types. The purpose of the automatic mixture control is to maintain the proper relation between the rate of fuel flow and air flow to the engine. The electrical type control shifts the capacity control lever of the fuel injection pump through the use of an electrical servo unit. The hydraulic type accomplished the same function except through a hydraulic mechanism. The controls are both of the mass air-flow type and are designed for use on the R-3350-41 engine.

PURPOSE: To develop automatic mixture control units of two different types for use with American Bosch fuel injectors on the R-3350-41 engine

AUTHORITY: Chief, Engineering Division.

REMARKS: One complete fuel injection system which includes the hydraulic type control was delivered to Wright Aeronautical Corporation in December, 1942. After delivery this equipment underwent considerable engine development and completed a 150-hour endurance test in October and November, 1943. These engine tests were required by Contract No. W 535 AC-19028 and Supplementary Agreement No. 1. The development of the electrical type control has been held, pending the completion of this development.

SERVICE TEST OF AMERICAN BOSCH
FUEL INJECTION SYSTEM

533-73	American Bosch Corporation Springfield, Mass.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-227	(535) 43-33215-E
Classified Project No.	Contract No.

DESCRIPTION: Fifty Model No. 58-18-A1B fuel injection systems for use on

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R-3350-41 engines, for service test in the B-29 airplane, are being procured. This equipment is similar to that being delivered on Purchase Orders Nos. 42-7089 and 42-4050.

PURPOSE: To obtain fifty service test Bosch fuel injection systems for installation on R-3350-41 type engines in the B-29 airplane.

AUTHORITY: CTI-382, 17 November 1941, from Commanding General, Army Air Forces.

REMARKS: The authority for this procurement was initiated in May, 1943, Two of these units have been delivered to Wright Aeronautical Corporation and are installed on R-3350-41 engines. The final run of these engines, preparatory for shipment, has not been made. The delivery of the remainder of these fuel injection systems is scheduled for January, 1944.

BENDIX TYPE 58-18-A1A FUEL INJECTION SYSTEM

533-72, 533-74

Bendix Products Division, South Bend, Ind.
Mfg. or Activity charged with Development

MX-227
Classified Project No.

(2119) 44-10017
(33-038) 44-2996-E
Contract Nos.

DESCRIPTION: Fifteen complete Bendix Model No. 48-18-A1A fuel injection systems are being procured. These are similar to the unit developed for the R-3350-19 engine by Bendix Products Division and Wright Aeronautical Corporation on Contract No. W 535 AC-19028.

PURPOSE: To obtain fifteen complete Bendix fuel injection systems for both service and experimental tests on R-3350-19 engines.

AUTHORITY: CTI-382, 17 November 1941, from Commanding General, Army Air Forces.

REMARKS: Procurement authority for this equipment was initiated in May and August, 1943. Two of the subject fuel injection systems have been delivered and are now at Wright Aeronautical Corporation installed on engines and awaiting final run. Delivery of the remainder of these systems is scheduled for January and February, 1944.

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QS-9 AND QD-9 MODEL CARBURETORS

519-161, 519-147 Expenditure Order Nos.	Bendix Products Division, Bendix Aviation Corp. South Bend, Indiana Mfg. or Activity charged with Development
None Classified Project No.	41-6929 Contract No.

DESCRIPTION: Single and double barrel updraft injection carburetors, with automatic mixture control. The fuel is metered at higher pressures than in other models of injection carburetors, for the purpose of reducing the effect of vapor formation on the mixture strength. The improved vapor characteristics are obtained by having the pressure drop through the jets in the fuel control body ahead of the drop through the poppet valve of the regulator. Thus, the metering is done at higher pressures without increasing the fuel inlet pressure.

PURPOSE: To develop a pressure type carburetor incorporating automatic altitude compensation and improved vapor characteristics for use on engines rated in the range of 400 to 600 horsepower.

AUTHORITY: Chief, Engineering Division.

REMARKS: On 13 April 1942, a QS-9A1 carburetor was received in the laboratory for test. Following the laboratory tests the carburetor was installed on an engine on a test stand using a flight propeller. After one hundred hours of engine running time, the carburetor failed. It was sent to the manufacturer 17 December 1942, for revision to incorporate the latest design changes, and has not been returned to date.

As a result of airbox and engine tests, both at the Materiel Command and at the manufacturer's plant, several modifications have been made in the QD-9A1 carburetor, the principal change being the development of a spinner injection nozzle, and improvement in the regulator and accelerating pump. Further tests are being conducted to determine the metering consistency and the altitude characteristics.

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48-HB MODEL CARBURETOR

519-168	Holley Carburetor Co. Detroit, Mich.
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The principle of operation is the same as that of the 1685-HB model carburetor. The principal difference is in the capacity of the throttle body, which is rectangular to the proportions of the standard 48 size. The throttle segments are shaped such as to form a variable venturi as in other models of Holley carburetors. The stabilizer is mounted on the nozzle bar in the airstream, and is intended to compensate for carburetor air temperature as well as load and altitude. The accelerating pump is throttle operated the same in principle as the 1685-HB model, however, the details of construction differ considerably. The throttles and metering pin are driven by a system of levers and linkages, similar to that used on the 700-H model carburetor.

PURPOSE: To develop a carburetor suitable for use on the R-2600-BB type engine to be interchangeable with Stromberg PR-48A1 model carburetor.

AUTHORITY: Chief, Engineering Division.

REMARKS: Air box tests revealed that this carburetor has three main features that are objectionable. Poor compensation for inlet fuel pressure variations. This characteristic was partly corrected by the incorporation of balance diaphragms in the fuel chamber inlet ball valves. Altitude and temperature compensation were not satisfactory. The incorporation of partially evacuated stabilizer capsules improved the temperature compensation. However, load compensation at certain altitudes and powers was unsatisfactory.

The sensitivity of the metering due to attitude changes of the carburetor from a climb where it runs lean to a dive where it runs rich, presents a difficult problem to solve. The attempted corrections did not result in a satisfactory solution. Because of the foregoing and due to unsatisfactory results of flight tests at the engine manufacturer's plant, development of this type carburetor has been discontinued.

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CHANDLER-EVANS TYPE 1900 CPB-3

CARBURETORS FOR SERVICE TEST

519-164, 519-153	Chandler-Evans Corp. South Meriden, Conn.
Expenditure Order Nos.	Mfg. or Activity charged with Development
None	(535) 42-2806
Classified Project No.	Contract No.

DESCRIPTION: In 1941, a decision was made that the two 4-engine bombers as used by the Army Air Forces should have all accessories from different sources if possible. Therefore, steps were taken to obtain another source of carburetors for the B-24 type airplane. Inasmuch as the newly designed pressure type Chandler-Evans carburetor appeared to be very promising, it was decided that the development of this carburetor should be expedited if at all possible, in an attempt to make it a suitable alternate to the Bendix carburetor used in the B-24 airplanes.

PURPOSE: To develop an additional source of carburetors for use on the B-24 type airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: A quantity of 24 Chandler-Evans 1900 CPB-3 carburetors have been received on Purchase Order No. (535) 42-2806. Flight tests have been conducted on two B-24 airplanes to compare the test carburetors with the performance of the standard Bendix injection type carburetor. Two carburetors have been sent to Consolidated Aircraft and two to Buick Aviation Division for flight and service tests. The remainder of the carburetors have been installed on airplanes for flying time at Patterson and Wright Fields.

The experimental work on this project has been completed and the Expenditure Order has been closed since the operation of the carburetor is entirely satisfactory with the exception of the minor question of range and cooling which will be investigated and corrected through engine work carried on at the engine manufacturer's plant and flight tests carried on at the airplane manufacturer's plant.

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CHANDLER - EVANS TYPE CPB-4 CARBURETOR

519-167 Expenditure Order No.	Chandler-Evans Corp. South Meriden, Conn. Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-27976 Contract No.

DESCRIPTION: The first Chandler-Evans 1900 CPB-2 carburetors for the B-24 type airplanes contained a fuel servo regulator that was found to be unsatisfactory for service use. This type regulator was superseded by a "direct metering" type regulator which was rapidly developed into a suitable carburetor for service use. However, in the development of the Chandler-Evans Corporation 58 CPB-2 carburetor for the R-3350 type engines, the fuel servo type regulator was enlarged and slightly modified, but in general, retained the undesirable characteristics of the 1900 CPB-2 type regulator. Since the "direct metering" regulator is considered superior to the servo type, it is desired to check the 58 CPB-4 carburetor with the "direct metering" type regulator on an R-3350 type engine.

PURPOSE: To develop a better fuel regulator for the Chandler-Evans 58 CPB-4 carburetor for use on the R-3350 engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: One Chandler-Evans 58 CPB-4 carburetor, with a "direct metering" type regulator, has been procured on Purchase Order No. (535) 43-27976-E and is being tested in a carburetor laboratory and on the engine test stand. Difficulty has been experienced with slow acceleration on the R-3350-21 engine on the torque stand. A series of development tests are pending to remedy this trouble. A recording type oscillograph will be used to record the pressures and engine conditions involved.

Difficulty has been experienced with lean mixtures at rated and take-off powers on engine tests However, the carburetor flows in limits on the carburetor air box. Tests will be conducted to determine the cause and remedy of this difficulty. Very little work has been accomplished on this project due to other projects carrying higher priority in the laboratory. However, a test setup has been fabricated for investigating ambient temperature variations affecting the mixtures.

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1685-HB MODEL CARBURETOR

519-157	Holley Carburetor Co. Detroit, Michigan
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This carburetor is an improved design to provide a new type automatic control. The main changes in the automatic compensative unit are an increased length sylphon to reduce the sensitivity of the control and the location of the automatic unit in the air intake to make the carburetor function independently of ambient temperatures. Other new features are a throttle operated accelerating pump and a more positive idle cut-off. Also, a "dry hole" nozzle suction port for the stabilizer system having a new type air filter in the passage to the automatic load and altitude compensation stabilizer unit has been added to improve consistency in cruising range at full throttle and dependability of automatic unit.

PURPOSE: To improve the Holley 1685-H carburetor.

AUTHORITY: Chief, Engineering Division.

REMARKS: As a result of difficulties being experienced on the Holley 1685-HA carburetor, as used in the B-25 airplane, a conference was held at the Holley Carburetor Company on 19 June 1941. Since the main difficulty being experienced was with the stabilizer unit on the carburetor, which corrects for altitude and load condition, the Holley Carburetor Company redesigned the 1685-HA carburetor with a new type automatic control which is located in the air intake of the carburetor. This redesigned carburetor has been designated as the 1685-HB model. Most of the development of endurance tests has been completed at the engine manufacturer's plant.

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SINGLE POSITION MIXTURE CONTROL

519-178
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: To simplify operation of the carburetor controls and to eliminate any possibility of airplane take-off with the mixture control giving automatic lean mixtures. An override valve was designed which would automatically change the mixtures from those normally used in auto lean to the auto rich mixtures as the engine reached a given condition.

PURPOSE: To develop an override valve which would allow single position mixture control operation giving normal auto lean mixtures in the cruise range and normal auto rich mixtures in the power and take-off range.

AUTHORITY: Chief, Engineering Division.

REMARKS: Fighter Branch of Production Engineering Section expressed a need for a single position mixture control which would free the pilot from consideration of selection of the proper mixture control position to use under various engine power conditions. On a basis of this information and information received from Packard Motor Car Company that carburetors on the V-1650 engines in combat were being operated with a single position mixture control, a project was initiated to develop a control to allow single position mixture control operation. A PT13G1 carburetor was procured and a design study was made on installation of a control which would automatically give auto rich mixtures in the power range with the mixture control placed in the auto lean positon. A unit was fabricated and favorable indications have resulted from tests. Further tests will be conducted to determine the reliability of this type of control.

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CONSTANT MINIMUM HEAD REGULATOR

510-181 Expenditure Order No.	Bendix Products Division Bendix Aviation Corporation, South Bend, Ind. Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Wide open throttle lowcruise operation has necessitated accurate control of the fuel-air ratio to be delivered to the engine. In order to accomplish this control with a large carburetor throttle body, Bendix Products Division, Bendix Aviation Corporation, has developed a regulator which maintains a constant minimum head across the metering jets such that a constant fuel-air ratio is maintained throughout the low cruise range to the idle range at which point the idle metering needle controls the mixture through linkage with the throttle.

PURPOSE: To develop a carburetor which will maintain the desired fuel-air ratio at wide open throttle minimum cruise condition.

AUTHORITY: Chief, Engineering Division.

REMARKS: A PD18A1 model carburetor has been fabricated by the Bendix Products Division and has undergone engine tests at Packard Motor Car Company on the V-1650-3 engine. The carburetor indicated slight discrepancies on the engine test stand. It was delivered to the Engineering Division, Materiel Command for further airbox tests with varying temperatures and altitudes imposed on the carburetor. These tests indicated very satisfactory operation of the constant minimum head regulator, and it was proposed that flight tests be made on the P-51B airplane at North American Aviation, Inc. using this carburetor. Further development work is contemplated using this type regulator on various other models of carburetors built by Bendix Products Division, Bendix Aviation Corporation.

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CARBURETOR RAM COMPENSATION

519-180 Expenditure Order No.	Chandler-Evans Corporation S. Meriden, Conn. Bendix Products Division Bendix Aviation Corporation South Bend, Indiana Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Difficulties were reported from the European combat theater that bomber type aircraft were being operated under part throttle conditions with full closed turbo supercharger wastegate, thus causing a high ram condition being imposed upon the top deck of the carburetor. The present pressure type carburetors were designed to operate at a top deck pressure of 33 or 36" Hg absolute and therefore a ramming of the carburetor occurred when high ram pressures were imposed on the top deck. From a carburetor standpoint, it appeared undesirable to operate the engines with part throttle carburetor and full closed turbo supercharger wastegate. However, it was pointed out that the airplane was more maneuverable with regard to acceleration when the high pressure was maintained on the top deck. A project was therefore instigated to develop and test pressure carburetors which would automatically compensate for high ram pressures.

PURPOSE: To develop automatic control which will compensate for high carburetor deck pressures.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Bendix Products Division of Bendix Aviation Corporation has fabricated a PD12H2 and a PD12F5 carburetor designed to compensate automatically for high ram pressures to a specific weight of 10 lbs.

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per cubic foot. These carburetors have been tested in the Power Plant Laboratory, and the PD12H2 carburetor has been run on an engine on a torque stand. A slight leaning condition was observed at high powers with the PD12H2 carburetor and therefore an investigation is being made to determine the cause of discrepancies in results between airbox and engine test stand operation.

A Chandler-Evans Model 1900 CPB-3 carburetor was tested in the Power Plant Laboratory to determine its characteristics for automatically compensating for pressures in excess of those encountered at sea level. The information gained from these tests has been forwarded to the Chandler-Evans Corporation to be used as a basis for further development work.

WATER INJECTION

519-169 519-170, 519-176 Expenditure Order No.	Bendix Products Division South Bend, Indiana Mfg. or Activity Charged with Development
None Classified Project No.	P. O. No. (2119) 43-2090 Contract No.

DESCRIPTION: An Authority for Purchase was initiated on 1 June 1943, for the procurement of 200 regulator units together with 100 derichment valves for water injection from the Bendix Products Division to be used for conservation of high octane fuel on aircraft engines. The water regulators are designed to meter water to the engine in proportion to the fuel flow and discharge with the fuel through the main discharge nozzle. The derichment valves are to be used to lean the fuel-air ratio when the water injection system is in effect. The regulators are to be used also for water injection as an anti-detonate at war emergency powers.

PURPOSE: To develop water injection for the conservation of high octane fuel, and as an anti-detonate at war emergency powers.

AUTHORITY: Chief, Engineering Division

REMARKS: The units are to be fabricated by Bendix Products Division and will be tested on an engine at the Materiel Command. Engine tests have been conducted on R-2800-21 and R-2800-43 engines using the water injection as an anti-detonate at war emergency ratings. These tests have indicated satisfactory operation on these engines

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and have led to the use of water injection in combat airplanes at high power operation.

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SECTION 4

SUPERCHARGER PROJECTS

SUPER-
CHARGE

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TURBINE WHEEL ENDURANCE TESTS

522-440	Power Plant Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: These tests are part of a program of comparative turbine wheel and bucket material tests which have been run on a considerable number of different alloys and wheels made by the several turbosupercharger manufacturers.

PURPOSE: To establish suitability of various wheel and bucket materials for use in turbo superchargers.

AUTHORITY: Chief, Engineering Division.

REMARKS: These tests consist of a 150 hour hot gas test on the turbine wheel utilizing the exhaust from an engine to drive the turbine. The established procedure has been to operate turbine wheel at 21,300 RPM for 50 hours, 23,400 RPM for 50 hours, 25,600 RPM for 50 hours; if the turbine wheel is still operating at this time, the RPM is boosted to 27,000 and the test is continued until bucket failure occurs. These tests have been extremely useful in differentiating between mediocre and superior turbo supercharger wheel and bucket materials. Materials currently on test include 19-9 DL turbine disc with 6059 bucket material; 19-9 DL disc with 61 alloy buckets and timken disc with 61 alloy buckets. These tests are of considerable assistance in determining those alloys best suited for production utilization.

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TYPE B-2 TURBO SUPERCHARGER MODIFICATION

522-318	General Electric Co., West Lynn, Mass.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	P.O. 42-5684 42-5683
Classified Project No.	Contract No.

DESCRIPTION: These superchargers are designed for engines in the 2500 to 3000 horsepower category and were originally rated at 25,000 feet. These machines are being modified to include new oil systems, anti-friction bearings in place of the original sleeve bearings, air seals behind the turbine wheel, flexible oil lines, a new type turbine wheel and buckets and additional minor improvements.

PURPOSE: To provide superchargers of increased performance and improved durability for engines in the 2500 to 3000 horsepower category.

AUTHORITY: Chief, Engineering Division.

REMARKS: The modification proposed for the old type B-2 machines converting them to type B-21 will result in a substantial increase in the rated altitude of the machine. This rating will be slightly in excess of 30,000 feet.

These modifications are being carried out under change orders to the above purchase orders on a total of 8 Type B-2 superchargers. These changes will be accomplished in time to be effective for the airplanes for which the Type B superchargers were originally intended.

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TYPE CH-5 TURBO SUPERCHARGER

522-400	General Electric Company West Lynn, Massachusetts
Expenditure Order No.	Mfg. or Activity Charged with Development
None	W-535-ac-26997
Classified Project No.	Contract No.

DESCRIPTION: Type CH-5 turbo supercharger being procured on this contract is designed for engines with a normal power rating between 1600 and 2000 horsepower. It is anticipated that this machine will carry 2000 horsepower to 35,000 feet. This is an increase of 5000 feet over the present performance of the type C-23 turbo supercharger with no increase in weight. This gain in performance is accomplished by a redesign of the impeller and compressor casing and also of the turbine buckets and nozzle blades.

PURPOSE: To develop a high performance single stage turbo supercharger for engines of 1600 to 2000 normal horsepower primarily the XP-47J and modified P-47D airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Although this machine has a compressor casing which is somewhat larger than the C-23, there is no increase in weight over the standard production machine. The operating range of this supercharger is such that the power range between 1000 and 2800 horsepower can be accommodated at 30,000 feet. This is considered outstanding performance for a single stage compressor.

A total of 8 CH-5 superchargers are being procured for P-47 airplanes and a turbo supercharged version of the P-61. There are also other possible requirements for this supercharger in the B-32 airplane. This latter project is still being investigated by the Aircraft Laboratory; however, facilities arrangements are being investigated for a possible extensive employment of this supercharger in production airplanes.

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TYPE RA TURBO SUPERCHARGER

522-433	General Electric Company West Lynn, Massachusetts
Expenditure Order No.	Mfg. or Activity Charged with Development
None	W-535-ac-40113
Classified Project No.	Contract No.

DESCRIPTION: This development project covers the procurement of a machine which is essentially a type BH turbo supercharger with four stages of axial flow compression ahead of the centrifugal compressor. The axial flow fan is driven from the turbine and impeller shaft through a reduction gear which gives a true axial arrangement. It is anticipated that with a rated speed of 24,000 RPM the altitude rating will be 45,000 feet with no ram when used with an engine rated between 1000 and 1700 horsepower. This unit will have the same diameter as the type BH supercharger but will be approximately 20 inches longer.

PURPOSE: To develop a high efficiency turbine supercharger for engines rated between 1000 and 1700 horsepower to provide sea level performance at 45,000 feet while maintaining favorable low power cruising characteristics.

AUTHORITY: Chief, Engineering Division.

REMARKS: Owing to the fact that parallel development on axial flow compressor design is currently in progress by the General Electric Company on Army Air Forces secret projects, delivery of this unit has been delayed until 1945.

Only one unit is being procured on the above contract and the design is such that makes it suitable primarily for experimental testing only. Based on tests to be performed, the machine will be redesigned for smaller dimensions and decreased weight to make it suitable for aircraft installation.

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TYPE BH TURBO SUPERCHARGER

522-400	General Electric Company West Lynn, Massachusetts
Expenditure Order No.	Mfg. or Activity Charged with Development
None	W-535-ac-26997
Classified Project No.	Contract No.

DESCRIPTION: The type BH turbo superchargers which are being procured on the above contract are designed to accommodate engines with a normal power rating of 1000 to 1600 horsepower at 24,000 turbine RPM. These superchargers are somewhat heavier and larger than the standard production type B machine but they have the advantage of greatly increased altitude performance, approximately 35,000 feet, and a much wider cruising range than existing machines. These superchargers will be installed in the XB-35 airplane.

PURPOSE: To develop a high performance single stage turbo supercharger for engines of 1000 to 1600 horsepower for future airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: The BH turbo supercharger design accomplishes a wider operating range at high altitude because of its larger compressor casing and the backward sloping impeller design. This operating range is achieved without greatly sacrificing the higher altitude characteristics which normally approach values expected of a two stage machine.

A total of 31 of these superchargers are being procured on this contract. Four of these machines are for use in the special ground test development rig which is being set up by the Glenn L. Martin Company for analyzing performance of the XB-35 airplanes.

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TYPE BL TURBO SUPERCHARGER

522-448	General Electric Co., West Lynn, Massachusetts.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Type BL turbo supercharger is a highly advanced single stage compressor and turbine design which will provide for engines rated between 1200 and 1600 horsepower normal having an altitude rating approximately 36,000 feet. The design of the impeller and compressor and also of the turbine wheel nozzles will permit its use with War Emergency Ratings of 2,000 horsepower and still retain the wide cruising range at high altitude. This machine will weigh approximately the same as the present type B turbo supercharger and will be slightly smaller in overall dimensions.

PURPOSE: To develop a single stage supercharger with performance equal to that of heavier two-stage machines and small enough to interchange with existing type B superchargers.

AUTHORITY: Chief, Engineering Division.

REMARKS: This machine incorporates the very latest in compressor design including backward sloping impeller, enlarged compressor casing passages and modified tangential outlet compressor casing. This tangential outlet is cut-off at angle both to save weight and to provide flexibility of installation. Turbine bucket design will be such that considerable reaction will be provided in the blading. This will avoid the usual inefficiency which occurs in the conventional impulse type bucket at high pressure ratio and abnormally high gas flows. An Authority for Purchase has been initiated covering the procurement of six units.

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TYPE BM TURBOSUPERCHARGER

522-400	General Electric Company West Lynn, Massachusetts
Expenditure Order No.	Mfg. or Activity Charged with Development
None	W-535-ac-26997
Classified Project No.	Contract No.

DESCRIPTION: This turbo supercharger is a two stage compressor design for engines rated between 1200 and 1600 horsepower and is rated at 40,000 feet.

PURPOSE: To procure a service test quantity of multi-stage turbo superchargers suitable for application in parallel to engines in the 3,000 horsepower category.

AUTHORITY: Chief, Engineering Division.

REMARKS: Sixty-nine type BM-2 turbo superchargers are being procured for use with the XB-36 airplane which employs the Wasp Major engine. Delivery of two of these machines for ground nacelle test purposes has already been accomplished. Delivery for the remainder is adequate to meet the airplane requirements. This machine will serve as an initial design upon which to base further improvements in two stage compressors. Steps have already been initiated towards the development of a smaller unit which can be installed in the place of the above mentioned BM-2 superchargers with an appreciable reduction in weight.

TYPE CM-2 AND CM-5 TURBO SUPERCHARGERS

522-400	General Electric Company West Lynn, Massachusetts
Expenditure Order No.	Mfg. or Activity Charged with Development
None	W-535-ac-26997
Classified Project No.	Contract No.

DESCRIPTION: The type CM turbo supercharger is a two stage compressor design for engines in the 1800 to 2200 horsepower category. It is rated at 40,000 feet for that horsepower. These machines are presently installed in the XB-19A and XP-54 airplane and are about to undergo flight testing.

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PURPOSE: To develop high altitude turbo superchargers to meet extremely high altitude performance requirements.

AUTHORITY: Chief, Engineering Division.

REMARKS: Of the Type CM-2 turbo superchargers, 17 machines are being procured for installation for the XB-19A and XB-39 airplanes with spares. The type CM-5 machines are allocated for second articles XP-54 airplane. Both of these turbo supercharger models are rated at 40,000 feet. It is anticipated, however, that including the effective ram of the airplane at high altitude, that the actual performance of the supercharger will be in the neighborhood of 45,000 feet. Both the CM-2 and CM-5 superchargers, when operating with a military rating of approximately 2600 horsepower, will have rated altitude in the neighborhood of 32,000 feet.

TYPE B-39 TURBO SUPERCHARGER

522-400	General Electric Company West Lynn, Massachusetts.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	W-535-ac-26997
Classified Project No.	Contract No.

DESCRIPTION: The type B-39 turbo supercharger is the same size as the present production type B turbo supercharger. The distinction lies in the compressor casing which has been redesigned and a new type diffuser is provided to handle the higher air flows corresponding to the power range for which this machine is intended. The machine is designed for engines of 1200 to 1700 horsepower and has an altitude rating of approximately 29,000 feet.

PURPOSE: To develop a turbo supercharger which will be interchangeable with present production type B machines but will possess a higher air flow capacity to accommodate larger engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: Type B-39 turbo supercharger has the same outline dimensions as the present production type B superchargers but higher performance and wider operating range is expected as a result of the redesign impeller and compressor casing.

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A total of 8 of these superchargers are being procured on the above contract. Virtually all of these machines have been delivered and are being installed in P-38 airplanes for experimental purposes.

B-29 NACELLE TEST

522-438	General Electric Company, West Lynn, Massachusetts.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	W-33-038-ac-828
Classified Project No.	Contract No.

DESCRIPTION: This test involves the use of a complete power nacelle from a B-29 airplane. The engine and propeller are mounted on the end of a cylinder within which is installed the remainder of the power plant equipment such as oil coolers, inter-coolers, turbo superchargers, parts of the exhaust system and induction system and also the supercharger regulating equipment. The interior and the cylinder can be evacuated to altitudes in excess of 40,000 feet and the cooling air and induction system air can be supplied at low temperature so as to completely simulate high altitude operation of the turbine superchargers and the induction system.

PURPOSE: To obtain pertinent information on the performance of B-29 power plant which will be applicable to that airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: It is proposed that this test will produce results beneficial to the development of the B-29 airplane. Among the tests which are being run are power and critical altitude tests of the entire power plant system; tests to determine operation of the engine and superchargers when air is bled from the induction system for cabin supercharging. As soon as the combat type R-3350 engine with fuel injection is available, this engine will be installed on the stand and testing will be conducted to obtain data upon which to base performance predictions of the B-29 power plant.

All of the necessary stand calibration and vibration investigations have been completed and actual performance investigations are ready to begin. The initial engine furnished for this test does not have the second order vibration dampener with the result that operation between 2500 and 2700 engine RPM is prohibited; however, all possible testing will be accomplished at points up to normal power. The remaining calibration will be performed on a later engine.

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FLAME DAMPERS AND HEAT EXCHANGERS FOR TURBO SUPERCHARGED INSTALLATIONS

522-382 - 522-425	See Remarks
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The design of flame dampers for type B-17 and B-24 airplanes has been fairly well established and these units are now in production. Experimental research is now in progress to provide flame supression on P-38, B-29, and P-47 airplanes. The flame damping program on turbo supercharged airplanes is being adjusted to provide heat for thermal wing deicing and cabin heat inasmuch as the means which accomplishes the flame damping is identical with that which furnishes hot air for these other requirements.

PURPOSE: To develop quick detachable heat exchangers for flame suppression and integral type heat exchangers for combination flame damping, thermal wing deicing, and cabin heating.

AUTHORITY: Chief, Engineering Division.

REMARKS: The production type half-moon heat exchangers have been fairly successful in the service on B-17 and B-24 airplanes. Flame dampers for P-38 utilizing heat exchangers as an integral part of the exhaust system are being developed. These tests, if successful, will have the added advantage of permitting the turbo supercharger to operate at lower temperatures which will promote longer turbine wheel and bucket life and increase the operating strength of the turbine wheel. The heat exchangers which are used in combination with thermal wing deicing and cabin heating equipment are being developed by several manufacturers among whom are Airesearch Manufacturing Company, Stewart Warner Corporation, Ryan Aeronautical Company and Solar Aircraft Company, and various others.

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AXIAL FLOW COMPRESSOR MODEL TESTS

522-436	Power Plant Laboratory Aircraft Laboratory
Expenditure Order No.	Lab. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The Power Plant Laboratory, in cooperation with the Aircraft Laboratory, is promoting a study of axial flow compressor blade designs. These tests consist of the construction of wooden airfoil blade sections which will be tested by the Aircraft Laboratory.

PURPOSE: To promote the development of more efficient axial flow compressor design which will be applicable to supercharger compressors currently being developed for use in conjunction with turbo superchargers.

AUTHORITY: Chief, Engineering Division.

REMARKS: These studies are being carried on as a part of the program to develop compressors suitable for extremely high altitude performance where high efficiencies must accompany the high pressure ratio required.

The Power Plant Laboratory has contracted with the General Electric Company for compressors which employ axial flow stages. The results of these studies will be applicable to this supercharger development.

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AIR COOLED TURBINE WHEEL

522-450
Expenditure Order No.

General Electric Company
West Lynn, Massachusetts
Mfg. or Activity Charged with Development

None
Classified Project No.

(33-038) 44-4234-AF
Contract No.

DESCRIPTION: This development covers the design of a turbine wheel whose disc is cooled by means of air which circulates through a hollow shaft into the center of the turbine wheel. Cooling air then circulates outward inside of the wheel disc and then returns to a point near the center of the wheel on the shaft side where the cooling air is then discharged. The cooling air does not at any time mix with the hot gases which drive the turbine wheel.

PURPOSE: The purpose of this development is to foster an improvement in turbine wheel design which will permit the use of non-strategic alloys.

AUTHORITY: Chief, Engineering Division.

REMARKS: Current turbine wheel design is based upon an average operating temperature of the wheel disc between 600 and 900°F. between the center of the disc and the rim. These temperatures are sufficiently high that metals using large percentages of nickel, chromium and molybdenum are required to sustain the necessary tensile strength properties at these elevated temperatures. With the air cooled design these operating temperatures can be reduced perhaps 200 to 300 degrees which will be sufficient to permit the use of higher strength alloys whose properties are limited to a lower temperature range.

Two turbine wheels are being procured on this contract exclusively for experimental testing to determine the advantages to be gained by this type of construction and to discover any changes required to improve design. Several possible applications of this idea are in view; among these are use in compound engine turbine designs and also in two stage turbine wheel projects leading to gas turbine developments.

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SECTION 5

FUEL AND OIL PROJECTS

FUEL & OIL

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FUEL TESTS CONDUCTED ON 91 GRADE FUEL

531-212
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

MX-274
Classified Project No.

None
Contract number

DESCRIPTION: Because of the increased demand for 100 octane number fuel, it has been necessary to prepare instructions for the operation of nominal 100 octane number fuel engines on Grade 91 fuel while in the continental limits of the United States. These instructions include operation at reduced power for take-off, normal rated and cruising conditions.

PURPOSE: To conduct tests on a group of nominal 100 octane number fuel engines on Grade 91 fuel in conformance with Technical Order 02-1-38.

AUTHORITY: Chief, Engineering Division.

REMARKS: A group of three fighter airplanes, which include P-40F, P-47C, and P-51A, have been ground tested, which included run-up tests on the ground and 50-hour flight tests under normal operating conditions at the end of which time the engines were disassembled for inspection. Tests have been completed on the above airplanes and a Memorandum Report is being prepared.

FLIGHT DETONATION AND VOLATILITY TESTS

531-202
531-210
531-216
Expenditure Order No.

Phillips Petroleum Co.
Bartlesville, Oklahoma

Transcont. & West. Air.
Inc., Kansas City, Mo.
Mfg. or Activity Charged with Development

MX-274
Classified Project No.

W-535-AC-40635
W-535-AC-35716
Contract Number

DESCRIPTION: In order to obtain research data on the operation of experimental fuels, special blend agents, additives, etc. during flight, and to determine the effects of the volatility of fuels on the -

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operation of service aircraft, it is necessary to conduct tests during flight since dynamometer stand and laboratory bench testing may not give the desired correlation, due to cooling differences, altitude effects, etc.

PURPOSE: To rate a series of fuels, blend agents and additives during flight, and to determine volatility effects of a series of experimental fuels.

AUTHORITY: Chief, Engineering Division, and CTI 1509 and Add. 1.

REMARKS: Fuel tests have been conducted on a Lockheed Lodestar airplane since September 1943 at both standard C. R. and at 8 to 1 C.R. Tests are in progress on a special fuel blend at present, after which, volatility tests on a series of fuels with varying distillations will be run during the winter. A C-49K airplane operated by TWA has conducted a series of volatility tests and is currently doing detonation testing on a special fuel blend after which it will return to testing the volatility effects of another series of experimental fuels.

FLIGHT DETONATION TESTS OF AVIATION FUELS

531-226
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: In order to determine the actual fuel requirements of engine-airplane combinations to fabricate range charts, and to evaluate fuel performance, it is necessary to conduct fuel tests on service aircraft under actual flight conditions, since dynamometer stand or laboratory tests may not give true pictures of the actual flight conditions due to cooling differences, change in altitude conditions, airplane characteristics, etc., which are extremely difficult to reproduce on the test stand.

PURPOSE: To determine fuel requirements of service airplanes, to fabricate range charts and to evaluate fuel quality in flight.

AUTHORITY: Chief, Engineering Division and C.T.I. 1509, Add. 1.

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REMARKS: Flight tests are being conducted on a series of airplane-engine combinations. A B-24J is currently being operated at San Diego, California by Consolidated-Vultee Aircraft. A B-24J airplane is being equipped for fuel testing at Hamilton Field, California, and will be flown by personnel of the 4th Air Force for testing of experimental aircraft fuel. An R-3350 engine is set up in the Test Rig at Boeing Aircraft at Seattle, and is currently testing a special fuel. A C-54A airplane is being flown by American Airlines. Equipment is being procured to allow tests to be conducted on a series of other airplanes by the Air Forces.

FUEL ABOVE 100 OCTANE

531-55 531-77
531-96 531-112
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

MX-274
Classified Project No.

None
Contract Number

DESCRIPTION: Fuels above 100 octane are currently being procured under two specifications, namely, AN-F-28 and AN-F-27. For convenience, the standard designation of performance number is now applied to fuels above 100 octane number. Performance number indicates the approximate per cent of power available for take-off in comparison with isooctane. Thus, fuel, Grade 100/130, indicates that power available for take-off is 130% of that power available from isooctane if detonation is a limiting factor. The 100 used in the grade designation specifies the lean mixture knock rating and applies to cruising conditions. Grade designations for the two specified fuels are 100/130 and 98/130. The latter grade designation refers to xylidine blended fuel, AN-F-27.

PURPOSE: To develop laboratory test methods for controlling fuel qualities and to develop new fuels of improved quality and in sufficient quantity for world wide requirements.

AUTHORITY: Chief, Engineering Division.

REMARKS: The xylidine blended fuel was developed for Continental use only and contains 1% xylidine and approximately 15% sub-marginal base stocks, which, in effect, increased the production of Grade 130 by 15%. Original plans for this fuel were that it should eventually be consigned for off-shore shipment. Due to the fact, however, that 98 octane number, its cruise knock rating, would

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result in a loss of about 7% cruise power if the particular engine is limited by detonation, off-shore shipment of this fuel has not been made. A referce fuel designated 28-R has been made in a 70,000 barrel batch for use by engine manufacturers in engine development work and model testing. This fuel was made to the minimum qualities as regards knock ratings and volatility that would be permitted by Specification AN-F-28. A similar fuel is being prepared for Specification AN-F-27 and is presently designated as 27-P, indicating prototype fuel for Specification AN-F-27. Consideration has been given to the production of experimental test quantities of nominal Grade 110/150 fuel. Fuel similar in some respects to this proposed fuel has been used by the British in a limited number of fighter squadrons and ~~has been made~~ in England by the addition of 2% of monomethyl aniline to current fuel to AN-F-28. The fuel proposed for experimental testing in this country could be made by the addition of 1.4 ml. TEL and 3% xylidine to fuel Specification AN-F-28. A fuel of the type described above would have a cruise knock rating of 10% in excess of present Grade AN-F-28 and take-off knock rating 15% in excess of AN-F-28. The only other alternate method known at the present time to substantially increase the knock rating of aircraft engine fuels is through the use of triptane. Triptane has been a laboratory curiosity until very recently, at which time the Army Air Forces aided General Motors Corporation in the construction of a triptane plant. Production of this product to date is still limited to pilot plant quantities and would not permit an increase in fuel quality unless it should become available in greater quantities. One tank car of this product is being procured for further experimental testing and development.

SERVICE TEST OF SPECIFICATION AN-F-28, Grade 100/130 FUEL

531-209 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
MX-274 Classified Project No.	None Contract Number

DESCRIPTION: Tetraethyl lead is an organic compound which, when added to fuel, has definite anti-knock properties. For many years the Army Air Forces has considered 4.0 ml. TEL. per gallon as the top concentration which could be used without a serious increase in aircraft engine maintenance. These service tests were set up to determine to what extent the additional lead concentration affected aircraft operation and maintenance.

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PURPOSE: To conduct service tests on Specification AN-F-28, Grade 100/130 fuel containing 6 ml. TEL. lead per gallon in order to determine whether or not this fuel is satisfactory for service use.

AUTHORITY: Letter from Asst. Chief of Air Staff, M.M.&D., dated 29 July 1943, to Technical Executive.

REMARKS: Service test on 6 ml. test fuel was set up at the following stations with the widest selection of airplanes:

Foster Air Field, Victoria, Texas, P-39's, P-40F's.
Dalhart Army Air Field, Dalhart, Texas, B-17F.
Biggs Army Air Field, El Paso, Texas, B-24H and B-24J.

This service test involved the operation of the above aircraft on the 6 ml. test fuel for a period of 100 to 200 flying hours. At the completion of the test, certain engines were disassembled and inspected at which time, no apparent malfunctionings were noted. The accurate maintenance records show the operating difficulties on all the test airplanes revealed no increase in maintenance when compared to operation with Specification AN-F-28 fuel, and a very definite decrease in maintenance when compared to AN-F-26, Grade 91/96 fuel. Each of the operating activities submitted a report at the completion of the test to the Materiel Command stating that, in their opinion, the test fuel performed satisfactorily. It was concluded as a result of this service test, that present equipment designed to operate on fuels containing 4 ml. TEL. per gallon may be satisfactorily operated on fuels containing 6 ml. TEL. per gallon without any increased maintenance required. The information obtained from these tests is now being used in preparing tentative specifications for nominal Grade 94/114 fuel. Several tests are also being conducted at Hamilton Field on a 91/96 grade fuel to which has been added additional lead to give a total of 6.0 ml. per U. S. gallon. Twenty P-39 type aircraft are involved in the service test and 10 aircraft are being operated on AN-F-26 grade 91/96 fuel containing 4.6 ml. TEL. per U. S. gallon, and the other 10 are being operated on AN-F-26 fuel + lead to equal a total of 6 in the final blend. Approximately 70 hours of operation have been completed and verbal reports indicate that more satisfactory operation occurs from operating on the 6 ml. fuel.

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TEST OF FUELS CONTAINING XYLIDINE

531-194 531-202
531-216 531-231
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

MX-367
Classified Project No.

See Remarks
Contract Number

DESCRIPTION: Two fuels are included in these investigations, namely, fuel to Specification AN-F-27 containing 1% xylidine and fuel nominal Grade 94/114 containing 3% xylidine. Because of freezing point limitations on the fuel, water solubility of amino aromatic compounds (xylidine), and the limitations on the supply of xylidine, concentrations in excess of 3% have not been considered for testing in aircraft engines.

PURPOSE: To determine the feasibility of using aircraft engine fuels containing xylidine to increase the available supply of high octane fuel.

AUTHORITY: Teletype dated 7 May 1943 from the Commanding General, Army Air Forces to the Technical Executive, Materiel Command, and C.T.I. 1509 dated 7 December 1943, and Addendum I thereto dated 13 December 1943.

REMARKS: Fuel to Specification AN-F-27 was developed to increase the potential supplies of Grade 130 fuel for offshore shipments. For certain technical reasons, namely, lowered cruise knock rating, increased ring sticking tendency, and potential instability in storage, fuel to this specification has never been shipped off-shore. Since prime consideration must be given at the present time to increasing the available supplies of Grade 100/130 to combat theaters, it has been necessary to develop a fuel which will replace Grade 100/130 for training and for commercial use within the continental limits of the United States. It appears possible to supply such a fuel for continental U. S. consumption by using 3% xylidine in 97% fuel, Grade 91/96, Specification AN-F-26 and adding tetraethyl lead to give a total of 6.0 ml. TEL. per U. S. gallon. An extensive test and development program on this type of fuel has been initiated to include multi-cylinder engine calibration and endurance tests on dynamometer and torque stands and in flight, aqua system storage tests, tests on synthetic rubbers used in fuel systems, and flight service tests. Engine calibration and endurance tests include tests on Packard V-1650-3, Allison V-1710-89 and -93, Pratt & Whitney R-2800-10, Wright R-3350-19 engines. In addition to the above listed laboratory calibration and endurance tests, flight tests establishing calibration points and knock ratings on fuel 94/114 are being carried out by 4th Air Force on a B-24J airplane, Phillips Petroleum Company using Lockheed Lodestar, and Transcontinental and Western Air, Inc. using C-49K airplane. The latter two flight tests are being

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carried out under Army Air Forces contract numbers W-535 AC-40635 (Phillips Petroleum Company, Bartlesville, Oklahoma), and W-535 AC-35716, Special Service Order No. 3 (Transcontinental and Western Air, Inc., Kansas City, Missouri). Pending successful completion of laboratory tests and endurance testing, approximately 2,500,000 gallons of this fuel will be used in flight service testing in Army Air Forces training stations in the continental United States. It should be pointed out that similar laboratory and flight service testing was carried out on the development of fuel to Specification AN-F-27 prior to the incorporation of this specification. As pointed out above, however, the use of this fuel outside the continental limits of the United States has not been effected. The use of fuel nominal Grade 94/114 will be on an experimental basis pending sufficient use of this material to show that such a fuel will replace Grade 130 in continental United States, and will show no marked increased maintenance or operational difficulties.

AIRCRAFT ENGINE LUBRICATING OIL TESTS

532-29 532-39 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
MX-302 Classified Project No.	None Contract Number

DESCRIPTION: Aircraft engine lubricating oil tests are performed to determine the effect of various types of lubricating oils on engine conditions. These tests are performed with a view to determining the ability of an oil to furnish adequate lubrication under high operating loads, to determine the sludge forming and the varnish forming tendencies of the oils.

PURPOSE: To develop aircraft engine lubricating oils and to study the effect of various types of lubricating oils on overall engine conditions.

AUTHORITY: Chief, Engineering Division.

REMARKS: The ten Cooperative Oil Test engines and spare parts have been returned to the Materiel Command from Waukesha Motor Company in an acceptable condition and these engines are currently being installed in the new Fuel and Oil Testing Laboratory. As soon as this installation is completed, exploratory tests will be conducted to determine proper operating conditions to reproduce multi-

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cylinder aircraft engine test results. This work is being carried out cooperatively with the Coordinating Research Council, the membership of which consists of aircraft engine manufacturers' representatives and petroleum refiners' representatives.

Multi-cylinder aircraft engine tests on experimental lubricating oils with and without additive compounds, are continuing and particular emphasis has been placed on the testing of oils prepared by oil refiners specifically to meet Specification AN-VV-O-446a, and at the same time to be unsatisfactory for aircraft engine lubrication. These tests, a number of which have already been conducted, are for the purpose of establishing minimum quality during tests in the Cooperative Oil Test engines.

LUBRICATING OIL COLD TEMPERATURE CONDITIONS

532-35 532-37 Expenditure Order No.	Esso Laboratories, Elizabeth, N.J. Mfg. or Activity Charged with Development
MX-291 Classified Project No.	W-535 AC-23132 Contract Number

DESCRIPTION: The pour point of lubricating oil may be considered the yardstick for determining the suitability of non-additive types of lubricating oil for use under cold temperature operating conditions. The pour point in turn may be divided into two parts, namely, (a) the viscosity pour, and (b) the wax pour. The viscosity pour point is being adequately provided for by the use of a hopper tank in the oil dilution system. A study of how to provide for the wax pour point has been initiated.

PURPOSE: To develop a lubricating oil suitable for use in tactical aircraft at temperatures to at least -60° F. without the use of oil heaters.

AUTHORITY: Chief, Engineering Division.

REMARKS: AAF Purchase Order 42-7246 covers this investigation which is being carried out by the Esso Laboratories, Linden, New Jersey. This contract is approximately 90% completed and the final report will be rendered by the Esso Laboratories upon completion.

As a direct result of the early progress on this project and later developments, Specification AN-O-5 has been prepared and issued for the procurement of Grade 1080-P and 1100-P lubricating

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oil. This specification is practically identical to AN-VV-O-446a with the exception that a diluted pour point has been specified. The oil obtained on this specification is, therefore, considered satisfactory down to -65° F. minimum temperature when diluted with 30% diluent. All oil procured to Grade 1100 of Specification AN-VV-O-446a for approximately the last year has been required to meet the diluted pour point specification.

LUBRICATING OIL FILTERS

532-64 532-67	Power Plant Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: During operation of aircraft engines the lubricating oil is contaminated by various materials such as oxidation products, carbon, partially oxidized oil, sand, metallic chips, moisture, etc. Past experience has indicated that normal contamination does not deleteriously effect engine durability even though no oil changes are accomplished between engine overhaul. Oil filters are said to improve engine life between overhaul.

PURPOSE: To determine whether oil filters will increase aircraft engine life and dependability and to determine most satisfactory type of filter for military use.

AUTHORITY: Chief, Engineering Division.

REMARKS: AAF Specifications 28489 and 28490 have been issued covering oil filters which may be permanently installed in aircraft in flight. Air Service Command is porcuring 250 of these units and Materiel Command is procuring 50. Flight tests on similar units have been satisfactory. However, installation weight of the power plant is increased.

Ground filter units are of two types, the simple filter units similar to those used in flight, (750 on order by Air Service Command), and the more complex type which clarifies the oil as it filters, (250 on order by Air Service Command.) These two types are being service tested for comparative utility. The ground filter does not require

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increasing the aircraft weight but neither does it protect the oil system from contamination by metal in the event of any engine failure. The flight filter does offer such protection.

PREPARATION OF AIRCRAFT ENGINES AND SPARE PARTS FOR STORAGE AND SHIPMENT

518-214
518-226
Expenditure Order No.

Power Plant Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: A considerable amount of power plant equipment in the past has been damaged by corrosion during shipment and storage, particularly when this shipment involves transportation overseas. This corrosion in some instances was sufficient to render the power plants or parts unserviceable upon delivery. Since this involved a virtual waste of time and labor required to produce the equipment originally the time, labor and dangers involved in its transportation, and since this loss might prove to be critical with regard to the planning of tactical operation, necessary action was instigated to improve corrosion preventive methods.

PURPOSE: To develop proper procedures for the preparation of aircraft power plants and related equipment to insure safe corrosion-free storage and shipment.

AUTHORITY: Chief, Engineering Division.

REMARKS: As a result of the combined efforts of the Naval Air Experiment Station, Philadelphia, Pa. and the Materiel Command, two process specifications and some 32 complimentary material specifications have been adopted. In general, this system of corrosion prevention involves the use of corrosion preventive compounds and the dehydration of the package containing aircraft engines or parts. Investigations are being continued to improve on the methods adopted and, in particular, a study of moisture barriers has been continued with the adoption of new materials as these prove to be satisfactory. Both permanent and semi-permanent types of corrosion preventives for application to parts are being included in the investigation. A service test on such moisture barriers in the shipment of complete aircraft overseas failed due to the lack of strength of the moisture barrier

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used. Phases of this project which are related to other than power plants and allied equipment has been transferred to proper laboratories for the continuation of project. Investigations relative to power plants and supplementary parts are being continued.

TEST ON POLYFLUORO ORGANIC COMPOUNDS AS AIRCRAFT ENGINE COOLANTS

523-323	Purdue University Purdue Research Foundation Lafayette, Indiana
Expenditure Order No.	Mfg. or Activity Charged with Development.
None	W-535-AC-36034
Classified Project No.	Contract Number

DESCRIPTION: As a class, polyfluoro organic compounds have certain physical properties which would make them suitable for aircraft engine coolants. Depending upon the decrease of fluorations, metals with very low freezing points, low viscosities, high flash and fire points, fairly high specific heats and correct boiling points, may be obtained.

PURPOSE: To synthesize and test certain polyfluoro organic compounds to determine their adaptability as aircraft engine coolants.

AUTHORITY: Chief, Engineering Division.

REMARKS: Representatives of the Power Plant Laboratory have met several times with representatives of the Purdue Research Foundation to discuss the feasability of synthesizing various polyfluoro organic compounds, for the purpose of determining the physical properties of these compounds for possible use as aircraft engine coolants. These discussions resulted in the writing of a contract between the Army Air Forces and Purdue Research Foundation for the purpose of studying the fundamental properties of various fluoration hydro-carbons. To date approximately 3- fluoration hydro-carbons have been synthesized and their physical and chemical properties determined. The results of this work would indicate that there is considerable promise in accepting this type of compound for use as an engine coolant. Arrangements are now being made to obtain a sufficient quantity of the most promising compounds synthesized to date for testing in an internal combustion engine.

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COOLANT SYSTEM COATING MATERIALS

523-325 523-334 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Coolant system coating materials are desirable to protect the metals in an aircraft coolant system from corrosion.

PURPOSE: To determine by tests the coating materials which will satisfactorily protect metal coolant system parts from corrosion attack.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Materiel Command, in cooperation with various aircraft manufacturers and coating material manufacturers have conducted a series of tests on the most promising coating materials proposed to date. Up to the present time, extensive tests have been conducted on the Ault & Wiborg 40A drum liner and on the Dupont vitreous enamel. North American Aviation, Inc. is, at the present time, coating the header tanks of the P-51B radiator with the Ault & Wiborg 40A drum liner. Information to date would indicate that this material is not completely satisfactory for its intended use and therefore arrangements are going ahead for the flight testing of the Dupont vitreous enamel in three P-39 aircraft. These flight tests will involve testing coolant systems in which all aluminum parts in contact with the ethylene glycol with the exception of the cylinder heads coated with the vitreous enamel. It is expected that the engines coated with this material will be available by 15 February 1944 and the flight tests will be initiated shortly thereafter. A request for proposal has been sent to Packard Motor Car Company, Aircraft Division, to obtain their recommendations on the application of this material to the Packard V-1650 type engine. It is planned to conduct similar flight tests on Packard engines coated with this vitreous enamel.

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TEST ON ETHYLENE GLYCOL HIGH TEMPERATURE COOLANT.

523-339 523-295 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
MX-343 Classified Project No.	None Contract Number

DESCRIPTION: Ethylene glycol inhibited with triethanolamine phosphate is used as the standard Army Air Forces high temperature cooling liquid. This liquid exhibits a definite corrosive action when in contact with metals, and this corrosive action is accelerated under the conditions of high coolant temperature, stressed metals, and when the coolant has been contaminated with certain foreign materials.

PURPOSE: To investigate the chemical and physical properties of used ethylene glycol high temperature coolant in order to determine the manner in which corrosion difficulties occur in service and to develop new compounds and procedures to eliminate these service difficulties.

AUTHORITY: Chief, Engineering Division.

REMARKS: Results from the cooperative corrosion test program indicate that ethylene glycol deterioration occurs through a process of pyrolosis and oxidation in the presence of metals which result in the formation of organic acids. These acids, together with the residue from improperly cleaned coolant system parts in the presence of water, result in both chemical and electrolytic corrosion attack. Due to the fact that the corrosion may occur inter-granually, very serious weakening of the coolant system structure may result from a very small weight loss. Various additional corrosion inhibitors have been tested, the most successful of which has been the sodium salt of mercaptobenzothiazole. This salt reduces the attack in glycol-water mixtures. Service tests on P-51B and P-40F airplanes operating for 200 hours have been completed and the results substantiate the value of the NaMBT addition to the Specification AN-E-2 coolant. Arrangements have been made through the Air Service Command to make this material available to the service activities when needed.

As a corrosion inhibitor, the NaMBT is not considered to be ideal and accordingly, work is being continued to find the corrosion inhibitor which will perform more satisfactorily under all conditions of service operation and especially one which is more effective than concentrated AN-E-2 coolant. Concurrently, with the search for a

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new corrosion inhibitor, service tests are being run at the AAF Proving Ground on the NaMBT, AN-E-2 combination.

COOLING LIQUID TEST ENGINE

523-322 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: The cooling liquid test engine is a small single cylinder supercharged engine which is so designed as to permit maximum flexibility as regards coolant system operation.

PURPOSE: To design and have manufactured a small single cylinder supercharged coolant liquid test engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: Work was started on the design of a small coolant liquid test engine when it was apparent that present testing engine equipment was not flexible enough to permit the testing of various cooling liquids over a wide range of conditions. Accordingly, a design has been prepared of a cylinder head and jacket assembly suitable for installation on a standard C.O.T. engine which will permit cooling liquid tests to be accomplished. At the present time, the design of the cylinder head and jacket assembly have been completed and it is expected that these drawings will be turned over to a manufacturer for fabrication in the very near future.

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COOLANT TESTS ON ALLISON V-1710-81 ENGINES

523-328 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Coolant tests will be accomplished on the Allison V-1710-81 engine with various glycol-water mixtures to determine cooling characteristics of this engine.

PURPOSE: To determine cooling characteristics of the Allison V-1710-81 engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: Preliminary work on the Continental hyper No. 1 single cylinder engine indicated that the use of glycol-water mixtures result in a decrease in engine metal temperatures from the engine metal temperatures obtained when concentrated glycol coolant was used. These decreases in temperatures and hence the gains in engine performance which could be expected were of such magnitude to warrant a similar investigation on the full scale engine. The instrumentation and installation problem of such a test engine is quite difficult, primarily, due to the fact that very little work of this kind has heretofore been accomplished. However, at the present time, work is going ahead on the installation of 48 thermocouples in an Allison engine placed so as to give metal temperatures at critical points in both A and B banks. It is contemplated that at the completion of the installation work that sufficient data may be accumulated to obtain complete heat rejection data, engine metal temperature data, engine operating data and coolant system data. This data will then be used to evaluate the effectiveness of the various coolant mixtures used in the engine. At the present time, it is contemplated to operate this engine on concentrated glycol coolant, 80-20 glycol-water, 70-30 glycol-water, 30-70 glycol-water and pure water. This project has not been set up to enter into a long range development program, but set up merely to determine the effects of the various glycol-water mixtures on this engine when deemed necessary because of winterization and other requirements.

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AIRCRAFT ENGINE DETONATION INDICATOR

531-228 531-133 531-172 Expenditure Order No.	Power Plant Laboratory Mfg. or Activity Charged with Development
MX-274 Classified Project No.	None Contract Number

DESCRIPTION: A detonation indicator is an electrical or mechanical device which can be attached to an internal combustion engine to indicate, by means of accessory equipment, conditions of detonation during the combustion cycle. An indicator of this type will find useful application on tactical aircraft by permitting leaning of the fuel-air mixture to the engine to obtain greater economy in operation. With a suitable detonation indicator, this leaning can be carried out to a point of light detonation without causing damage to the engine. Depending upon the condition of engine operation relative to speed and load, the detonation indicator may permit a 5 to 20% saving in fuel consumption.

PURPOSE: To study and develop detonation indicators of various types suitable for installation on tactical aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Development work is continuing on the following types of detonation indicators at the Materiel Command:

1. Vibration pick-up units of the electro-magnetic type manufactured by the Sperry Gyroscope Company and the Allison Division, General Motors Corporation. A full scale engine test on the dynamometer stand and during flight have been conducted with this type of detonation indicator. Further testing of this equipment is being conducted with a view towards simplifying and the possibility of using one pick-up per engine rather than one pick-up per cylinder as is done at present.

2. Combustion chamber pressure pick-up units of the magnetostrictive type manufactured by the Lane-Wells Company. Further development work on this type of equipment is being carried on by the Materiel Command and the Standard Oil Company of California. At the present time, this equipment is giving satisfactory results, but there is some indication that difficulty is experienced under conditions of high cylinder head temperatures and high power outputs.

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3. Ionization type detonation indicator is, at present time, being developed jointly by the Brown Instrument Company and the Materiel Command. A contract is being negotiated with this company to cover the cost of their development work. Preliminary work has been started on a single cylinder knock test engine using both modified spark plugs and experimental ionization gaps designed and manufactured by the AC Spark Plug Division, General Motors Corporation. Test data has been obtained which indicates that the experimental ionization gap gives reproducible results and that detonation may be reliably and reproducibly indicated by means of this gap in conjunction with a suitable amplifier and filter circuit. This equipment has now been installed on a full scale single cylinder test engine to determine its suitability under the conditions imposed by a larger engine. Tests are being contemplated on a Franklin 0-200-5 engine as the step which will immediately follow the high output single work. Depending upon the results obtained from this test, decision will be made as to the type full scale aircraft engine to be used for further testing.

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SECTION 6

IGNITION PROJECTS

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IGNITION SYSTEM RADIO SHIELDING

520-348	See REMARKS
Expenditure Order No.	Mfg. or Activity charged with Development
None	P.O. (2620) 44-10044
Classified Project No.	Contract No.

DESCRIPTION: This project covers the development of ignition system shielding capable of eliminating all ignition system radio noise at very high frequency ranges. An entirely new ignition system shielding development has been found to be necessary to provide satisfactory performance of new types of very high frequency radio equipment. This development covers the design of the complete ignition shielding including that required for magnetos, ignition harness assemblies and spark plugs.

PURPOSE: To develop noise free radio shielded ignition systems for use in AAF airplanes equipped with high frequency radio apparatus.

AUTHORITY: Chief, Engineering Division.

REMARKS: The manufacturers interested in this development are:

Titeflex Metal Hose Company, Newark, New Jersey.
General Electric Company, Schenectady, New York.
American Bosch Corporation, Springfield, Mass.
Wright Aeronautical Corp., Paterson, New Jersey.
Pratt & Whitney Aircraft Division, East Hartford, Connecticut.

The American Bosch Corporation is now developing a nine cylinder magneto for use in the B-17 series airplanes that is to be capable of eliminating all radio noise radiating from the magneto assembly.

The Titeflex Metal Hose Company is scheduled to submit an entirely new type radio shielded ignition harness assembly for use in conjunction with the new American Bosch magnetos in B-17 airplanes.

It is anticipated that flight tests of the new nine cylinder radio shielded ignition systems will be conducted during April 1944. The data to be obtained from the above mentioned nine cylinder radio shielded project will be applicable for use in all Army Air Forces ignition systems.

The Wright Aeronautical Corporation, General Electric Company, and Pratt & Whitney Division are sponsoring the development of noise free, eighteen-cylinder ignition systems.

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LOW TENSION HIGH FREQUENCY IGNITION SYSTEMS

520-363 Expenditure Order No.	See REMARKS Mfg. or Activity charged with Development
None Classified Project No.	See REMARKS Contract No.

DESCRIPTION: This project covers the development of aircraft ignition systems having entirely new electrical characteristics. The new system consists of a low tension magneto generator and low tension distribution system from the generator to the spark plug. A high frequency converter unit is located in the low tension transmission line. The spark plugs are equipped with transformer coils which transform low tension current to the high tension current required to fire the spark plug.

PURPOSE: To develop an aircraft ignition system capable of operating at altitudes above 50,000 ft. and to eliminate spark plug oil fouling difficulties.

AUTHORITY: Chief, Engineering Division.

REMARKS: Manufacturers charged with development are as follows:

P. R. Mallory & Co., Inc., Indianapolis, Indiana - P.O. (11-107) 44-10027
General Electric Co., Schenectady, N.Y. - P.O. (535) 41-5805
Tico Electric Co., Springfield, Mass. - P.O. (535) 41-6165
AC Spark Plug Division, Flint, Mich. - --
American Bosch Corporation, Springfield, Mass. --

Engine calibration tests of an R-1830 engine equipped with a Mallory system and calibration tests of an R-2800 engine employing General Electric low tension equipment have been completed. Also, full scale engine ground endurance tests of the Mallory and General Electric units have been conducted. Flight service tests of Mallory and General Electric systems are scheduled to be conducted 1 April 1944. Complete systems are to be submitted for approval tests by the AC Spark Plug Division and American Bosch Corporation during March 1944. The Tico assembly will be made available for Materiel Command tests 15 January 1944.

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HIGH ALTITUDE SPARK PLUGS

520-365	AC Spark Plug Division
Expenditure Order No.	Mfg. or Activity charged with Development
None	P.O. (33-096) 44-1091-E
Classified Project No.	Contract No.

DESCRIPTION: This project covers the development of aircraft spark plugs for use in Army Air Forces engines operating in high altitude airplanes. A high altitude spark plug is one that is satisfactory for use with a potential of 12,000 volts at a minimum altitude of 40,000 ft. The specifications covering this development are such that entirely new spark plug design features have been established. The new high altitude design features render the plug performance to be independent of altitude conditions. Electrical flashover within the spark plug terminal well at high altitude is eliminated by the use of an electrical sealing type spark plug terminal. The new terminal design insulates the ignition cable terminal connection in such a manner that flashover is impossible.

PURPOSE: To develop spark plugs capable of giving satisfactory operation at unlimited altitudes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Sample high altitude ceramic spark plugs have been subjected to full scale engine endurance tests and have been found to be entirely satisfactory for operation at high outputs in R-2800 series engines. Altitude flight calibration tests are now in progress using a P-43 airplane at the Materiel Command. Also, flight service tests of the high altitude spark plugs are being conducted in B-29 airplanes. The new high altitude spark plugs can be adapted to existing high tension aircraft ignition harness assemblies simply by replacing present type 5 mm. spark plug terminals. Also, the new plug design is being tested for possible use with new low tension R-3350 ignition systems for B-29 airplanes. The high altitude spark plug designs resulting from this project will be a radical departure from design principles followed in the past. The new altitude feature represents one of the most important design improvements established during the past five years.

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STARTING VIBRATOR ASSEMBLIES

520-382	American Bosch Corp.
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: A development of starting vibrator assemblies required to energize magnetos on future aircraft engines employing a large number of individual magnetos. The starting vibrator energizes magnetos for the purpose of starting the engine. The vibrator operates from a 24 volt battery source and supplies interrupted voltage to the magneto primary coil circuit.

PURPOSE: To provide a means of supplying ignition on large aircraft engines for starting purposes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Single unit starting vibrator assemblies suitable for energizing a single magneto have been supplied in all Army Air Forces airplanes since September 1942. The starting vibrator replaces the conventional high tension booster coil and has been unusually satisfactory. Multiple outlet vibrators are now required for use on aircraft engines such as the V-3420, R-4360 and R-3350-BB assemblies. Sample American Bosch multipel outlet vibrator assemblies are scheduled to be submitted to the Materiel Command for approval tests in February 1944.

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SECTION 7

RESEARCH PROJECTS

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XI-1430 ENGINE

503-259
503-315
503-356
503-398
503-509
Expenditure Order No.

Continental Aviation and
Engineering Corporation
Detroit, Michigan
Mfg. or Activity Charged
with Development

W-535-AC-327267
W-535-AC-21085, W-535-AC-327367,
W-535-AC-16136, W-535-AC-18644,
W-535-AC-13708, W-535-AC-16110
Contract Number

M-62-40
Classified Project No.

DESCRIPTION: The XI-1430 is an inverted Vee, 12 cylinder supercharged fighter engine. The engine has a military power of 1700 BHP and a W.E.R. of 2000 BHP. The single stage model is intended for use with a turbosupercharger for installation in high performance fighter aircraft. One two-stage model has been used for hundreds of hours of testing to 1600 BHP without external boost. The engine has a displacement of 1425 cu. in. and operates at 3000 RPM, normal, and 3300 RPM take-off. A dual rotation reduction gear has been built and tested. A compact model of the single stage engine weighs 1475 lbs. with no reduction in power.

PURPOSE: To develop a compact high output power plant for new types of fighter and attack airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Successful 50 hour tests have been passed with the present steel, chrome faced, top piston ring. The Lockheed XP-49 airplane is at Wright Field with two single stage turbosupercharged engines installed. Nacelle tests have been conducted in the wind tunnel at Wright Field on an XP-67 installation. Two single stage turbosupercharged engines are being installed in the McDonnell XP-67 airplane. Counterweighted crankshafts and improved crankcases have eliminated the weakness which resulted in cracked crankcases.

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THREE CYLINDER COMPOUND TEST ENGINES

503-479	Power Plant Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: A three cylinder compound engine has been laid out incorporating two high pressure cylinder 6" bore x 6" stroke. These cylinders discharge their exhaust into a low pressure cylinder 8-1/2" bore x 6" stroke. The crankpins of the two 6" cylinders are in line while that of the 8-1/2" cylinder lags behind the two high pressure cranks by 120°. The exhaust opening in the high pressure cylinders is approximately 60° before bottom dead center, Consequently the low pressure cylinder receives the exhaust at top dead center at the point of release of the exhaust from the high pressure cylinders. It is necessary to provide balance pressure pistons on the exhaust valves because of the common connection through the low pressure cylinder from the exhaust valve of one high pressure cylinder to the other. It is also necessary to use the same balance pressure piston on the intake valves of the high pressure cylinder because of the high intake air pressure.

PURPOSE: The purpose of this study is to carry the compound engine project beyond the point reached with a two cylinder compound engine which was previously fabricated and tested at Wright Field.

AUTHORITY: Chief, Engineering Division.

REMARKS: Drawings of the parts are in the Engineering Shops for fabrication of the components of the 3 cylinder test engine. The cylinder head pattern has been made and a casting taken from it. This showed evidence of core shifts and pattern is being reworked. Billets are on hand for the crankshaft, connecting rods, and cylinder sleeves. The crankcase is fabricated from boiler plate by welding and is in process of fabrication. Preliminary design indicates an 18 cylinder, 6 bank engine in radial form would develop in excess of 5000 BHP. A turbo compressor with two-stage compression will be required to furnish the combustion air and the altitude boost. The engine will be liquid cooled, and a geared compressor will furnish part of the ground boost. The fuel consumption at 3000 H.P. is expected to be of the order of .3 lb. per BHP hr. No outside contracts are as yet involved in this project.

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POROUS CHROME-PLATED CYLINDER BARRELS

503-035 Expenditure Order No.	Power Plant Lab. Mfg. or Activity Charged with Development
None Classified Project No.	W-535-AC-38274 W33-038 ac-592 (11197) Contract No.

DESCRIPTION: The porous chrome is the same as hard chrome except after plating the current is reversed to produce a network of small channels in the cylinder surface. This relieved type of surface is being explored to determine the best possible type of porous plate for use in salvaging worn cylinder barrels.

PURPOSE: To provide a suitable means of salvaging worn aircraft engine cylinder barrels.

AUTHORITY: Washington teletype No. E-594 dated 2 January 1943.

REMARKS: The following are the most pertinent Memorandum Reports on this subject:

Memorandum Report No.	Subject
W-U-EXP-M-57-8840-1	Conference on Chrome-Plating of Worn Aircraft Engine Cylinder Barrels as a Salvage Procedure.
W-U-ENG-57-8938-1	Conference on Chrome-Plating of Worn Aircraft Engine Cylinder Barrels as a Salvage Procedure.
W-U-ENG-57-8938-2	Conference on Chrome-Plating of Worn Aircraft Engine Cylinder Barrels as a Salvage Procedure.
W-U-ENG-57-8938-3	Conference on Chrome-Plating of Worn Aircraft Engine Cylinder Barrels as a Salvage Procedure.
W-ENG-57-9023-1	Testing of Porous Chrome-Plated Cylinder Barrels on R-1820 Series Engines.

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W-U-ENG-57-9023-2 Testing of Porous Chrome-Plated Cylinder Barrels on R-1820 Series Engines.

W-U-ENG-57-9027-1 Testing of Porous Chrome-Plated Cylinder Barrels on R-1340 Series Engines.

W-U-ENG-57-9027-2 Testing of Proous Chrome-Plated Cylinder Barrels on R-1340 Series Engines.

Considerable successful testing has been accomplished, particularly on the R-1820, R-1340, and R-985 engines. Further testing is in progress as the R-1830, R-2600, R-680, I-440, V-1650 and V-1710 engines.

As a result of the previous work, the Air Service Command is at present equipping a plant at the San Antonio Air Service Command to chrome-plate 6000 cylinders per month to begin operation during January 1944. In addition, contracts are being let to 8 civilian operated chrome-plating plants.

Testing to date indicates a marked reduction in cylinder and in some cases piston ring wear. Further indications are that a relieved surface has a greater load carrying capacity. Other methods of applying a relieved surface to a chrome-plated cylinder are being explored.

ENDURANCE TEST OF HIGHLY LOADED SPIRAL BEVEL GEARS

521-12 Expenditure Order No.	Gleason Works, Rochester, N.Y. Mfg. or Activity Charged with Development
None Classified Projects No.	W-535-AC-18942 Contract Number

DESCRIPTION: Several designs of right angle gear boxes suitable for use in driving propellers are being fabricated. These gear boxes incorporate spiral bevel gears and suitable ball bearings designed on the basis of probable load carrying capacities in excess of 1000 horsepower.

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PURPOSE: To determine the load capacity and endurance of spiral bevel gears for use in right angle propeller drives.

AUTHORITY: Chief, Engineering Division.

REMARKS: Testing is being done by Gleason Works at 5000 lbs. per inch face. This study has already shown that properly mounted bevel gears can be loaded 700% more than was undertaken. Gleason Works is continuing the tests beyond the contract requirements because of their own interest in the project.

ACROTORQUE HYDRAULIC TRANSMISSION

518-197 & 518-181 Expenditure Order No.	Acrotorque Company, Stanford, Conn. Mfg. or Activity Charged with Development
MX-141 Classified Project No.	W-535-AC-15463 W-535-AC-12679 Contract Number

DESCRIPTION: The Acrotorque hydraulic transmission consists of a pump unit driven by the power plant of the airplane. This pump unit has a constant displacement and is connected by means of high and low pressure piping to one or two hydraulic motor units. The motor units have a variable speed ratio between the engine and propeller. The maximum pressure in the hydraulic system is 3500 p.s.i.

PURPOSE: To develop a variable speed hydraulic transmission for remote operation of the propellers on military aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: No reports have been received from the contractor during the past six months. A letter from the Materiel Command to Acrotorque requesting information is unanswered. It has been requested that necessary steps be taken to close out the Expenditure Order and terminate the project. This action is considered advisable because of apparent lack of interest on the part of the contractor and the excessive weight which seems to be inherent in the hydraulic transmission.

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TYPE I-16 SUPERCHARGER DEVELOPMENT

522-429
Expenditure Order No.

General Electric Co., W. Lynn, Mass.
Mfg. or Activity Charged with Development

MX-172
Classified Project No.

W-535-AC-37422
Contract Number

DESCRIPTION: To cover the development and procurement of one hundred Type I-16 superchargers.

PURPOSE: To promote the development of jet propulsion on Army Air Forces airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Delivery on this contract will start in January or February 1944.

GASOLINE CONVERSION EQUIPMENT FOR TYPE I SUPERCHARGER

506-16
Expenditure Order No.

General Electric Co., Schenectady, NY.
Mfg. or Activity Charged with Development

MX-172
Classified Project No.

W-535-AC-38744
Contract Number

DESCRIPTION: To cover the development of equipment so that Type I superchargers may be equipped to burn leaded aviation gasoline as fuel.

PURPOSE: To relieve the problem of fuel supply.

AUTHORITY: Chief, Engineering Division.

REMARKS: Status of development to present date unknown; expect a report in full will be made in the near future.

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TURBODYNE DEVELOPMENT

506-17
Expenditure Order No.

Northrop Aircraft, Inc.
Mfg. or Activity Charged with Development

CL Confidential No.
Classified Project No.

Navy Contract
Contract Number

DESCRIPTION: This covers the Army Air Forces portion of funds transferred to the Bureau of Aeronautics for the purchase and development of turbodyne units.

PURPOSE: To promote the development of jet propulsion on Army Air Forces airplanes.

AUTHORITY: Washington Directive.

REMARKS: This work is being carried out under Navy Contract.

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SECTION 8

COLD WEATHER TEST PROJECTS

COLD
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WINTERIZATION OF AIRCRAFT

446-20, 446-11	Power Plant Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Modification of airplanes for satisfactory functioning of production combat airplanes and cargo airplanes C-60 class or larger, between the temperature range of -65°F to +160°F so that such airplanes can be used in any or all theaters of operation, with a minimum penalty.

PURPOSE: To develop means by which airplanes of the above class can be operated in extreme ambient air temperature ranges.

AUTHORITY: Authorization was contained in paragraph 3.b. of Headquarters, Materiel Command, Technical Instructions, Serial No. CTI-1300 dated 22 April 1943.

REMARKS: Winterization of engines installed in aircraft as accomplished under CTI-393 dated 9 September 1942 for winter operation in 1942 - 43 has been materially changed as a result of cold weather tests conducted during the winter of 1942 - 43. Basically it was found during these tests that engines operate satisfactorily under cold weather conditions regardless of the ambient air temperature providing adequate fuel vaporization can be effected. For this reason provisions for adequate carburetor heat are a necessity for satisfactory operation while full closing cowl flaps or nose shutters are eliminated as well as push rod housing lagging and nose shields.

Collection of moisture in the oil system and breather pipes has been demonstrated to be a serious handicap to satisfactory winter operation. Requirements have therefore been set up to provide for drainage of water where it collects in low points of the oil system.

The technique of diluting the oil supply has not been accomplished to provide satisfactory results on all occasions. Lack of adequate dilution has caused many engine failures or time delays while the oil supply to the engine was heated so that the oil would become fluid. Dilution indicators or controllers are being developed by the Equipment Laboratory who are coordinating developments on these units with the Power Plant Laboratory.

On the basis of tests conducted on combat type airplanes at Ladd Field, Alaska, during the winter of 1943 - 44, it is expected that the modifications accomplished on these airplanes in 1943 will be proven and further recommendations will be made for future production airplanes for operations in non-temperate climates.

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VOLATILE FUEL REGULATOR

446-11
Expenditure Order No.

American Liquid Gas Corp.
Los Angeles, California
Mfg. or Activity Charged with development

MX-342
Classified Project No.

Purchase Order No.
(535) 43-22331-E
Contract Number

DESCRIPTION: A fuel regulator that will control the fuel and air ratio supplied to aircraft engines during the initial phases of starting and running aircraft engines especially under cold weather conditions.

PURPOSE: To develop a fuel regulator that controls the quantity of fuel delivered to the engine during the cranking and initial running period of the engine so that easy starting of engines can be effected in cold weather.

AUTHORITY: This project developed from unsatisfactory reports which stated engines could not be started in cold weather and is authorized by CTI-1300 as an experimental item.

REMARKS: It has been demonstrated during the course of tests in starting engines at low temperatures that if the oil supply is properly diluted so that the engine may be cranked, a successful start can be obtained by metering fuel that is volatile enough to vaporize sufficiently in its travel from the point of injection to the cylinder so as to produce a combustible mixture. Because of the narrow combustibility, ranges of the hydrocarbons available for fuels, metering devices that supply fuel in the quantity required by the engine during the cranking and initial firing period of the engine are necessary for consistently successful starts. The Algas fuel regulator now under test is designated to supply fuel in the quantity required by the engine. The Algas system has been installed on several combat type airplanes assigned to the Cold Weather Test Detachment at Ladd Field, Alaska, for service tests during the winter of 1943 - 44.

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Propeller
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SECTION 1

ELECTRIC PROPELLER PROJECTS

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ELECTRIC REVERSE PITCH PROPELLERS

580-203
Expenditure Order No.

Curtiss Propeller Division
Curtiss-Wright Corporation
Caldwell, New Jersey
Mfg. or Activity charged with Development

none
Classified Project No.

W-535-ac-26602
Contract Number

DESCRIPTION: Two propeller assemblies, 4-blade, constant speed, fast feathering, reverse pitch, No. 60 shaft size, hub model No. C644S-A0 with hollow steel blades of design No. 1016-1C4-18, 16'-8" diameter, blade cuffs and necessary controls are included.

PURPOSE: To provide propellers sufficiently large for use on No. 60 shaft size engines powered up to 3000 H.P.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated in order to have available reverse pitch propellers for the higher powered engines which are now in the course of development. The first prototype propeller has been tested at Allison Engineering Division for vibration stress measurements and endurance at miscellaneous powers on their V-3420 engine. A second propeller of this design has completed electric motor whirl test and control tests in both normal and reverse pitch conditions at Wright Field and has been returned to Curtiss to be installed on an R-3350 engine at Wright Aeronautical Corporation to obtain endurance time. As far as the several tests have progressed to date, this propeller appears satisfactory for use on the given engines. A B-29 airplane has been assigned for installation of Curtiss propellers of model and size covered by this project. It is planned to run flight and service tests. This type of propeller is concurrently specified for use on the B-32 type airplane and can be considered as an alternate for the B-29.

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MODERNIZED CURTISS ELECTRIC HUB ASSEMBLIES

581-89 581-91 581-92	Curtiss Propeller Division Curtiss-Wright Corporation Caldwell, New Jersey
Expenditure Order No.	Mfg. or Activity Charged with Development
none	W-535-ac-18418 W 535-ac-18420
Classified Project No.	Contract Number

DESCRIPTION: A total of four (4) hub assemblies, 3 and 4-bladed electrically operated, constant speed, feathering, Models C532S-D, C634S-C, C642S-B, suitable for use on No. 50 and No. 60 shaft engines developing from 1500 to 3000 hp. These projects will provide an entirely modernized Curtiss electric type controllable hub incorporating numerous improvements which have shown up as necessary from a service test on their existing types. These hubs differ from existing type hubs in that they will accommodate larger blades, the pitch change motors will be redesigned to provide for the heavier loads, a considerably faster rate of pitch change will be provided, and the no-voltage brake will be changed to improve its service life and to provide greater locking torque. An appreciable propeller weight saving will be accomplished by these developments. The hubs are intended for use with blades having basic diameter from 13'-0" to 19'-0".

PURPOSE: To develop lighter, more efficient propeller hubs of Curtiss design for use on medium bombardment, fighter, and attack type aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Development work on these projects has been considerably delayed due to production concerned with the war and other higher priority experimental development projects. The two C532S-D hubs (581-89) are scheduled for delivery in March and April 1944. The C634S-C hub (581-91) is scheduled for delivery in July 1944. The C642S-B hub (581-92) is scheduled for delivery in January 1944. A prototype propeller of design C642S-B has completed considerable test time on the R-3350 engine and approximately 6 hours on the XR-4360 engine. This propeller with 836 and 837 design blades is the type specified for the XP-58 airplane.

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CURTISS MODEL C644S-C PROPELLER HUB

561-197	Curtiss-Wright Corp. Curtiss Propeller Div. Caldwell, New Jersey
Expenditure Order No.	Mfr. or Activity charged with Development
none	Pending
Classified Project No.	Contract Number

DESCRIPTION: A propeller hub, four-bladed, with No. 4 shank size, suitable for use on No. 60 shaft engines. The hub assembly will include such features as an improved flange type blade retention, two rates of pitch change (one for normal operation and another of a fast rate of approximately 45 degrees per second for feathering, reversing and unreversing). The pitch changing mechanism of the hub derives its power from the rotation of the propeller shaft for normal operation and changes electrically in a manner suitable for the application of the conventional Curtiss contant speed and manual controls. The normal rate of pitch change will be between 2.5 and 5 degrees per second. A small unfeathering motor is used to change pitch at such times as the propeller shaft is either stationary or rotating at speeds of less than engine idling. The control arrangement is such as to automatically switch to the unfeathering motor below this minimum of unfeathering speed. Provision will be made for thermal anti-icing of the blades with hot air. The hub will be suitable for use with blades ranging in diameter from 15 to 19 feet.

PURPOSE: To develop a new type hub capable of exceptionally fast rates of pitch change and reverse pitch operation for use on large bomber and cargo type aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated January 1944. Delivery of the hub is scheduled for approximately June 1945.

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LARGE DIAMETER CONTROLLABLE PROPELLER

581-178
Expenditure Order No.

Curtiss Propeller Division
Curtiss-Wright Corporation
Caldwell, New Jersey
Mfg. or Activity charged with Development

none
Classified Project No.

W-535-ac-40502
Contract Number

DESCRIPTION: A 3-blade, No. 60 shaft size, feathering, controllable pitch propeller with blades of 21' basic diameter. The propeller shall have a pitch changing mechanism which provides for reverse pitch and full feathering operations as well as constant speed operation and a maximum rate of pitch change of approximately 45° per second. The propeller shall be suitable for conventional, automatic, constant speed and manual selective pitch operation. This propeller is designed for use on the XB-36 airplane powered with 3000 horsepower engines.

PURPOSE: To develop a propeller with a high rate of pitch change incorporating reverse pitch, constant speed and full feathering features.

AUTHORITY: Chief, Engineering Division. By direction of Technical Staff.

REMARKS: This project is to make available a propeller suitable for the XB-36 airplane. Present production type hubs have a rate of pitch change in the order of 2.4° per second which frequently has caused overspeeding of the engine with consequent damage. Increasing rate of pitch change is mandatory if reverse pitch operation is to be used.

Curtiss Propeller Division is well along in the development and fabrication of this propeller. It is expected that it will be ready for test during the early part of the calendar year 1944.

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LARGE DIAMETER PROPELLER FOR HIGH ALTITUDE BOMBARDMENT AIRPLANES

580-202
Expenditure Order No.

Curtiss Propeller Division
Curtiss-Wright Corporation
Caldwell, New Jersey
Mfg. or Activity charged with Development

None
Classified Project No.

W-535-ac-26604
Contract Number

DESCRIPTION: Three (3) propeller assemblies, 60 shaft size, constant speed, fast feathering, 3-blade, model C-636-S, with hollow steel blades of 19'-0" diameter (120 activity factor). These propellers will be suitable for either tractor or pusher installations, will have fast reverse pitch operation, anti-icing, spinners, cuffs and necessary controls, and will be designed for operation on a two-speed geared engine. The steady increase in altitude at which modern engines are maintaining power ratings requires an increase in propeller size for efficient operation. At 35,000 ft. the air density is approximately 31% sea level density, and as a result a propeller capable of handling 3000 hp. at 35,000 ft. must be comparable in size to one absorbing 10,000 hp. at sea level. The blades are exceptionally wide and in a 3-blade propeller have a blade area equivalent to that of a normal 4-bladed propeller of the same diameter. The propeller is the largest undertaken as yet by this company. Reverse pitch operation is included in order to assist wheel brakes to shorten the length of the landing runs. This propeller is intended for use on the XB-36 airplane.

PURPOSE: To develop a suitable propeller for use on high altitude bombers carrying engines of 3000 hp. supercharged to maintain this rating up to 35,000 ft.

AUTHORITY: Chief, Engineering Division as a result of a directive from the Technical Staff, Engineering Division to develop and have available a propeller suitable for the XB-36 airplane.

REMARKS: Design work on this model is continuing on highest priority. The hub, blade retention, and turning mechanism parts are being manufactured. The final layout of the pitch changing mechanism is being completed and parts are being detailed. Test rigs for the major component parts, including worm gear and actuating clutches, have been in use for some time and tests to date indicate substantial agreement between calculated and actual performance. Delivery of the complete propeller for test is expected in April 1944.

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ELECTRIC REVERSE PITCH PROPELLERS FOR B-26 AIRPLANE

580-195
Expenditure Order No.

Curtiss Propeller Division
Curtiss-Wright Corporation
Caldwell, New Jersey
Mfg. or Activity charged with Development

none
Classified Project No.

P. O. 42-9248
Contract Number

DESCRIPTION: Parts necessary to convert two (2) 4-bladed propellers of Curtiss model No. C543S, blade design 814, 13'-6" diameter, to reverse pitch operation for installation and test on a B-26 type airplane.

PURPOSE: To provide reverse pitch propellers for type test and flight test on a B-26 series airplane. This is one of several developments undertaken to prove the value of reverse pitch propellers to shorten the length of ground run after landing.

AUTHORITY: Chief, Engineering Division.

REMARKS: The propellers have been delivered and were given a complete type test in accordance with Army requirements. Following these tests which were satisfactorily passed, the propellers were installed on a B-26 airplane for flight test. Tests to determine the braking action of the reverse pitch propeller have been completed. Preliminary results have been analyzed and indicate very favorable results. The original propeller installation was damaged due to the crash of the B-26 airplane.

A B-26B equipped with reverse pitch propellers is now undergoing tests at Ladd Field, Alaska to determine their advantage when landing on snow and ice.

DUAL ROTATION ELECTRIC PROPELLER FOR 2500 HP ENGINES

580-208
Expenditure Order No.

Curtiss Propeller Division
Curtiss-Wright Corporation
Caldwell, New Jersey
Mfg. or Activity charged with Development

none
Classified Project No.

W-535-ac-28065
Contract Number

DESCRIPTION: This propeller is a 6-blade constant speed, controllable

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pitch, dual rotation model, design No. C(57)625-A, complete with all controls and suitable for use on a tractor airplane installation at the ratings of engines in the 2500 Hp. range, equipped with 50-70 shafts. The blades are hollow steel, three of design No. 836 (Right Hand) and three of design No. 837 (Left Hand) 14'-2" diameter. Anti-icing provisions, spinner and cuffs are to be provided. The propeller can be used as an alternate for the XP-75 or similar type airplane particularly should the engine have its power rating increased.

The pitch control mechanism incorporates an electric motor in the hub of the inboard propeller which drives the control mechanism of the inboard propeller through a reduction gearing and is connected to drive the control mechanism of the outboard propeller by means of a differential gearing arrangement.

PURPOSE: To undertake the development of a Curtiss constant speed, electrically operated, 6-blade dual rotation propeller suitable for engines of approximately 2500 hp. with 50-70 shaft sizes and capable of utilizing blades with an activity factor of 80 and a basic diameter of approximately 15'.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated because of an anticipated requirement of larger propellers for the higher powered engines.

Engines in the 2500' - 3000 hp. class, using 50-70 shaft sizes, are being equipped with superchargers, which make operating altitudes of 35,000 ft. definitely practical. At such operating altitudes larger diameter blades, or at least blades with higher activity factors than now available, will provide better performance for the airplanes involved.

Design work is completed and procurement of parts for this propeller is practically completed. The propeller is expected to be available at Wright Field for testing approximately during the early part of the calendar year 1944.

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DUAL ROTATION ELECTRIC PROPELLER FOR 3000 HP. ENGINES

580-196
Expenditure Order No.

Curtiss Propeller Division
Curtiss-Wright Corporation
Caldwell, New Jersey
Mfg. or Activity charged with Development

none
Classified Project No.

W-535-ac-26557
Contract Number

DESCRIPTION: A constant speed, six-blade, dual rotation propeller suitable for use on engines in the 3000 hp. class with 60-80 shaft sizes, expected to maintain ratings up to 40,000 ft. The propeller will be equipped with exceptionally wide hollow steel blades. The pitch change mechanism is of new design which will allow a high rate of pitch change for reversing and feathering. The power for this rapid pitch change is derived directly from the rotation of the propeller shaft rather than from the airplane electrical system. The former pitch change motor is therefore eliminated. The two three-blade elements of this propeller will be connected by inter-gearing in order that both sets of blades may be controlled by one pitch change mechanism.

PURPOSE: To obtain an approved type dual rotation propeller suitable for use on engines rated in the 3000 hp. class supercharged to maintain these ratings up to approximately 40,000 ft.

AUTHORITY: Chief, Engineering Division.

REMARKS: This development was initiated to supply suitable propellers for use on the XP-72 and XB-35 airplanes.

This propeller was originally scheduled to be an eight-blade dual rotation type but since the blade design involved covers a blade with a higher activity than normally obtained, it has been concluded that six blades will be sufficient to make the propeller equivalent, from a performance standpoint, to an eight-blade propeller with conventional blades.

Model designation of the subject propeller will be C(68)64S and it will use 830 and 831 design blades. Preliminary design work is being done but it will be several months before layouts are completed. However, a considerable portion of the work being done on the C636SP propeller (580-202) will apply to the propeller.

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SIX-BLADED (50-70) INDEPENDENTLY OPERATED DUAL ROTATION PROPELLER

580-241
Expenditure Order No.

Curtiss Propeller Division
Caldwell, New Jersey
Mfg. or Activity charged with Development

none
Classified Project No.

P.O. 44-3781-E
Contract Number

DESCRIPTION: A Curtiss dual-rotation propeller, model C(57)62SP-B with 836 and 837 blades, 13' nominal diameter. This propeller is of the independently or separately operated dual-rotation type in which each three bladed unit is independently controllable. The outboard propeller is also capable of feathering and reversing at an increased rate of pitch change. This propeller is the type being specified for temporary use on the XB-42 airplane of Project MX-392.

PURPOSE: To make available a propeller type which will perform satisfactorily on the XB-42 airplanes until such time that a propeller specifically designed for this application is available.

AUTHORITY: Chief, Engineering Division.

REMARKS: This propeller type, when used on the XB-42 airplanes, will be a pusher installation with each half of the propeller being independently driven by separate engines and independently controlled by separate pitch change mechanisms. The outboard propeller is reversible for use as a dive brake. As this is a stop-gap propeller it was not possible to include reversing on the inboard propeller in the time available before delivery was required.

The ultimate propeller design for this installation is being developed on E.O. 581-179.

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INDEPENDENTLY CONTROLLED DUAL ROTATION PROPELLERS

561-179
Expenditure Order No.

Curtiss Propeller Division
Curtiss-Wright Corporation
Caldwell, New Jersey
Mfg. or Activity charged with Development

none
Classified Project No.

W-535-ac-40482
Contract Number

DESCRIPTION: A six-bladed, 50-60 shaft size, dual rotation propeller, with independent control between the two propeller units. The propeller incorporates a pitch changing mechanism which will provide for reverse pitch and full feathering operation. When combined with suitable blades, the propeller shall provide for automatic, constant speed, and manual selective pitch operation. The rate of pitch change is expected to be approximately 45 degrees per second. Curtiss hollow steel propeller blades of design Nos. 836 and 837, 13'-0" diameter shall be included. The development is intended as the ultimate or final propeller for use on the XB-42 airplane.

PURPOSE: To develop a new type dual rotation propeller capable of independent operation between the two rotating propeller units.

AUTHORITY: By directive from Chief, Technical Staff, Engineering Division, to develop and have available a propeller suitable for use on the XB-42 airplane.

REMARKS: This project was originally intended for development of a six-bladed, 60-80 shaft size, dual rotation propeller, for ultimate use on the XB-35 airplane. However, Curtiss Propeller Division is seriously overloaded with more engineering projects than its present engineering staff can handle and due to a more urgent need for a dual rotation propeller for the XB-42 airplane, it was agreed that the original contract would be amended to delete the XB-35 requirement and substitute in its place that of the XB-42.

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LARGE DIAMETER HYDRAULIC CONTROLLABLE PROPELLER

581-137

The Acrotorque Company
Stamford, Connecticut
Mfg. or Activity charged
with Development

MX-240
Classified Project No.

W-535-ac-28076
Contract Number

DESCRIPTION: This project covers complete engineering, study, laboratory tests, stress anlayses, and three propeller assemblies, Contractor's design Project No. 132, four-blade, 16'-6" diameter, with Curtiss design 1018 hollow steel blades installed. The propeller hub consists of a self-contained hydraulically operated mechanism with a high rate of pitch change, full feathering, reverse pitch operation, and open center shaft permitting cannon installations. This type of propeller is intended as an alternate on the B-29 type airplane with R-3350 type engines. This development pertains only to the hub, the blades being of a type now under production.

PURPOSE: To develop a new type hydraulically operated, self-contained controllable propeller suitable for airplanes of the B-29 type.

AUTHORITY: Chief, Engineering Division.

REMARKS: This is an entirely new type propeller, having many desirable features, such as fast feathering, fast rate of pitch change, reverse pitch operation, open center shaft permitting cannon installation, a secondary extremely low rate of pitch change for fine adjustment and installation of synchronization equipment necessary on multi-engine aircraft, etc. The propeller is adaptable to the use of hollow steel blades such as are now being built by the Curtiss Propeller Division.

If this type propeller proves satisfactory, service test quantities will be procured for airplanes of the B-29 type. However, it is questionable whether this propeller can be made available for production in the near future due to its being a new development.

Delivery of the first propeller for tests is expected in approximately March, 1944.

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WIDE HOLLOW STEEL BLADES

590-109
590-110
Expenditure Order No.

Curtiss Propeller Division
Caldwell, New Jersey
Mfg. or Activity charged with Development

None
Classified Project No.

W-535-ac-16693
W-535-ac-16831
Contract Number

DESCRIPTION: A hollow steel blade with conventional Curtiss design in a very wide planform. The blades of this development will be of 15'-0" diameter with an activity factor of approximately 120. The design will incorporate a tilt in the blade to permit its use in either a pusher or a tractor propeller installation. Blades of right and left rotation design Nos. 830 and 831 will be developed. They can be used in single or six and eight blade dual rotation hub assemblies.

PURPOSE: To develop a hollow steel propeller blade with wider planform than any so far constructed in order to obtain a blade feasible for use on airplanes with diameter restrictions of approximately 15'-0" and using engines of relatively high horsepower and altitude ratings.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated to develop a blade for propellers for high out-put engines. At high altitudes the great decrease in air density makes an increase in effective blade area necessary. An increased activity factor appears to be the most satisfactory way to increase the horsepower absorption of the propeller since the number of blades is limited by the strength and size of the hub and the diameter of the blades is limited by the size of the airplane. These blades are of identical design except for direction of rotation. The 830 blades are right-handed and the 831 blades are left-handed and will be used in both dual and single rotation propellers. They are suitable for use on the XP-72, XB-35, XP-58 and similar type airplanes. Preliminary design work of the 830 blade design is completed. It appears desirable to build this blade with both a full rib and with a partial rib in order to determine the most satisfactory design.

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1951

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18 FOOT BASIC DIAMETER HOLLOW STEEL BLADES

590-140
Expenditure Order No.

None
Classified Project No.

Curtiss Propeller Division
Curtiss-Wright Corporation
Caldwell, N. J.
Mfg. or Activity charged with Development

None
Contract Number

DESCRIPTION: This project is to develop a satisfactory hollow steel blade for use on high horsepower engines. It consists of a series of tests on blades with the same basic planform but with various types of ribs and methods of welding. Based on the results of the tests, the most satisfactory type of blade will be approved for production manufacture for use with engines of the 2000-3000 horsepower class. The types of blades to be tested are: 1014 - no rib; 1016 - stiffener rib; 1018 - full welded rib; 1020 - brazed rib, 1022 - union welded rib; 1024 - flash welded rib.

PURPOSE: To develop a satisfactory blade of 18'-0" basic diameter for use with high powered engines, such as the R-3350 and the V-3420.

AUTHORITY: Chief, Engineering Division.

REMARKS: Previous testing on the 1014 type blade indicated that it would be desirable to stiffen the blades with some type of rib or stiffener to prevent the thrust and camber faces from deforming under load or changes in atmospheric conditions encountered during high altitude flights. Due to the difficulty in manufacturing the 1018 type blades with a full welded rib, the other types of construction listed above are to be tested with the view to developing a satisfactory blade which can be more simply manufactured.

All of the above-mentioned testing will be done with 16'-6" diameter blades installed in a C634S three-blade hub.

The 1014 blades have completed the type tests. The 1016 and 1018 design blades have completed electric motor testing and are being held up temporarily pending the availability and installation of an R-3350 engine.

Considerable preliminary design has been accomplished on this basic blade. As soon as R-3350 engines can be obtained for type testing a series of blades will be tried to investigate the relative merits of several cross sections.

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1952

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CENTRIFUGALLY CAST HUB

561-145
Expenditure Order No.

Curtiss Propeller Division
Curtiss-Wright Corporation
Caldwell, New Jersey
Mfg. or Activity Charged with Development

None
Classified Project No.

W-535-ac-39371
Contract Number

DESCRIPTION: This project covers the development of the process of centrifugally casting the Curtiss single-piece, 3-bladed hub. Currently used hubs are forged from a solid block with an excessive amount of waste material. The centrifugal casting process, if satisfactory, will save from 100 to 250 lb. of steel (depending on the size). The program includes the complete type test to determine the strength of the hub.

PURPOSE: To develop centrifugally cast propeller hubs to attempt to save strategic materials.

AUTHORITY: Chief, Engineering Division.

REMARKS: Numerous items used in the present war effort are being centrifugally cast by several companies. Discussions with the several companies have led to the belief that it would be possible to centrifugally cast certain parts of propellers. Being able to use this process on propeller hubs would save a large amount of steel, as well as save a considerable amount of fabricating time.

A test hub satisfactorily completed a formal type test for use on an R-2600 engine. It was then subjected to an overspeed test on the electric whirl rig in an effort to determine the power and speed necessary to cause the hub to fail. However, the hub did not fail up to the limiting power and speed of the whirl rig which amounted to approximately five times the normal loading on the hub. This test demonstrated the practicability of the cast hub and further testing of hubs cast with steels utilizing less strategic alloys is being investigated. A quantity of 50 hubs similar to the one tested is being procured for service test.

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1953

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SECTION 2

HYDRAULIC PROPELLER PROJECTS

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1954

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SUPER HYDROMATIC PROPELLERS

580-204	Hamilton Standard Propellers Div. of United Aircraft Corp. East Hartford, Connecticut.
Expenditure Order No.	Mfg. or Activity charged with Development
None	W-535-AC-25787
Classified Project No.	Contract No.

DESCRIPTION: Six (6) propeller assemblies, 3 bladed, 11' -6" diameter, single rotation, Super Hydromatic, Design No. 3250-2C12A1-6. These propellers have fast feathering, reverse pitch, constant speed operation, and are equipped with hollow steel blades of 90 activity factor. The propeller incorporates a new type of hydraulic system which is independent of the engine lubrication system and a new type of hollow steel blade. This particular propeller is intended for experimental and service tests on the B-17 type airplane but could also be used on other similarly powered airplanes such as the B-24, C-47, C-87, etc.

PURPOSE: To develop a new type propeller which includes an increased rate of pitch change, hydraulic system independent of the engine and both full feathering and reverse pitch operation.

AUTHORITY: Chief, Engineering Division.

REMARKS: This type propeller will make all existing designs of Hamilton Standard propellers obsolete. Reports from the various combat areas, unsatisfactory reports, etc., on propeller overspeeding have repeatedly shown the need for high rates of pitch change. It is questionable, however, whether they can be made available for production in the near future without seriously setting back delivery schedules of other type propellers.

At the present time flight tests are being conducted by the Contractor on the XA-19B airplane loaned on Contract AC-16283. Extensive tests, including a complete type test and flight test on the B-17 series airplane, will be conducted upon delivery of the propellers. Delivery however, has been delayed to the latter part of the calendar year 1944 to permit the contractor to work on high priority projects needed in the immediate future for experimental and production airplanes.

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HAMILTON STANDARD HYDROMATIC PROPELLER

580-247	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: A Hamilton Standard, 4-blade, hydromatic type propeller, constant speed, feathering, 16'-7" diameter, hub model 24F60, blade design 6497A-6. This propeller is of the type suitable for installation on the B-29 airplane. The blades have a particularly wide planform near the shank regions in order to eliminate the possible need for blade cuffs or fairings. Blade material is of "hard" aluminum alloy. This propeller is to be used with the R-3350 engine, geared .35:1.

PURPOSE: To conduct a standard type test on the propeller to determine whether it will be satisfactory for use with the R-3350 engine when the combination is installed on the B-29 airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project proposes to test the substitution of a 4-bladed propeller for a 3-bladed propeller on the B-29 airplane. A partial type test consisting of a 20-hour endurance run, a 1-hour overspeed run, and calibrations has been completed on the electric test motor. The propeller successfully withstood the centrifugal loads of an attempted destructive whirl test. The later test was included because of a recent failure of this type propeller on a B-29 airplane wherein the blades pulled out from the hub, apparently due to the overspeeding.

Continuous attempts have been made to obtain an engine to run engine endurance tests in the torque stand. As yet no engine has been available for test. The engine test schedule will depend on the availability of an engine.

Installation tests of the governing and feathering systems in the airplane have been in progress continuously for several months. A number of improvements have been recommended as a result of these tests.

It is further contemplated that a new blade design, No. 6521, will soon be substituted on the B-29 airplane. This blade is identical to the 6497 design except that its material is "soft" instead of "hard" aluminum alloy. The purpose of this change is to ease production. The new design 6521 is more readily obtainable (forgings) and will be easier to fabricate.

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LARGE FOUR-BLADE PROPELLER FOR BOMBER

Hamilton Standard Propeller
Div. of United Aircraft Corp.
East Hartford, Connecticut
Mfg. or Activity charged with Development

580-199
Expenditure Order No.

None
Classified Project No.

W535 AC-25467
Contract No.

DESCRIPTION: Two constant speed, controllable pitch, hydraulically operated, four-blade superhydromatic propellers, 19'-0" diameter, equipped with suitable hollow steel blades for use on 3000 horsepower engines at 35,000 feet altitude. These propellers are intended for use on four or six engine cargo and bomber type airplanes. The propeller will have an angle range sufficient to cover both feathering and reverse pitch operation. There will be a high rate of pitch change for constant speed operation, feathering, unfeathering and reversing. The necessary spinner and anti-icing equipment are included. Part of this project includes vibration tests, by Hamilton Standard, to obtain propeller blade operating stresses on a suitable engine.

PURPOSE: To develop a suitable propeller to be used on 3000 horsepower engines, maintaining power ratings up to 35,000 feet for application on large cargo and bomber type airplanes such as the C-74 and the B-36.

AUTHORITY: Chief, Engineering Division.

REMARKS: This is one of several developments on extremely large diameter propellers now being undertaken for possible use on various large cargo and bomber type airplanes under development. This particular propeller is intended for experimental tests in torque stands as the production propeller on the C-74 airplane and can be considered as a possible alternate for the XB-36 airplane. Considerable preliminary design work on this propeller has been accomplished by the manufacturer. All final delivered drawings should be furnished by the early part of the calendar year, 1944, which should permit completion of the contract by June, 1944. At that time the propeller will be given a complete type test in accordance with requirements of the C-74 airplane.

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1957

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REVERSE PITCH GOVERNING SUPERHYDROMATIC PROPELLER

580-250	Hamilton Standard Propellers, East Hartford, Connecticut
Expenditure Order No.	Mfg. or Activity charged with Development
None	Pending
Classified Project No.	Contract No.

DESCRIPTION: The propeller assembly consisting of a hub of a superhydromatic type, 4 blades, suitable for use on a No. 60 spline propeller shaft with blades of the Hamilton Standard steel core and shell type. The propeller shall be suitable for dive braking applications and when in reverse pitch shall be capable of governing. The propeller hub is designated as model No. 1260 and is designed to have a blade angle range of 120 degrees, a minimum angle of -25 degrees and a maximum angle of +95 degrees. The hub further has its own oil system independent from that of the engine system. The blades are of 15'-0" diameter and have an activity factor of 80. They have a hollow steel core to which is attached a steel shell to give the proper aerodynamic shape.

PURPOSE: To develop a propeller capable of governing in reverse pitch for use on fighter airplanes to reduce diving speeds and on the larger bomber type airplanes to reduce the length of landing roll.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated 8 December 1943 as a result of Proposals Nos. 2666 and 2671 received from Hamilton Standard Propellers. Delivery of the project is scheduled for approximately 1 September 1944. Other developments on reverse pitch propellers do not include governing in this condition, (the propeller is adjusted to change angle to some fixed pitch setting and remains there regardless of the attitude of the airplane. This may result in either underspeeding or overspeeding depending upon flight conditions).

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DUAL ROTATION HYDRAULIC PROPELLER FOR 3000 H.P. ENGINES

580-196 Expenditure Order No.	Hamilton Standard Propellers Div. of United Aircraft Corp. East Hartford, Connecticut Mfr. or Activity charged with Development
None Classified Project No.	W-535-AC-23649 Contract No.

DESCRIPTION: Two 15'-0", eight-blade, constant speed, dual rotation propellers based on the Hamilton Standard Super Hydromatic, self-contained, hydraulically operated pitch control mechanism. The propeller is to incorporate hollow steel blades of a new type now under development (a tubular steel core supporting a thin walled shell formed to the desired airfoil shape). This propeller design is intended for use on engines rated 3000 hp. up to 40,000 ft. altitude and with 60-80 shaft sizes. The propeller-engine combination is scheduled for use in bomber and fighter type airplanes (XB-35 and XP-72) now being developed. The propeller consists of two 4-blade units, each one having its own self-contained hydraulic mechanism, utilizing a series of piston type pumps arranged radially around the engine side of the hubs for pressures required. A stationary assembly, fastened directly on the engine nose, incorporates a governor and means are provided for controlling the mechanisms of each propeller. This design does not require any special provisions to be made by the engine manufacturers to permit installation of the propeller.

PURPOSE: To obtain an improved type dual rotation propeller suitable for use on engines rated in the 3000 hp. class supercharged to maintain these ratings up to approximately 40,000 feet.

AUTHORITY: Chief, Engineering Division. This type propeller was specified for use on the XB-35 airplane and as a result a directive was issued by the Technical Staff, Engineering Division, to undertake its development.

REMARKS: The preliminary design of this propeller is completed. It is a larger version of the dual rotation propellers utilizing the Super Hydromatic, self-contained, hydraulic mechanism and will be fundamentally similar to propellers being developed under other projects. This project requires the development of a new type hollow steel blade.

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As soon as Hamilton Standard has mastered the design of the single rotation Super Hydromatic propeller and placed it in satisfactory operating condition, the final design and fabrication of the subject propeller can be accelerated. Engineering personnel are working to capacity to accomplish the experimental development program being undertaken by them and this project is being given high priority. Delivery is expected to be in sufficient time so that it will be available when needed for the airplane installation.

DUAL ROTATION HYDRAULIC PROPELLER FOR 2500-3000 H.P. ENGINES

580-157 Expenditure Order No.	Hamilton Standard Propellers Div. of United Aircraft Corp. East Hartford, Connecticut Mfg. or Activity charged with Development
None Classified Project No.	W-535-AC-15866 Contract No.

DESCRIPTION: Six-blade, controllable pitch dual rotation, Super-hydromatic propellers incorporating a self-contained hydraulically operated pitch control mechanism now being developed by Hamilton Standard Propellers. The propellers are for dual rotation engines of approximately 2500 - 3000 hp. with 50-70 shaft sizes. The propeller will be 13'-2" in diameter and will include exceptionally wide blades. The propeller governor is incorporated in the propeller itself and no special provisions by engine manufacturers are required for its installation or operation.

PURPOSE: To undertake the development of a new type dual rotation propeller utilizing a self-contained hydraulic mechanism, a much greater rate of pitch change than is now available in controllable propellers and is capable of reverse pitch as well. Blades will be of a new type hollow steel construction being developed by Hamilton Standard Propellers.

AUTHORITY: Authorization for this development was obtained in an agreement entered into between Hamilton Standard and the Government on 4-25-40 concerning free development of certain physical articles in return for release for export of various types of Contractor's propellers.

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REMARKS: This particular design and size was selected as a result of verbal understanding with airplane manufacturers on requirements of propellers for advanced type airplanes with engines of higher horsepower and altitude ratings than were then being used. This propeller design incorporates the use of a new self-contained hydraulic mechanism. Prior to the fabrication of the dual rotation propeller, Hamilton Standard concentrated all efforts on the development of a single rotation prototype, which since has completed extensive tests. The dual rotation propeller is essentially an arrangement of two single rotation propellers with suitable means for controlling the pitch change mechanism of each separate unit. Construction of the dual rotation propeller has almost been completed and tests will be started as soon as it is delivered which should be in the early part of the calendar year 1944.

INDEPENDENTLY OPERATED DUAL ROTATION PROPELLER

580-172 Expenditure Order No.	Hamilton Standard Propellers Div. of United Aircraft Corp. East Hartford, Connecticut Mfg. or Activity charged with Development
None Classified Project No.	W-535-AC-19379 Contract No.

DESCRIPTION: A 6-bladed constant speed, independently controlled, dual rotation propeller incorporating a self-contained, hydraulically operated, pitch control mechanism. The propeller is to be designed for use with 2 engines connected by extension shafting to a common gear box. The propeller, although mounted to the gear box in the manner of dual rotation propellers, will be completely independent in so far as test operation is concerned. Each absorbs the power of one independent engine. The propellers will be capable of feathering and reverse pitch as well as to control constant speed operation. Propellers are to be designed for use on 50-70 propeller shaft sizes and will be suitable for powers up to approximately 3000 hp. total. Originally this development contract specified a 6-bladed dual rotation propeller of 40-60 shaft sizes. This particular type propeller is no longer needed and an amendment is to be issued to the contractor to change the development as indicated above.

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PURPOSE: To undertake the development of an independently operated 6-bladed dual rotation type propeller based on the superhydromatic, self-contained, hydraulic mechanism conceived by Hamilton Standard.

AUTHORITY: Chief, Engineering Division.

REMARKS: Originally this propeller was undertaken to provide the propeller fabricated by the airplane contractor for use on the XP-59 airplane. This airplane has since been cancelled. Hence propeller is no longer needed. There is no immediate application for this propeller, however, it is intended that flight tests will be run on an XB-42 airplane when one can be made available. The blades to be installed in this propeller will be of a new type under development consisting of a structural steel core supporting surrounding airfoil portions made up of thin steel plate.

"SOFT" ALUMINUM ALLOY PROPELLER BLADES FOR B-29 AIRPLANE

588-59 Expenditure Order No.	Hamilton Standard Propellers Div. of United Aircraft Corp. East Hartford, Connecticut Mfg. or Activity charged with Development
None Classified Project No.	Pending Contract No.

DESCRIPTION: Twelve blades, Hamilton Standard Propellers, design No. 6521A-6, are being procured and upon delivery a complete type test will be conducted with four of these blades in a 24F60 hub at the rating of the R-3350 engines currently being installed in B-29 airplanes. These blades are identical in shape to the 6497A-6 blades now used but the material is 25ST instead of the Hamilton Standard Propeller No. 26 dural used in the 6497A-6 blades. (25ST is commonly termed "soft" aluminum alloy while the HSP No. 26 is called "hard" aluminum alloy).

PURPOSE: The purpose of this project is to conduct sufficient ground and flight tests to approve the use of four bladed 6521A-6 propellers on B-29 airplanes.

AUTHORITY: Chief, Engineering Division. This project was requested by Production Engineering Section.

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REMARKS: Flight vibration tests conducted by Hamilton Standard Propeller on a B-29 airplane at Salina, Kansas, indicated that the vibratory stresses are sufficiently low to permit the use of the 6521A-6 blades in the four way hydromatic hubs. Therefore, a standard A.A.F. type test is to be conducted on this propeller and if completed satisfactorily the propeller will be recommended for installation on production airplanes. This project was initiated 7 September 1943.

ARMOR PROTECTION FOR HYDROMATIC PROPELLERS

581-195	Hamilton Standard Propellers, East Hartford, Connecticut.
Expenditure Order No.	Mfg. or Activity charged with Development
None	Pending
Classified Project No.	Contract No.

DESCRIPTION: A hydromatic steel dome shell hardened to serve as armor protection in combat. This dome is intended to replace the conventional aluminum alloy dome now in current use. It should offer protection against flak and machine gun fire and not result in a very large increase in propeller weight. The design is being based on the model 24F60 propeller as used on the B-29 type airplane.

PURPOSE: To develop armor protection for the hydromatic propellers.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated on 9 December 1943. Reports have been received from different combat units to the effect that propeller domes are being damaged in battle. This is resulting in loss of engine oil and inability to feather propeller. The project intends to reduce this damage by providing light armored protection for the propeller dome. Gun fire and simulated anti-aircraft fire will be used in tests to determine the amount of protection afforded by the steel dome shells, reference Hamilton Standard Propellers Proposal No. 2668.

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ARMORED SPINNER FOR B-29 AIRPLANE PROPELLERS

561-191	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	Pending
Classified Project No.	Contract No.

DESCRIPTION: Armored spinner for use on Hamilton Standard propellers installed on B-29 airplanes. As a result of experience gained in combat using Hamilton Standard Hydromatic propellers, it is considered essential to protect the dome assemblies of these propellers on the B-29 series airplanes from damage by fire which could result from frontal attack. By use of A.P.H.E. shells a direct hit on the propeller dome causes the dome to either disintegrate or pierces it so that the oil is immediately released. In most instances the dome is damaged to such an extent that the propeller cannot be feathered and a serious situation exists with a damaged rotating propeller and engine. The added weight due to the use of an armored spinner is considered justified by the protection offered against this situation. The project will involve a study of the effectiveness of various types of arrangements for the spinner. Several trial spinners will be constructed for firing tests and as soon as a feasible design is obtained a final spinner for type test will be built. This type of passive defense is not generally justified due to the weight penalty, but due to the accumulative damage to the airplane which may occur as a result of a damaged propeller it is very desirable to obtain, if possible, a practical spinner design.

PURPOSE: To obtain a suitable armored spinner design to provide the most protection against gun fire for propeller hub parts with a minimum of weight penalty.

AUTHORITY: Engineering Division I.O.M. dated 25 August 1943, Subject: Armored Propeller Spinner for B-29 Engines.

REMARKS: Complete data are being gathered to show the protection obtained by various arrangements of armored plate and a few arrangements of these for use in spinners have been drawn. A table is being prepared showing the protection obtained from spinners of varying weights and as soon as the most feasible combination is obtained, experimental spinners will be constructed for firing tests and type tests.

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ENGINE - PROPELLER OIL SYSTEM TESTS

Hamilton Standard Propellers
Div. of United Aircraft Corp.
East Hartford, Connecticut
Mfg. or Activity charged with Development

592-49
Expenditure Order No.

None
Classified Project No.

W-535-AC-38219
Contract No.

DESCRIPTION: Tests of five different aircraft engines to determine the following:

1 - The continuous oil supply to the standard governor mounting pad from the engine oil system at rated engine speed with various back pressures.

2 - The pressure loss in the oil line from the governor pad to the propeller shaft outlet at various rates of flow.

3 - The leakage in the line from the governor pad to the shaft outlet at various pressures.

4 - Continuous oil supply to the propeller shaft from the engine oil system at various back pressures.

PURPOSE: To determine which additional engines, if any, require modification of the oil system to permit satisfactory propeller operation.

AUTHORITY: Chief, Engineering Division.

REMARKS: The engines upon which the tests are to be conducted will be furnished by the AAF and will have accumulated at least 100 hours operating time under typical service conditions. Tests have been completed on one engine. Tests on other engines have been delayed due to priority of more important work.

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LOAN OF XA-19B AND RB-25C AIRPLANES TO HAMILTON STANDARD PROPELLERS

530-159 Expenditure Order No.	Hamilton Standard Propellers Div. of United Aircraft Corp. East Hartford, Connecticut Mfg. or Activity charged with Development
None Classified Project No.	W-535-AC-16283 Contract No.

DESCRIPTION: This project covers the loan of the XA-19B and RB-25C airplanes to Hamilton Standard Propellers. These airplanes were loaned in order to further development work being carried out by the contractor on propellers and propeller accessories. The contractor is required to furnish reports of all tests conducted on these airplanes. Lending airplanes directly to the company and allowing them to run tests at their plant as the occasion demands tends to considerably expedite the tests of the various articles in flight.

PURPOSE: To expedite flight testing of new equipment, specifically propellers and propeller accessories which are being developed by Hamilton Standard Propellers for the Government.

AUTHORITY: Chief, Engineering Division.

REMARKS: These airplanes were loaned for an indefinite length of time since the development work carried on by this company is continuous. To date the contractor has used the XA-19B airplane for various tests to determine operation of experimental equipment prior to delivery to Wright Field. These tests included the following:

1. Anti-icing tests on a number of propellers.

2. Ground adjustments and flight tests to determine effectiveness of portable field dynamic balancing equipment.

3. Flight tests on several hydromatic propellers checked for operation.

4. Flight tests of the superhydromatic propellers to check governing characteristics.

This airplane has completed in excess of 200 hours of flight testing to date. The RB-25C airplane has been similarly used for:

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1. Flight tests on feathering, synchronizing and reversing of the new type superhydromatic propeller.

2. Vibration tests in flight under varying conditions to determine the effect of propeller unbalance on the airplane propeller vibration characteristics.

3. Flight tests on a newly developed micro-synchronizer.

This airplane has completed approximately 160 hours flight time to date.

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SECTION 3

MECHANICAL PROPELLER PROJECTS

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LARGE DIAMETER CONSTANT SPEED PROPELLER

580-200	Aeroproducts Division, G.M.C. Vandalia, Ohio
Expenditure Order No.	Mfg. or Activity charged with Development
None	W535 AC-25415 and AC-39677
Classified Project No.	Contract No.

DESCRIPTION: Nine (9) propeller assemblies, self-contained hydraulic, controllable, three-blade, hollow steel blades with an activity factor of 124, 19'-0" diameter, reverse pitch and feathering operations. This propeller may be used as an alternate or substitute for the XB-36 airplane using engines of 5000 h.p., supercharged for operation up to altitudes of 35,000 feet. The installation provides for pusher propeller arrangement. The blades are of tubular structure with wrap around sheet and have an extremely wide plan-form. The two (2) propellers from AC-25415 will be for type test and Contract AC-39677 provides seven (7) propellers for trial installation on the airplane. The three blades of this propeller are equivalent in blade area to the normal four-blade propeller of the same diameter.

PURPOSE: To develop a large diameter, three-blade propeller suitable for airplanes of the XB-36 class.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated to make available suitable propellers for the large, high altitude bomber aircraft, which are now under development. This project is similar to others being conducted with the Hamilton Standard and Curtiss Propeller companies. Tests and development work on smaller pilot models of the large blade contained herein are progressing satisfactorily. Delivery of the complete full scale blade is expected in 1944.

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THREE- AND FOUR-BLADE FEATHERING AND REVERSE PITCH PROPELLER

980-226	Aeroproducts Division, G.M.C. Vandalia, Ohio
Expenditure Order No.	Mfg. or Activity charged with Development
None	W-535-AC-39416
Classified Project No.	Contract No.

DESCRIPTION: 3- and 4- blade constant speed, feathering, reverse pitch, single rotation propeller assemblies suitable for use in engines in the 2500 to 3000 hp. class. These propellers utilize hollow steel blades of the Aeroproducts method of construction. They will be of exceptionally wide planform. The diameter is as yet undetermined. Originally this contract intended procurement of a 6-blade dual rotation propeller of 60-80 shaft size suitable for the XB-35 airplane. The propeller was to be considered as an alternate installation to that of the Hamilton Standard design. Since there appeared to be no immediate need for this alternate in as much as Curtiss is also developing an alternate propeller the contract change is being initiated to have the single rotation 3- and 4-blade types for which there is a need.

PURPOSE: To develop 3- and 4-blade propellers of the higher hp. class suitable for new type airplanes of the immediate future.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was originally started on 5 March 1943. It will represent the first development of propellers by Aeroproducts which includes all the latest features being considered as highly desirable. These features include exceptionally wide blades (high activity factor), fast rate of pitch change, sufficient range of pitch travel to permit both reverse and feathering operation, etc. Ultimately it is expected that these single rotation propellers when developed can be combined into double units of dual rotation propellers.

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HYDRAULIC FEATHERING PROPELLER

580-166	Aeroproducts Division, G.M.C. Vandalia, Ohio
Expenditure Order No.	Mfr. or Activity charged with Development
None	AC-17484
Classified Project No.	Contract No.

DESCRIPTION: Hollow steel blades, Aeroproducts design No. A20-156-17, 11'-7" diameter, hub design No. A552F-X4, and regulator suitable for use on an airplane of the C-47 type having installed an R-1830 engine. This propeller in other diameters could be used on any one of several types of airplanes of approximately the same power conditions.

PURPOSE: To develop an alternate source of hollow steel blade propellers suitable for use on airplanes now in production.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated in an attempt to provide a feathering type propeller of Aeroproducts design suitable for use on any one of several types of airplanes. The propeller was first developed without the feathering features and subjected to a complete type test in accordance with Army requirements. Upon satisfactory conclusion of the test, the propeller hub was returned to the manufacturer for the addition of the feathering features. An AT-18 airplane has been obtained and tests are progressing satisfactorily. The only part of this propeller which can be considered a development is the feathering feature. The propeller itself without feathering has been used to date as a single-engine airplane installation and is working quite satisfactorily. The addition of the feathering feature is necessary if the propeller is intended for use on any one of several production airplanes such as the B-24 and B-17F series.

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DUAL ROTATION CONTROLLABLE PITCH PROPELLER

580-150 Expenditure Order No.	Aeroproducts Division, G.M.C. Vandalia, Ohio Mfg. or Activity charged with Development
None Classified Project No.	W-535-AC-15431 Contract No.

DESCRIPTION: This propeller assembly consists of two 3-blade units which, when mounted on an engine, rotate in opposite directions on separate concentric shafts. It is of constant speed type, hydraulically operated by a self-contained hydraulic system. The blade operating mechanism is contained in the hollow steel blade shanks. In general, the pitch-changing mechanism incorporates a piston in each blade shank. The motion of this piston along the longitudinal axis of the blade is transferred by long helical splines into a rotational motion of the blades. The particular assembly is identified as design No. AD7562 and is intended for use on engines having 50-70 propeller shaft sizes with ratings up to 3000 hp. The design is based on the fundamental principles incorporated in a successful single rotation propeller design now used extensively by the Army Air Forces.

PURPOSE: To undertake the development of a 6-blade dual rotation controllable pitch propeller suitable for use on airplanes with engines for higher power and critical altitude ratings than now prevail.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated early in 1940 when it became obvious that new type airplanes would definitely require dual rotation propellers. It was initially undertaken with Engineering Projects, Inc., which has now become Aeroproducts Division. The development was undertaken before a definite application to any particular airplane could be selected in order to get preliminary design work underway. This propeller satisfactorily completed type test when fitted with 12' dia. blades of A20 series design. Whirl testing has been completed on the 13' dia. version with A20 blades and engine test is now in progress. This test includes a production type, high pressure, hub, and spinner. This hub assembly is suitable for use with blades of A20 and H20 series design being developed on E. O. 580-224.

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DUAL ROTATION PROPELLER FOR P-75 AIRPLANE

580-249	Aeroproducts Division, G.M.C. Vandalia, Ohio
Expenditure Order No.	Mfg. or Activity charged with Development
None	Pending
Classified Project No.	Contract No.

DESCRIPTION: A six-blade, dual rotation propeller, 50-70 shaft size, for use with the Allison V-3420 engine on the P-75 airplane. The propeller will be in 13'-6" diameter, designated as Model No. AD7562, and will have provisions for attaching an external engine cooling fan. The blades will be of the Aeroproducts H20 design fabricated by the conventional Aeroproducts process.

PURPOSE: To provide a dual rotation propeller for experimental tests on the P-75 airplane.

AUTHORITY: Chief, Engineering Division. Specific request for this project was made by Production Engineering Section.

REMARKS: This project was initiated 21 December 1943. This is the first model Aeroproducts 13' 6" dual rotation propeller to be procured for test.

SIX-BLADE DUAL ROTATION PROPELLER

580-224	Aeroproducts Division, G.M.C. Vandalia, Ohio
Expenditure Order No.	Mfg. or Activity charged with Development
None	W-535-AC-37814
Classified Project No.	Contract No.

DESCRIPTION: Six-blade, dual rotation constant speed propeller, 50-70 shaft size, Model AD7562 with D20 and H20 series blades, 12' and 12'-7" dia. respectively. It is intended for use on V-3420 series engines as installed in XP-75 aircraft. It is a refinement of the propeller procured on Contract AC-15431 (Ref. E.O. 580-150).

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PURPOSE: To provide a dual rotation propeller suitable for tractor installation on single-engine fighter aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: This propeller is similar in principle to the 40-60 shaft size dual rotation propeller made by Aeroproducts, the only difference being that it is of a larger size and capable of absorbing considerably more Horsepower. The first propeller having D20 series blades, failed on electric motor whirl test due to vibratory stresses excited by blade passage. A complete test program to determine methods of correction using various combinations of A20, D20, F20, and H20 series blades is in progress. A vibration survey and engine test on a propeller fitted with 12'-7" dia H20 series blades is scheduled January 1944.

HOLLOW STEEL BLADE WITH TRAILING EDGE EXTENSION

590-145 Expenditure Order No.	Aeroproducts Division, G.M.C. Vandalia, Ohio Mfg. or Activity charged with Development
None Classified Project No.	Pending Contract No.

DESCRIPTION: Hollow steel propeller blade, Aeroproducts design No. F20-156-17, 11'7" diameter, of conventional brazed hollow steel construction but using an extension on the camber sheet at the trailing edge of the blade to obtain additional width. This represents an attempt to obtain higher activity factor blades (increased width) by adding an extension along the trailing edge of the blade. By this means a production type blade can be "expanded" (widened) with few changes in the fabrication process without having to undertake a completely new development.

PURPOSE: To determine the suitability of this type construction for the purpose of providing additional activity factor or width to a blade without having to develop a completely new design.

AUTHORITY: Chief, Engineering Division.

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REMARKS: This method of increasing the width can be accomplished with very little trouble using present production tools and further will not hold up production on other experimental projects in progress. Several blades were fabricated and tested on the electric motor test stand and proved satisfactory. Arrangements are being made to accomplish performance tests on the P-47 type airplane to obtain comparative performance with several other type blades (Curtiss, American Propeller Corporation, etc.).

LOAN OF AT-11 AIRPLANE TO AEROPRODUCTS

580-240 Expenditure Order No.	Aeroproducts Division, G.M.C. Vandalia, Ohio Mfg. or Activity charged with Development
None Classified Project No.	W(33-038)-AC-1682 Contract No.

DESCRIPTION: This project covers the loan of an AT-11 airplane, serial No. 42-57025 to Aeroproducts Div., G.M.C. for a 12-month period to accomplish development work on propellers and propeller accessories. The contractor is required to furnish reports of all tests conducted on this airplane. The following types of propellers are intended for flight tests on this airplane:

1. Full feathering propellers.
2. Negative pitch propellers.
3. "Cut-Off" blades.
4. Synchronizers and governor controls.

Lending airplanes directly to the contractor and allowing them to run flight tests at their plant as the occasion demands tends to considerably expedite development work.

PURPOSE: To expedite propeller development.

AUTHORITY: Chief, Engineering Division.

REMARKS: The airplane was delivered 11 November 1943. Arrangements have been made for Aeroproducts to be supplied with necessary airplane maintenance tools and to purchase aircraft fuel and oil, etc. Two Aeroproducts pilots have been checked out in the airplane.

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SECTION 4

MISCELLANEOUS PROPELLER PROJECTS

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SMALL SELECTIVE PITCH PROPELLER FOR TAPERED SHAFT ENGINES

Roby, Inc.,
Wichita, Kansas.
Mfg. or Activity charged with Development

577-47
Expenditure Order No.

None
Classified Project No.

W-535-AC-24046
Contract No.

DESCRIPTION: Two propeller assemblies, two-bladed selective pitch (controllable) with wood blades of small diameter. This propeller is a commercial article manufactured by Roby, Inc., for use on small pleasure-craft airplanes equipped with Continental O taper shaft engine. The blade pitch is controlled mechanically from the cockpit. One propeller is intended for type test on a suitable engine and the other for flight test possibly on a small liaison type airplane.

PURPOSE: To prove the suitability of this type of propeller for use on the liaison and target type aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: This is one of several developments initiated in an attempt to provide controllable pitch propellers for the low-powered liaison and target type airplanes now being built.
This propeller is a commercial article which has satisfactorily completed AAF type tests. A flight test has likewise been satisfactorily completed to compare the Roby controllable pitch propeller with a fixed pitch wooden propeller of Sensenich Brothers manufacture. A service test order for 20 propellers was initiated and these propellers have been delivered and are now in service at Fort Sill, Oklahoma. The time accumulated on each of these propellers ranges from 10 to 530 hours. No difficulty has been as yet encountered. Recently a blade with a different blade section has been installed in the Roby hub and flight tests will be run in the immediate future in an effort to improve the take-off and rate of climb characteristics of the airplane.

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AAF DESIGN BLADES FOR ROBY HUBS

577-79	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: AAF design blades using the lag screw method of blade retention and a single shoulder shear ferrule are to be incorporated in the Roby selective pitch hub for type test for use on an L-2, L-3, L-4 airplane powered by an O-170-3 engine rated at 65 hp. at 2300 r.p.m. The blade angle of this propeller is controlled in flight from the cockpit by the pilot.

PURPOSE: To provide an improved method of retaining the wooden blades in the Roby selective pitch type hub.

AUTHORITY: Chief, Engineering Division.

REMARKS: This is one of several developments initiated in an attempt to provide controllable pitch propellers for low powered liaison and target airplanes. The Roby hub is a commercial article that has been satisfactorily type tested for use on the subject airplane-engine combination.
The blades incorporating the lag screw method of retention have been completed and tested in the Roby hub. The type test has been successfully completed, and flight tests are now in progress.

SELECTIVE PITCH "O" TAPER SHAFT PROPELLER

577-82	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	P.O. (535)43-22929-F
Classified Project No.	Contract No.

DESCRIPTION: This is a propeller designed for use on an "O" taper shaft, O-170-3 engine rated at 65 horsepower at 2300 r.p.m. A manually operated pitch changing mechanism will be incorporated in the hub. This propeller is being designed to incorporate the lag screw method of blade retention and the internal suspension of the blades. A V-belt governor control will be adapted to this hub for complete type tests at a later date.

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PURPOSE: To develop an inexpensive controllable propeller for the target and liaison type airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: A contract has been let to the Steel Products Engineering Co. to fabricate two complete hub assemblies. The contractor has had some difficulty procuring satisfactory castings and consequently the delivery of the assemblies has had to be delayed. The hub assemblies are expected to be delivered in the early part of the calendar year 1944.

CONSTANT SPEED PROPELLER FOR L-5 AIRPLANE

581-188 Expenditure Order No.	Aircraft Specialties Co. Zimmer Thomson Corp. Long Island, New York Mfg. or Activity charged with Development
None Classified Project No.	Pending Contract No.

DESCRIPTION: Procurement and type test of a constant speed propeller for the L-5 airplane. The pitch changing mechanism shall embody the principle of the variable diameter V belt as described in the military invention No. 3742. The propeller will be subjected to a complete type test, including flight tests, for use on the L-5 airplane powered by an O-435 engine rated at 185 hp. at 2550 r.p.m. The propeller shall incorporate the lag screw method of blade retention developed by the Materiel Command.

PURPOSE: The light weight, low-powered liaison type airplane has shown a definite need for a controllable propeller in order to take full advantage of the available horsepower during any flight altitude. The purpose of the project is to develop an inexpensive constant speed propeller that will derive its power from sources other than electrical or hydrualic.

AUTHORITY: Chief, Engineering Division.

REMARKS: Action has been taken to initiate a contract. In the meantime the contractor has proceeded and is designing and building the propellers. It is expected that the propeller will be delivered during the early part of the calendar year 1944.

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MANUALLY CONTROLLED MECHANICAL PROPELLER FOR L-5 AIRPLANE

581-192 Expenditure Order No.	Propeller Laboratory Mfg. or Activity charged with Development
None Classified Project No.	Pending Contract No.

DESCRIPTION: A 2-blade, manually controlled, propeller for use on the L-5 airplane powered by an O-435 engine rated at 125 hp at 2550 r.p.m. The performance of the aircraft has indicated that a multi-position propeller is needed to take advantage of the maximum horse-power available during all flight altitudes. At present there are not any propellers of this type available for use on engines of this power. It is intended to design a completely manually controlled propeller, motivated mechanically by the pilot from the cockpit, eliminating the necessity of a hydraulic system or an electrical circuit. The propeller will be of a conventional design and will employ the lag-screw method of blade retention.

PURPOSE: To provide an inexpensive, light weight, manually controlled propeller for use on the low powered engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: This propeller is not being designed exclusively for the L-5 but for any aircraft powered by a No. 20 shaft engine. Propellers of this type have been designed for smaller engines but none are available for this particular engine size. The assembly drawings have been completed and the details are in the process of design.

SMALL DIAMETER, CONSTANT SPEED PROPELLER

577-44 Expenditure Order No.	Freedman-Burnham Engr. Corp., Cincinnati, Ohio Mfg. or Activity Charged with Development
None Classified Project No.	W-535-AC-24034 Contract No.

DESCRIPTION: One (1) propeller assembly, constant speed, two-blade, design No. C-300-A, equipped with wooden blades of 6'-4" diameter;

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and two (2) sets of two (2) spare blades each of 6'-0" and 6'-2" diameter. This is a new type constant speed propeller having detachable wood blades being developed for use on target type or radio-controlled type airplanes. The propeller is intended for installation on an engine rated 200 hp. at 3000 r.p.m.

PURPOSE: To develop a simple, inexpensive, constant speed type, small diameter propeller suitable for use on target type airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: The larger propeller manufacturers are at present overburdened trying to meet the demand for the larger diameter propellers needed for combat airplanes, and it is necessary to develop propellers of this type using the engineering and manufacturing facilities of the smaller companies.
The Freedman-Burnham Corporation has advised that bench and shakedown tests are being conducted at their plant and that the propellers should be delivered on or about February 1944.

CONTROLLABLE PROPELLER FOR LIAISON TYPE AIRPLANES

581-158 Expenditure Order No.	Propeller Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: A controllable, constant speed, small diameter propeller designed to be suitable for use on an L-2, L-3 or L-4 airplane powered with an O-170-3 engine developing 65 horsepower at 2300 r.p.m. This propeller will incorporate a V-belt governor control and wooden blades retained in the hub by means of the AAF conceived lag screw method of blade retention. Constant speed performance is obtained by means of a system of variable diameter V-belt pulleys actuated by counterweights.

PURPOSE: To develop an inexpensive constant speed propeller for light liaison type airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Steel Products Engineering Co. of Springfield, Ohio, contracted to machine a hub spider and blade attaching parts.

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These parts have been completed and delivered. The propeller successfully completed the electric motor portion of the type test but failed after two hours on an O-170-3 engine. The failure was attributed to an inferior casting and was not a result of poor design. The type test will be continued upon delivery of a new hub spider. This delivery is expected during the early part of the calendar year 1944.

WICKWIRE-SPENCER PROPELLER FOR THE XBQ-1 AIRPLANE

577-110 Expenditure Order No.	Wickwire-Spencer Aviation Corp., Blue Island, Ill. Mfg. or Activity charged with Development
MX-53 Classified Project No.	W-33-038ac822 Contract No.

DESCRIPTION: Procurement and test of three Wickwire-Spencer automatic propellers, model W12T30-9 with blades of design No. 929. The Wickwire-Spencer propeller to be procured utilizes sweep-back and tilt of the propeller blades to theoretically cancel out aerodynamic forces on the blades which permit engine torque and centrifugal force only to act upon the blades. These two forces are the means whereby pitch change of the blades is accomplished. The propeller is expected to maintain constant speed at a given manifold pressure regardless of the altitude of the airplane.

PURPOSE: To develop an automatic propeller for the XBQ-1 airplane.

AUTHORITY: This project was authorized by the Chief, Engineering Division in order to have available suitable propellers for engines of the R-680 type. Specific authorization was received through approval of E.O. 577-110, dated 27 September 1943.

REMARKS: These propeller assemblies have been fabricated and delivered to Fleetwings, Inc. to conduct engine cooling and flight tests. A type test propeller has also been delivered and it has partially completed electric motor testing.

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AUTOMATIC VARIABLE PITCH PROPELLER FOR L-5 AIRPLANE

580-245
Expenditure Order No.

Wickwire Spencer Aviation Corp., Blue Island, Ill.
Mfg. or Activity charged with Development

None
Classified Project No.

Pending
Contract No.

DESCRIPTION: This project will cover the development of a two blade automatic variable pitch propeller suitable for use on the L-5 airplane. This airplane utilizes an O-435 engine rated at 185 hp and 2550 r.p.m. with a No. 20 spline shaft geared 1:1. This propeller will maintain substantially constant r.p.m. for any given throttle setting regardless of the airspeed or altitude of the airplane and without adjustment of any control by the pilot. This propeller utilizes engine shaft torque to decrease pitch and aerodynamic and centrifugal forces to increase pitch. This propeller is similar to Wickwire Spencer design No. W12T20 except that it will incorporate a self filling damping system.

PURPOSE: To provide an inexpensive variable pitch propeller for the L-5 airplane which will increase the airplane's performance.

AUTHORITY: Chief, Engineering Division.

REMARKS. This propeller will be approximately 7 ft. 6 in. in diameter. The blades will be manufactured from 1/28 in. maple wood laminations and will use lag screw retention.
This project was initiated 15 November 1943.

MANUAL PITCH CONTROLLED TEST CLUB

561-142
Expenditure Order No.

Propeller Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

Miscellaneous
Contract No.

DESCRIPTION: A four-blade No. 50 shaft test club capable of having blade angles changed manually without partially disassembling the test club. The test club hub is designed to incorporate either Erco wood or

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Curtiss dural blades. In place of standard bearing stacks an attempt is being made to use aluminum bronze bushings. A blade end gear is fastened to the butt end of the blade which meshes with a worm, the shaft of which extends through the face of the hub. Blade angles may be changed in increments of one-tenth of one degree.

PURPOSE: To develop a test club hub in which the blade angles can be changed quickly and efficiently without throwing the propeller out of balance.

AUTHORITY: Chief, Engineering Division.

REMARKS: Ground adjustable test clubs now commonly used by the Army Air Forces require too much time to increase or decrease the blade angle. In most cases the hubs are of the split type held together by clamp rings and hub bolts. In order to change the pitch of the blade in this type hub, a mechanic has to loosen all bolts and clamps, make an adjustment in blade angle, tighten the bolts and clamps and balance the club. The proposed hub will enable the engine operator to change the pitch on each blade by merely loosening a set screw and turning the worm shaft.
A test club hub has been fabricated and delivered to Wright Field for test. Testing is expected to start in the early part of the year 1944.

TEST CLUBS FOR 3000 TO 4000 HP. ENGINES

578-43	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This project includes the necessary studies and design of a six-blade, fixed pitch, wood test club suitable for engines up to and including those developing 4000 hp. The diameters required for four-blade test clubs are excessive, hence, the development of this six-blade club. The specific application of this club is for the X-Wasp engine.

PURPOSE: To have an engine test club available, principally for service activities, for block testing engines with No. 60 or 70 shafts in the power range between 3000 to 4000 hp.

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AUTHORITY: Chief, Engineering Division.

REMARKS: The design of the test club has been completed and Drawing No. XL2N19275 prepared for construction of the test club. Wood blocks to be used for fabrication of two of these clubs are completed and carving of the club will start in the near future. One of these clubs will be used for calibration purposes and the other will be available for engine test.

ADJUSTABLE PITCH TEST CLUBS FOR LO" H.P. ENGINES

578-46 Expenditure Order No.	Camfield Mfg. Company, Grand Haven, Mich. Mfg. or Activity charged with Development
None Classified Project No.	W-535-AC-29161 Contract No.

DESCRIPTION: Ten (10) test club assemblies, 4-blade, adjustable pitch, with impregnated and compressed wood blades, 6'0" diameter. These test clubs are to be suitable for installation on direct drive engines, ranging from 200 to 950 hp. and will be equipped with sleeve adaptors to permit their use on 20, 30 and 40 size propeller shafts. The blades will be fabricated from resin impregnated, compressed, laminated wood and will be of a molded type having a variable specific gravity. The advantage of the 20, 30 and 40 shaft adaptors is to permit the installation of each club on several sizes of engines.

PURPOSE: The purpose of this project is to determine, through service test, the suitability of compressed and impregnated, 4-blade, adjustable pitch test clubs for future production and service use.

AUTHORITY: Chief, Engineering Division.

REMARKS: A 4-bladed test club of this type submitted by the Navy recently passed a standard type test but failed at the shank during service tests. Subsequent failure of another Navy test club of the same design occurred.

A similar test club, Ref. E.O. 578-57, successfully completed a type test. This test club was similar except for the method of blade retention. The screw method of attachment is used in place of a wedge type in accordance with the Camfield design.

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The hub assemblies to be procured under this expenditure order have been delivered by a subcontractor to the contractor. The metal ferrules are being attached to the test club blades. Delivery is scheduled for the first part of January 1944.

ADJUSTABLE PITCH TEST CLUBS FOR HIGH H.P. ENGINES

578-47	Camfield Mfg. Company, Grand Haven, Michigan
Expenditure Order No.	Mfg. or Activity charged with Development
None	W-535-AC-29458
Classified Project No.	Contract No.

DESCRIPTION: Four (4) test club assemblies, 4-blade, adjustable pitch, compressed and impregnated wood blades; 2 for assembly on No. 50 shaft engines of approximately 1200 h.p., 8'-0" diameter and 2 for assembly on No. 50 shaft engines of approximately 2000 h.p. and 9'-0" diameter. In addition, this contract covers two (2) test club assemblies 6-blade, adjustable pitch, compressed and impregnated wood blades, 10'-0" diameter, for use on No. 60 shaft engines rated up to 2600 h.p.

These test clubs are to be similar in basic design to a smaller test club (Ref. E.O. 578-46) recently submitted for test by the Navy. The latter test club has completed an extensive test at Wright Field. The blades are of a molded type of impregnated and compressed wood. Each test club will be required to pass an appropriate electric motor test before acceptance by the Army Air Forces.

PURPOSE: To develop satisfactory adjustable pitch wood blade test clubs which may be used on engines rated in horsepower from 1000 up to 2500.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated as a result of a serious shortage of test clubs suitable for testing the various engines now used in the services. Heretofore, most of the test clubs incorporated metal blades but due to the shortage of material it has been necessary to find suitable substitutes. This project is one of several which attempt to provide wood blade detachable and adjustable type test clubs.

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The Navy has an identical project to this one. A test club incorporating four test club blades failed after successfully completing the electric motor portion of the type test and 12 hours of endurance on the engine. The failure was attributed to the rapid transition which took place from the shank to the airfoil sections.

A modified design has been submitted by the contractor using the screw method of retention. This has successfully completed sufficient testing at Wright Field to be considered approved for service test on engines.

An experimental 6-way test club similar to the one being obtained on this contract has been undergoing type test at Wright Field under a Navy order. This has been shipped to the Wright Aeronautical Corporation, Peterson, New Jersey, where tests are to be continued on an R-3350-14 engine. Procurement of the clubs under the Army order will be held up pending results of the above engine tests.

HAMILTON STANDARD DUAL ROTATION TEST CLUB

576-62 Expenditure Order No.	Hamilton Standard Propellers Div. of United Aircraft Corp., East Hartford, Conn. Mfg. or Activity charged with Development
None Classified Project No.	Pending Contract No.

DESCRIPTION: Development of a six-blade dual rotation, ground adjustable pitch test club of 60-80 shaft size and suitable for engines in the 3000 to 3500 horsepower class.

PURPOSE: To obtain test data on a test club for new dual rotation engines such as the Pratt & Whitney R-4360.

AUTHORITY: Chief, Engineering Division.

REMARKS: There is a serious need for test clubs for dual rotation engines of the several sizes now under development, specifically those of 40-60, 50-70, and 60-80 shaft sizes. Due to overloaded production schedules the several propeller companies are reluctant to undertake to build test clubs. Further, the quantities required

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are not sufficient to warrant tooling up for their production. Possibly a few hundred test clubs of all sizes will take care of all requirements (e.g., Army, Navy, engine manufacturers, etc.) but this is not enough for a production shop and far too many for fabrication in any of the companys' experimental shops. The subject development is not a prototype leading to production but one intended for use on only a few experimental engines. Other arrangements must be made for the production engines.

PROPELLER FEATHERING WARNING DEVICE

585-44 Expenditure Order No.	Propeller Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: A study will be made to attempt to find a method or means of warning the airplane pilot when an engine and propeller are operating in such a manner that the propeller should be feathered. This project contemplates only a study of possible equipment. Comments in connection with the study are to be obtained from various airplane manufacturers and operators, as well as the Army Air Forces.

PURPOSE: To provide a warning device to notify the pilot that an engine-propeller combination is not operating satisfactorily.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated on 8 December 1943. It is believed that a number of airplanes have been lost because of the fact that the pilot did not have a means of foreseeing an engine failure. The equipment under study on this project would provide one light for each engine to indicate when the propeller should be feathered for safety of an airplane.

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SECTION 5

ACCESSORIES & ICE CONTROL PROJECTS

ACCESS-ORY AND ICE CON-TROL

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ANTI-ICING INVESTIGATION

581-139 Expenditure Order No.	Frigidaire Division, GMC Dayton, Ohio Mfg. or Activity Charged with Development
None Classified Project No.	W-535-AC-31357 (535) 43-25012-E Contract Number

DESCRIPTION: This project covers a development program, including analyses of materials, development of equipment for testing, and tests on methods for preventing or removing ice formation on propellers. It requires Frigidaire to present recommendations as a result of this program as to the best means of accomplishing this purpose. Their approach to the problem is limited only in that the methods developed shall be practical and not require an excess of strategic and critical materials.

PURPOSE: To improve existing methods of propeller anti-icing.

AUTHORITY: Authorization for this investigation is contained in CTI 893 dated 9 September 1942 and amendments thereto, subject: "Winterization of Aircraft" containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

REMARKS: The present method of anti-icing propellers, the alcohol fluid system, has two objectionable features: (1) its inflammability, and (2) the maintenance and servicing of the feed shoes intended to increase blade coverage. It has other minor drawbacks: weight, inadequate coverage of the blade, etc.

Work is now being done under the third contract initiated under this project. During the first, test apparatus was installed, a method developed for judging relatively the effectiveness of anti-icing methods, and tests run on various paste or lacquer type chemical anti-icing materials. During the second the test apparatus was enlarged to allow lower temperatures to be reached, the method of judging effectiveness was amplified and improved, and a series of tests run on chemical materials of newer development. In this third contract, a finish material, acting on a theory of thin-film flexibility and hygroscopicity, has been developed. Tests are proceeding on this material, which is classified as a mechanical type of ice remover. This project now centers on complete

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Investigation of Vistanex in sheet form or by brush application as a material for use on propeller blades for anti-icing. This is a rubber-like material which is quite flexible and theoretically decreases the adhesion of ice to the blade due to deflection under the stress caused by centrifugal force. This material has shown very good anti-icing characteristics in the Frigidaire cold room and in preliminary flight tests on a B-24 airplane equipped with an outrigger. Durability under abrasion is not too good, as shown by water spray tests at Wright Field and this characteristic would have to be improved if this material is used.

The last contract has just been completed and data are being gathered to determine the extent of any future work considered advisable on this material.

PROPELLER ANTI-ICING TESTS

581-160
Expenditure Order No.

Propeller Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

(538) 43-23371-4
Contract Number

DESCRIPTION: To conduct icing tests under flying conditions through the use of a specially equipped airplane in order that an engineering study of ice formation and ice elimination may be made. It is intended that the airplane will be provided with spray equipment in order to induce artificial icing in flight at altitudes at which the right temperature conditions can be found. Recording and photographing apparatus will be installed in the airplane to obtain suitable records. An airplane of the B-24 type is considered to be most suitable for this work.

PURPOSE: To determine the most efficient method or methods of eliminating ice from propeller blades under actual flying conditions.

AUTHORITY: Authorization for this investigation is contained in CTI-893 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft", containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

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REMARKS: This project was initiated to make possible a thorough investigation of several proposed methods of ice elimination, such methods to include: electrical ice removing apparatus; thermal ice removing systems; and chemical ice removing compounds. Inasmuch as the unavailability of airplanes renders testing of these systems impossible at stations most ideally located for ice formation, it is necessary to provide an airplane with spray equipment and recording apparatus in order that artificial icing in flight may be accomplished.

A B-24 airplane has been equipped and is now being operated to conduct a thorough test program for various anti-icing methods. Preliminary tests have been concentrated on perfection of pastes and lacquers and obtaining elemental information on characteristics of propeller icing. Tests on lacquers will continue and, in addition, electrical means of anti-icing will be thoroughly investigated and at a later date perhaps an installation using heated air anti-icing will be made.

CHEMICAL DE-ICING STUDIES

581-163 Expenditure Order No.	Propeller Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: To conduct tests of chemical de-icing compounds for aircraft propellers for cold weather operation. These tests are to be used in the determination of the ice removal qualities of any given material, the resistance of such a material to abrasion by water, and cold weather handling properties.

PURPOSE: To develop a chemical ice removing compound for propeller blades and to conduct sufficient tests of this compound under icing conditions so that the ice removal efficiency of the material can be determined.

AUTHORITY: Authorization for this investigation is contained in CTI 895 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft" containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

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1992

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REMARKS: This project was initiated on 16 January 1943 to conduct investigations on a sufficient quantity of several chemical de-icing compounds prior to recommendation for test on service airplanes. The project provided for the procurement of various materials in small amounts for preliminary investigation. Many materials have been submitted by numerous manufacturers but none of unusual merit has as yet been obtained. Hamilton Standard lacquers Nos. 785 and 678A have shown good anti-icing characteristics.

General activity on the development of anti-icing pastes or lacquers has been rather scant during the last month. A few manufacturers have indicated that they are working on the problem and will possibly submit materials which may have merit for this application.

ENGINE EXHAUST HEAT METHOD OF PROPELLER ANTI-ICING

581-166 Expenditure Order No.	Propeller Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This project covers development of a method for utilizing the heat from an engine exhaust for the prevention or elimination of ice formation on aircraft propellers. This will include theoretical analyses, particularly with respect to determination of coefficients of heat transfer from the metallic surface to the air at high velocity; design of installations for conducting the heat from the exhaust to the propeller; and testing of the latter in laboratories and in the field to determine which is the most practical and effective.

PURPOSE: To provide an efficient means for the prevention or elimination of ice from propellers by utilizing available heat from the exhaust system of an aircraft engine.

AUTHORITY: Authorization for this investigation is contained in CTI-893 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft", containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

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REMARKS: Heat from the engine exhaust has been used with some success for the removal of ice on aircraft wings and accessories. Very little has been done to determine the effectiveness of this method for aircraft propellers. Such a method would be more efficient and less dangerous on combat airplanes than the present fluid systems. It is planned to conduct tests for the determination of heat transfer coefficients at high speeds and to use this basic information for the design of a suitable propeller de-icing system. The project will be continued until such a design is obtained or until no further consideration of such a system is deemed advisable.

Analytical investigation of this type of anti-icing is being accomplished. Tests are planned in the near future to investigate temperature distribution along the propeller blade and to study various methods of eliminating the heating medium from the propeller blade.

ELECTRIC METHODS OF PROPELLER ANTI-ICING

581-167	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Investigation of all electrical methods for the prevention of ice formation on propeller blades in flight or for the removal of ice from such propeller blades. This project will include a study of design and fabrication, as well as the procurement and testing of various electrical ice removing systems.

PURPOSE: To provide a more efficient means for the prevention or elimination of ice from propeller blades.

AUTHORITY: Authorization for this investigation is contained in CTI-893 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft", containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

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REMARKS: This expenditure order was initiated for the development of a practical electrical method for protecting propeller blades from ice formation. The program will also include a study of existing designs and the suitability of such designs for use on service aircraft.

This project includes the development of generators attached to the propeller to provide a source of electrical energy and electric heating elements attached to the blade. A study will also be made on a method of using electric power from the airplane electrical system transmitted through slip rings on the propeller. The latter method, however, is considered to be a severe drain on the airplane's electrical power supply unless an auxiliary source of electric power is available in the airplane. Preliminary tests indicate an average size propeller (such as used on present medium bombers) may require in excess of 2000 watts to provide sufficient heat.

Several generators of different designs have been tested. The one manufactured by Hamilton Standard Propellers has shown considerable promise and is designed for somewhat less wattage than the others. It is ready for service tests as soon as suitable heating elements can be obtained. Approximately 50 of these are on order and should be delivered in the near future. Tests on generators manufactured by Electric Machinery Manufacturing Company are reported under E.O. 581-176.

INVESTIGATION BY M.I.T. OF A SUITABLE ANTI-ICING MATERIAL FOR COATING PROPELLER BLADES.

581-170 Expenditure Order No.	Massachusetts Institute of Technology, Cambridge, Mass. Mfg. or Activity Charged with Development
None Classified Project No.	W535 AC-40172 Contract Number

DESCRIPTION: Massachusetts Institute of Technology is to set up a cold room installation, scale model size, to run tests on present anti-icing pastes, lacquers, or other materials for propeller blades, and from the data in these tests, at least point the way toward future development of more satisfactory materials.

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PURPOSE: To develop a suitable anti-icing material for coating propeller blades.

AUTHORITY: Authorization for this investigation is contained in CTI-893 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft" containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

REMARKS: M.I.T. has recently completed the first contract for the work on anti-icing materials. This involved mainly the development of equipment for measuring adhesion of ice to propeller blades treated with various materials submitted by the Materiel Command. Further work at M.I.T. will involve a test program on various materials to be submitted to them by DuPont (under E.O. 586-24), Ault & Wiborg, and a few other manufacturers who are undertaking the development of these materials. This test program has become rather routine since it uses equipment already developed.

THERMAL ELECTRIC BLADE ELEMENTS FOR PROPELLER ANTI-ICING

581-174	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This project will provide for the procurement of thermal electric (blade) heating elements from various concerns and the complete testing of these elements. This testing will be accomplished under actual and simulated icing conditions and will include service tests, abrasion tests, and all necessary thermal and electric tests. These elements are to provide a means of transforming the electrical energy produced by propeller hub generators or supplied from the airplane power supply by slip rings to heat energy capable of removing or preventing ice formations on propeller blades.

PURPOSE: To improve the electric (propeller) anti-icing system incorporating either propeller hub generators or slip rings for use with the airplane electric power supply to provide electricity to the blade heating elements.

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AUTHORITY: Authorization for this investigation is contained in CTI-893 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft" containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

REMARKS: Development of thermal electric elements was begun under E.O. 581-167 and several tests have been conducted to determine the type of elements most suitable. This project will enable the various types of elements to be tested to determine their practicability with respect to ice prevention and production. These elements are to be adapted for use on all propeller blades up to 13' diameter. The resistance of these elements will be such as to allow a heat output of at least 1600 BTU/hr/sq. ft. at the leading edge and 800 BTU/hr/sq. ft. at the after portions. The elements are to cover at least 20% of the chord on both faces of the propeller blades.

The first types of heating elements tested consisted of a rubber shoe or boot cemented to the blade. In the rubber shoe was imbedded a conductive material.

Heating elements manufactured by Goodrich, Goodyear, and U.S. Rubber are being received for test purposes. Abrasion resistance has been a problem but the later elements show much improvement over earlier designs. Dies for the manufacture of these elements are nearly completed at these Companies and fabrication of the heating elements for use during the service tests of generators (E.O.'s 581-167 & 581-176) will be available.

Possibly a metal strip attached to a propeller blade by means of some suitable metal adhesive will be the most practical type of heating element. Prospective elements of this type are being investigated using Cycle-Weld and attachment to the propeller blades is being tried at Chrysler, in Detroit.

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THERMAL ELECTRIC PROPELLER ANTI-ICING EQUIPMENT

581-176	Electric Machinery Mfg. Co. Minneapolis, Minn.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(535) 43-32836-E
Classified Project No.	Contract Number

DESCRIPTION: Development tests of thermal electric propeller anti-icing equipment manufactured by the Electric Machinery Manufacturing Company. This project requires Electric Machinery Mfg. Company to act as consultant to the Ice Research Base on the design of hub generators suitable for use on the 23E50 propeller and any engine now available. The testing will include type tests and service tests under actual and simulated icing conditions.

PURPOSE: To provide hub generators which will be capable of producing sufficient power to eliminate ice from the propeller blades.

AUTHORITY: Authorization for this investigation is contained in CTI-893 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft" containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

REMARKS: Generators designed by the Ice Research Base in conjunction with Materiel Command personnel at Wright Field are being built by Electric Machy. Mfg. Co. Models of these have been tested at Wright Field and, after load tests on an electric motor, were submitted to engine endurance tests on a Pratt & Whitney R-1830-43 engine. Short circuits developed in the armature lead wires after approximately 45 hours running. This mechanical failure is to be eliminated in further generators to be manufactured by this Company.

A generator designed by Electric Machinery failed rather early during an engine endurance test when short circuits occurred in the field coil connections. Additional development and improved manufacturing is to be pursued from this Company.

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THERMAL ICE PREVENTION SYSTEMS ON PROPELLERS

581-177	Curtiss-Wright Corporation Propeller Division Caldwell, N.J.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This investigation is to be conducted by Curtiss Propeller Division and will include development and test of a thermal ice prevention system for propellers; testing of this system on the B-25A airplane loaned to Curtiss under Contract W-535-AC-35366; submittal of test report describing development of equipment, and results obtained. Monthly progress reports are to be submitted. The development and test of the thermal ice prevention systems for propellers is to include an analytical study of the amount of heat required to prevent ice formation on propeller blades, design of a thermal system and the re-working and fabrication of a propeller to incorporate this system for tests.

PURPOSE: To provide a newer and more satisfactory method of ice elimination on propellers.

AUTHORITY: Authorization for this investigation is contained in CTI-893 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft" containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

REMARKS: Development of heated air method of anti-icing has been studied by Curtiss for severl months. The work has involved detailed analytical study and the construction of an installation for flight tests. The installation utilizes a heat exchanger located at the engine nose, a transfer assembly for entrance of the air into the propeller hub, and routing of the air through hollow steel blades.

Preliminary flight tests have been conducted with hot air supplied to 2 blades of a 4-blade propeller. Results indicate that considerable work must be accomplished to provide a satisfactory distribution system.

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ROTARY BLADE ANTI-ICING INVESTIGATION

581-182	Princeton University Princeton, N. J.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	W-535-AC-40660
Classified Project No.	Contract Number

DESCRIPTION: This project covers an investigation by Princeton University to attempt to find means of anti-icing rotary wing aircraft rotors such as are used on helicopters and autogiros. This project is a continuation of work accomplished by Princeton University under contract No. AC-36113. Monthly reports will be submitted summarizing the progress of tests. The project basically covers the investigation of different kinds of lacquers, pastes, etc., applied to the rotor blades as a means of preventing the ice from forming on the blade, with the possibility of later investigating the application of electrical thermal heating units attached to the blade or some means of utilizing engine exhaust gas heat.

PURPOSE: To develop a suitable means of anti-icing rotary wing aircraft rotors.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated with Princeton University, which had previously worked on the project, since it is considered advisable to continue to utilize the facilities available and to benefit from their experience.

The contract requires the construction of a low temperature room for test purposes, having sufficient dimensions to test a rotor of approximately 20' diameter. Construction of this room has been completed and preliminary tests accomplished. These indicate that suitable icing can be obtained on rotor blades and a thorough study of various methods of anti-icing is under way.

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NON-INFLAMMABLE ANTI-ICING FLUID

586-23	Mellon Industrial Institute University of Pittsburgh Pittsburgh, Pa.
Expenditure Order No.	Mfg. or Activity Charged with Development.
None	W 535 AC-40184
Classified Project No.	Contract Number

DESCRIPTION: This project is intended to cover the field of possible non-inflammable materials to substitute for alcohols in present anti-icing systems. The work will be broken down into three activities. Mellon Industrial Institute is to conduct initial tests on basic properties of materials such as heat in combustion, flash point, rate of combustion, amount of depression of the freezing point of water, etc. The Propeller Laboratory will then take the materials they recommend and conduct whirl tests with the standard fluid systems installed to determine the wetting pattern formed by this liquid. Firing tests are then to be run by or in cooperation with Armament Laboratory to determine the relative inflammability of these materials.

PURPOSE: To develop a non-inflammable material to substitute for alcohol in present standard propeller fluid anti-icing systems.

AUTHORITY: Authorization for this investigation is contained in CTI-893 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft" containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

REMARKS: This project has been undertaken due to the unsuitability of alcohol for use in propeller anti-icing due to its inflammable nature.

The work at Mellon has involved a thorough investigation of all materials likely to be suitable for the fluid system. They have conducted many laboratory tests for preliminary investigation, including a study of anti-icing characteristics of inflammability, explosion character as determined by firing tests, pro-knock effect on engines, rosion characteristics and toxicity. Firing tests have been conducted at Wright Field. Several promising materials have been obtained. These will be subjected to tests at Wright Field which will involve a determination of their effect on aircraft engines when inserted in the air intake and probably later their anti-icing effectiveness in flight. It is expected that a suitable substitute for alcohol will be obtained.

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ANTI-ICING PASTES AND LACQUERS

586-24 Expenditure Order No.	E.I. DuPONT de Nemours & Co., Inc. Wilmington, Delaware Mfg. or Activity Charged with Development
None Classified Project No.	W33-038-AC-314 Contract Number

DESCRIPTION: This project covers an investigation by DuPont's Research Laboratory on anti-icing pastes and lacquers to attempt to increase their effective life. The investigation will proceed along the lines normal to such investigations, namely, the determination of chemical reactions by which anti-icing pastes and lacquers remove ice, testing to determine the proper life of such materials and the means of increasing this life, and the development of materials for modification to provide a more durable anti-icing material.

PURPOSE: To develop a more durable finish for propeller blades incorporating a freezing point depressant for the purpose of removing ice from the propeller (or preventing the formation of ice).

AUTHORITY: Authorization for this investigation is contained in CTI-893 dated 9 September 1942 and amendments thereto, Subject: "Winterization of Aircraft" containing general directive to Materiel Command to properly equip combat and cargo airplanes with suitable winterization equipment.

REMARKS: This is one of several studies and investigations being conducted on anti-icing pastes and lacquers utilizing the resources and facilities of several research laboratories and universities and colleges. This particular project covers an investigation of chemical means of preventing the formation of ice.

The investigation will include setting up of cold room test facilities by DuPont for determining the relative value of several anti-icing lacquers already available or in the process of development. It is intended that these several compounds be more thoroughly studied than existing facilities of the Materiel Command permit. This program is expected to result in the development of a more durable anti-icing material for propeller blades. Present anti-icing pastes and lacquers, several of which have proved quite satisfactory, have the disadvantage of much too short a service life.

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The project at DuPont is to cover a complete survey of all prospective materials from a chemical engineering viewpoint. Test facilities at M.I.T. will also be utilized to test in detail the most promising materials and determine their suitability for flight test. This program was just started a few months ago and DuPont is progressing satisfactorily in the investigations of materials.

LOAN OF B-25 AIRPLANE TO CURTISS PROPELLER DIVISION

580-160 Expenditure Order No.	Curtiss Propeller Division Curtiss-Wright Corporation Caldwell, New Jersey Mfg. or Activity Charged with Development
None Classified Project No.	W-535-AC-35336 Contract Number

DESCRIPTION: A B-25 airplane has been loaned to the Curtiss Propeller Division to accomplish flight tests in the development of propellers and accessories. This may include investigation of operational characteristics of controllable propellers. Experiments with various types of governors and control devices, tests of reverse pitch propellers, and extensive tests related to propeller anti-icing. The airplane is loaned for an indefinite period of time. The contractor is required to furnish reports covering the results of all tests. The airplane is operated by Curtiss personnel. The test schedule is closely coordinated with the Materiel Command to assure most efficient operation of the airplane.

PURPOSE: To expedite obtaining flight test data which will be of immediate value in the development work of propellers and accessories carried out by the Curtiss Propeller Division.

AUTHORITY: Chief, Engineering Division.

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REMARKS: The airplane has been available to Curtiss Propeller Division for several months. During this time they have equipped the airplane with Curtiss propellers and installed many instruments for use in flight tests. Considerable time has been spent in conducting tests of propeller anti-icing means. An out-rigger has been installed on the airplane to spray water through nozzles for simulating natural icing conditions. By flying at below freezing temperatures ice can be formed on the left propeller. Water is obtained from tanks in the bomb bay. Recently tests have been conducted on a propeller design to try a heated air method of anti-icing. A heat exchanger is installed at the engine nose and various ducts provided for carrying the heated air into the hub and out through the hollow steel blades. These tests are reported under E.O. No. 581-177. Testing in the immediate future involves further investigation of propeller anti-icing.

BRAZING OF HOLLOW STEEL BLADES

590-125 Expenditure Order No.	Propeller Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	W-535-AC-29932 W-535-AC-35428 W-535-AC-27546 Contract Number

DESCRIPTION: This project covers a continuous research and development program by the Propeller Laboratory designed to improve the quality of hollow steel propeller blades by providing more suitable alloys for: (a) Brazing or otherwise joining segments of certain types of blades and (2) filleting blades of welded structure. This project classes alloys as: (1) Suitable for brazing with a minimum of distortion before heat-treating; (2) Suitable for brazing during quenching; (3) Suitable for brazing during hardening. At these temperature ranges the alloys must possess physical properties comparable to copper, now used as a minimum standard.

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PURPOSE: The study is intended to uncover means for elimination of blade distortion and other unfavorable properties encountered during fabrication as a result of cooling phenomena and means for reducing production time and simplifying inspection of brazed blades by eliminating or reducing the void network typical of this process.

AUTHORITY: Chief, Engineering Division.

REMARKS: At the time this project was initiated two related problems were involved: (1) The use of copper as an alloy for forming fillets in the welded blades produced by Curtiss Propeller Division and American Propeller Corporation, under prevailing techniques, resulted in time loss and blade rejection due to straightening after distortion; (2) The use of copper as a brazing alloy by Aeroproducts Division did not efficiently work into intended production methods.

At the present time other propeller companies, notably Hamilton Standard, are encountering similar difficulties in attempting to use brazing methods for fabricating blades. By grouping alloys under investigation it is expected that satisfactory alloys for several companies can be uncovered or developed simultaneously.

During progress of this project problem 1 above has been at least partially solved: first, by development of a filleting apparatus whereby the alloy is introduced into the blade more quickly and with better control than previously and second, by development of a lower-melting copper manganese alloy having filleting properties similar to commercially pure copper. Immediate plans for the future call for development of a low-melting alloy for use in the Hamilton Standard type of blade construction. Contracts have recently been renewed with the Battelle Memorial Institute and the University of Cincinnati who have been associated with this project. It is expected that the work will continue for another year.

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SECTION 6

ROTARY WING PROJECTS

ROTARY WING

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ALL METAL ROTARY WING AIRCRAFT ROTOR BLADES

582-116	Pending
Expenditure Order No.	Mfg. or Activity Charged with Development
None	Pending
Classified Project No.	Contract No.

DESCRIPTION: Design, manufacture, and test of all metal rotor blades intended for use on Sikorsky helicopters. This includes preliminary design to obtain lightest weight possible for metal construction and thorough investigaion of provisions necessary for incorporation of heated air or exhaust gas anti-icing. If exhaust gases are used stainless steel spar and leading edge construction will be necessary and possibly the use of all stainless steel. After design requirements of anti-icing have been accomplished a manufacturer with experience in the construction of members of this type will be found to accomplish the design of the blade from a structural standpoint and this manufacturer will be expected to construct blades for test purposes. Due to the uncertainties of this type of construction and the possibility of fatigue failure a relatively large margin of safety will be used.

PURPOSE: To obtain an all metal rotor blade suitable for use on helicopters and utilizing heated air anti-icing.

AUTHORITY: Chief, Engineering Division.

REMARKS: Discussion has been accomplished with Ale twings, Bristol, Pa., regarding the construction of blades as described above. It has developed that considerable study must be made to determine the most feasible provisions for the type of anti-icing intended. These studies are nearly completed and it is expected that the basic characteristics necessary for the blade design can be described very definitely in the near future.

It seems that several manufacturers should be very capable of developing this type of blade and it is planned to possibly prepare a specification for negotiation to obtain the most suitable contractor for structural design of the blade.

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TEST OF AUXILIARY ROTOR

582-117
Expenditure Order No.

Sikorsky Aircraft Division
Bridgeport, Connecticut
Mfg. or Activity Charged with Development

MX-256
Classified Project No.

AC-29845, (D1) AC-2514
Contract No.

DESCRIPTION: The Sikorsky helicopter auxiliary rotor has three (3) blades and a diameter of 8'-4". The blades are constructed of maple, mahogany, spruce and balsawood, drawing No. VS-05-15-2001 with an N.A.C.A. 0012 airfoil section. The leading edge half of the section is made of laminated maple and mahogany and the trailing edge half of balsawood. A laminated spruce strip extends through the center portion of the airfoil section from the leading edge to the trailing edge. The blade is covered with a mahogany sheet.

The auxiliary rotor, which is mounted on the left side of the tail boom, counteracts the torque of the main rotor and gives directional control to the helicopter. The pitch of the blades is varied by conventional rudder pedals.

PURPOSE: To whirl test the rotor and determine: (a) Thrust and power ratings at various r.p.m. (b) Maximum r.p.m. at which failure occurs.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated 22 November 1943. The whirl test for this rotor is to be set-up in a manner similar to the test of two YR-4 auxiliary rotors previously tested. The construction of the YR-4 blades was different insofar as they were smaller in size and did not have the mahogany covering.

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ROTARY AIRCRAFT ROTORS & CONTROL MECHANISMS

582-113	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: To conduct a complete study including investigations, tests and methods necessary to further the development of rotor blades, rotor hubs, rotor pitch control mechanisms and blade dampers for rotary wing aircraft. The study shall coordinate everything done to date and contemplated future designs.

PURPOSE: To aid and further the development of rotary wing aircraft, rotor hubs, blades, pitch control mechanisms and dampers.

AUTHORITY: Authorization for this investigation was obtained by Engineering Division Office Memorandum No. 43-2Y, dated 8 April 1943, which designated the Propeller Laboratory as the agency responsible for research, development, testing, checking, of design, installation and operation of complete rotor systems for rotary wing aircraft.

REMARKS: A study has been conducted and is proceeding satisfactorily to bring up to date the list of literature on rotary wing aircraft, particularly with reference to rotor mechanisms as developed to date. This literature is being obtained and studied.

Test equipment has been designed and a tentative test program has been set up for all rotors and associated mechanisms that are now being developed. The designs of present rotors and mechanisms are being studied with a view to bettering this design.

This project covers the general activity of personnel in the Propeller Laboratory who work on this type of equipment. It has been under way approximately 6 months and considerable knowledge and experience have been gained. It is expected that eventually these individuals will be authorities on the subject and thoroughly familiar with the problems involved. They will be in a position to accomplish the most expeditious and efficient development of this equipment.

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SECTION 7

STRUCTURAL APPLICATION PROJECTS

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FINISH FOR STEEL BLADES

586-18	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This project covers a continuous engineering study designed to uncover an abrasion and corrosion-resistant finish for steel propeller blades. This development includes investigation of all finishes which come to the attention of the Propeller Laboratory, and performance of abrasion, salt spray, fatigue and service tests of the same. It covers also development of such equipment as is necessary to conduct such tests, notably a water spray cabinet.

Advantage is taken of the facilities of the Materials Laboratory for conducting salt spray and fatigue tests.

PURPOSE: To obtain a finish for propeller blades which will be a satisfactory substitute for chromium plate, from a standpoint of corrosion and abrasion resistance, and in addition be non-specular black camouflage.

AUTHORITY: Chief, Engineering Division.

REMARKS: Up to this time approximately 350 combinations, including oxide, phosphate, and chromate coatings, paints, varnishes, oils, plastics, metal dips, platings (zinc, indium, nickel, tin, cadmium, etc.) etc. have been tested. At present, "Pentrate" (oxide coating) is being extensively used by several manufacturers as the paint base. It increases to some extent the wear resistance of the blades over that of plain baked enamel and provides a slightly harder bearing surface against the races. The manufacturers feel, however, that is is essentially undesirable on the basis of paint adhesion and corrosion inhibition. Zinc and zinc-indium plate are, therefore, under intensive service testing at present and appear promising. The finish now used on hollow steel propeller blades is evidently working satisfactorily in service although it is known that it is not ideal since a certain amount of rusting occurs. Zinc and Zinc-indium plated blades are nearly ready for service testing. This is being accomplished on a large number of blades.

Emphasis is not being placed on this development at the present time although laboratory tests are being continued to try any prospective finishes.

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FILLER MATERIAL FOR HOLLOW STEEL BLADE PLATE VIBRATION REDUCTION

590-153 Expenditure Order No.	Propeller Laboratory Mfg. or Activity Charged With Development
None Classified Project No.	Pending Contract No.

DESCRIPTION: This project involves an attempt to reduce the vibration of thrust and camber plate members of hollow steel propeller blades by the insertion of a low density filler material. Materials to be used are various versions of plastic and in general can be termed plastic foam. It is very light weight and of sufficient strength to encourage the belief that it will not crowd to the tip end of the blade due to centrifugal forces while whirling. It is believed that a material may be found which will have sufficient damping effect on the motion of the two plates forming the opposite sides of the blades to reduce to a minimum the stresses due to vibration of the plates. Blades will be filled with various materials to be tried and whirl tests conducted to determine the usefulness of the material. Vibration surveys will be run.

PURPOSE: To reduce the plate vibration involved in hollow steel propeller blades by use of a low density plastic material to fill the blades.

AUTHORITY: Chief, Engineering Division.

REMARKS: Several samples of very light fluffy material have been received at the Propeller Laboratory. These feature unusual strength and are to be tried in hollow steel propeller blades. Four blades have been sent to the Dow Chemical Company for insertion of the material and as soon as these have been returned to Wright Field, whirl tests will be conducted.

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SYNTHETIC RUBBER FILLED HOLLOW STEEL PROPELLER BLADES

590-158	Aeroproducts Div., G.M.C. Vandalia, Ohio
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Aeroproducts model No. D20Q-156-10M5 blades are of hollow steel construction embodying a central steel rib in the machined thrust member with a formed camber sheet .070" thick copper brazed to it. The cavities formed by this construction are filled with Ameripol Sponge Synthetic rubber. The process used to accomplish this is as follows:

1. Internal surface is shot blasted.
2. Two primer coats of Miller Rubber Co. No. 44606.
3. Two coats of cement, a 50-50 mixture of Miller Rubber Company No. A59B and No. A60B
4. 1/4" cubed synthetic rubber is cleaned and dropped into the voids.

A plug inserted in the shank end of the blade holds the synthetic rubber in place and allows air and gas to escape during treatment. The assembly placed in blow up dies is heated for 1 hour at 290°F and 2-1/2 hr. at 310° F. The finished blade weighs 75 lb. and has an activity factor of 111.5 in the 12'-2" diameter.

PURPOSE: To improve the strength characteristics of propeller blades by using rubber filler.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated 6 December 1943. This project is in conjunction with dual rotation propeller tests of E.O. 580-224. With the advent of wide hollow steel blades such as are required for the higher powered engines rated to high altitudes plate vibration in many instances becomes quite serious, sufficiently so to cause failure in the blade. Most of the hollow steel blades now in use have a longitudinal internal supporting rib through the center of the blade however as the blade becomes wider this central support is insufficient. Additional ribs would solve the problem but they are to difficult to insert. The present development attempts to provide this additional support without requiring too difficult a manufacturing process.

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HOLLOW STEEL BLADES
WITH SPECIAL PLATE THICKNESS DISTRIBUTIO

590-144 Expenditure Order No.	American Propeller Co. Toledo, Ohio Mfg. or Activity Charged with Development
None Classified Project No.	43-24145, 43-25216 43-31030, 43-32198 Contract Number

DESCRIPTION: This project consists of various designs of 13' 6" American Propeller blades with variations in plate thicknesses and methods of welding the tubes. All blades have the external dimensions of the B-26 production blades. One design has longituiinal lobes which act as stiffeners. Another has a uniform plate thickness at each section as opposed to thickened leading and trailing edges of the production blades. A third design is similar to the uniform plate but fabricated from tubes welded by the Unionmelt process. The fourth design is one having uniform plate with thicknesses reduced to the minimum consistent with strength requirements and blade stiffness.

PURPOSE: This project was initiated to obtain a hollow steel blade design with a plate thickness distribution giving minimum centrifugal twisting moments consistent with satisfactory blade stresses and torsional stability as well as being practical from a manufacturing standpoint.

AUTHORITY: Chief, Engineering Division.

REMARKS: The blades with longitudinal stiffeners (C383130-) have been given an overspeed test and vibration survey on an R-2800-21 engine. The blades with uniform plate (normal thickness C384130-) have been subjected to a complete type test and are to be service tested by Production Division. Both designs have been statically vibrated with stress measurements by means of Stresscoat.

The normal uniform plate blades using Unionmelt welded tubes and the thin uniform plate blades (C386106) are to be type tested as soon as is possible after arrival at Wright Field. The Unionmelt blades are being developed as this process should reduce fabrication time and costs. The thin blades are to be used as a basis for future designs so that various design hollow steel blades may be reduced in weight.

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There has been some delay in the fabrication of these experimental blades since this company has encountered several difficulties in the manufacture of production blades and of necessity has had to concentrate all effort on these problems. It is expected that the thin wall blades will be delivered early in 1944.

BLADES FOR HAMILTON STANDARD SUPERHYDROMATIC PROPELLER

590-148 Expenditure Order No.	A. O. Smith Corporation Milwaukee, Wisconsin Mfg. or Activity charged with Development
None Classified Project No.	W-535-AC-36135 Contract No.

DESCRIPTION: This project was initiated in order to obtain steel propeller blades which can be used for testing the superhydromatic propeller hub. The blades are to be the same as the A. O. Smith 12' 2" blade except the shank is to be made of material procured from Hamilton Standard Propellers and the finish machining of the shank will be done by Hamilton Standard. The blades are being obtained from A. O. Smith Corporation by Engineering Change Order on the above production contract.

PURPOSE: To obtain blades for testing three superhydromatic propellers and to determine the adaptability of the A. O. Smith process to changes in a blade design where only the blade shank is affected.

AUTHORITY: Chief, Engineering Division.

REMARKS: Upset tubing (45 pieces) has been procured from Hamilton Standard and sent to A. O. Smith Corporation. This tubing is made of SAE 4345 steel and will be used on the shank of the blades to the 24-inch station. The remainder of the blade will remain the same as the present 12' 2" A. O. Smith blade.

There has been some delay in the manufacture of these blades since A. O. Smith has concentrated their effort on their production blade program. In addition the hubs for which these blades are intended have been given low priority in preference to other Hamilton Standard projects and accordingly the requirement for the blades has not been urgent. This project could be

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completed within a few months if necessary. At present the exact blade design to be used may be changed to utilize a wider blade.

WEIGHT REDUCTION OF 18' BASIC DIAMETER HOLLOW STEEL BLADE

590-149 Expenditure Order No.	Curtiss Propeller Division Caldwell, New Jersey Mfg. or Activity charged with Development
None Classified Project No.	Pending Contract No.

DESCRIPTION: Procurement and testing of four hollow steel propeller blades of Curtiss 1016 design but with reduced plate thickness. The blades are to be in 16' 6" diameter and are to weigh approximately 10 per cent less than the present 1016 design.

PURPOSE: To obtain test data on lighter hollow steel blades in the 1016 design. Projects on other blade designs have been initiated to round out a program intended to give data relative to the reduction in weight of hollow steel propeller blades.

AUTHORITY: Chief, Engineering Division.

REMARKS: The 1016 blade design is a basic 18-ft. diameter blade designed for the B-32 airplane and similar installations. This blade design has internal longitudinal ribs integral with the thrust and camber plates respectively but not connected to each other. Testing has indicated that the longitudinal ribs are beneficial in reducing vibratory stresses. Recent improvements in manufacturing technique have resulted in better control of plate thickness in the finished blade. The variation in plate thickness due to necessary manufacturing tolerance has determined the minimum plate thickness which could be used in hollow steel blades. Blades are being procured with thin wall construction in order to determine both structural and manufacturing characteristics.

Work on this project has been slightly delayed due to the necessity of obtaining the most suitable basic design. As soon as this has been established the effort to decrease the weight

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of the blade by reduction in plate thickness will be resumed.

LARGE DIAMETER HOLLOW
STEEL PROPELLER BLADE

590-156 Expenditure Order No.	A. O. Smith Corporation Milwaukee, Wisconsin Mfg. or Activity Charged with Development
None Classified Project No.	Pending Contract No.

DESCRIPTION: A 19' 0" hollow steel propeller blade of AAF design suitable for installation on the B-36 airplane. The blade has a basic diameter of 21' 0" (reduced to 19' for this application) and has a No. 6 shank for use in the Curtiss model C6356 type hub. The shank of the blade can be readily adapted for use in other type hubs. The blade will have two longitudinal webs with thin wall leading and trailing edges. The maximum width of the blade is approximately 21" and it will have the "cuff" structure integral with the blade structure. The blade will be designed for the A. O. Smith flash welding type of construction. The design will be accomplished at the Materiel Command and development of manufacturing methods at A. O. Smith.

PURPOSE: To develop a large diameter light hollow steel blade based on new design methods and suitable for large bombardment type airplanes such as the B-36 or equivalent.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated 4 November 1943. Concurrent with this development experimental blades for the same application are being procured from Curtiss Propeller Division, Curtiss-Wright Corporation. The Curtiss blade design No. 1129 is considered on the conservative side and is based on design criteria of smaller blades. The weight of the Curtiss blade will be approximately 200 lb. The AAF blade, drawing No. XAAN10636, will weigh approximately 130 lb. This drawing no. XAAN10636 is based on stress analyses and aerodynamic studies recently accomplished at Wright Field. It has been forwarded to A. O. Smith. Procurement action has been initiated.

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STUDY OF WOOD CONSTRUCTION OF PROPELLER BLADES

577-74
Expenditure Order No.

Forest Products Laboratory
Madison, Wisconsin
Mfg. or Activity Charged with Development

None
Classified Project No.

P. O. 43-13721-E
Contract No.

DESCRIPTION: An expanded program for the study of variables of assembly, pressing, molding and materials for the production of resin treated laminated compressed wood and similar materials for use in propeller blades by the Forest Products Laboratory.

PURPOSE: To study the fudamental differences between compregs produced with various types of phenolic resins, particularly the water soluble versus the alcohol soluble resins.

The development of non-resin impregnated laminated compressed wood which has been stabilized against moisture absorption by pressing at higher than ordinary temperatures.

The study of test procedures to determine more accurately the strength properties affecting the suitability of these materials for propellers and the study of electro-static heating for gluing compreg propeller blanks and natural wood propeller blanks.

AUTHORITY: This project is authorized by CTI 734.

REMARKS: Failures of certain types of compreg on the test rig indicated a definite shortcoming in present laboratory test methods on these materials and the desirability for developing new tests on which the suitability of this new type material could be predicted. A complete survey of present testing methods is being made and new tests are being devised. A new laminated material, heat stabilized, laminated compressed wood non-resin impregnated, has been developed which shows considerable promise as a propeller material.

Extensive tests on radio-frequency gluing of compreg blanks have been made and indicate that entirely satisfactory joints can be produced if adequate insulation is maintained around the blank during the heating cycle.

No reports have been received recently from the Forest Products

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Laboratory on the progress of their work. It is understood that it is progressing normally. It is expected that in the near future results of their investigations will be received.

COMPREG PROPELLER BLADE BLOCKS

577-83 Expenditure Order No.	Formica Insulation Co. Cincin. O. Rudolph Wurlitzer Co. DeKalb, Ill. Mfg. or Activity Charged with Development
None Classified Project No.	P. O. 43-17307 - E Contract No.

DESCRIPTION: Study of various methods of producing resin impregnated, laminated compressed wood for propeller blades to determine the reason for the failure of certain types of this material. This includes the production by the Rudolph Wurlitzer Company of blade blocks made by their process using water soluble resins with birch veneers to be tested with the Air Forces method of screw retention; three types of blade blocks using maple veneers with modified alcohol soluble resins impregnating methods; the production by the Formica Insulation Company of blade blocks produced by their method of impregnation with alcohol soluble resin from birch veneers, to determine if the species of wood has been a contributing factor to the failure of earlier Wurlitzer materials.

PURPOSE: To determine if methods other than the standard Formica Insulation Company's process are suitable for the production of resin impregnated, laminated compressed wood propeller blades.

AUTHORITY: This project is authorized by CTI 734.

REMARKS: This project was initiated in an attempt to determine more accurately exactly what properties are required for the production of a suitable propeller blade material. Propeller blades made from the standard Wurlitzer material, consisting of birch veneer impregnated with a water soluble resin, were very nearly comparable to the Formica material which successfully passed all type tests, particularly insofar as laboratory static tests could determine. The great difference in performance of these two materials has made such a determination necessary.

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Several varieties of Wurlitzer material have been received. Their original water soluble, resin impregnated, birch compreg, which had previously failed on tests with the Schwarz retention, successfully passed the type test when mounted in the AAF screw retention, thus making this material available as soon as conversion to the AAF retention has been completed. Their attempt to produce a material identical to Formica pregwood produced a material which failed on type test in the Schwarz retention. The Formica Company is producing birch pregwood in accordance with their standard method which will be tested to determine whether birch is equally as satisfactory as maple for this purpose.

Numerous blades have recently been received of various types of construction as described above. These are being distributed for service tests where no type test is considered necessary.

RESIN BONDED, NON-IMPREGNATED, WOOD PROPELLER BLADES

The Resinous Prod. & Chemical Co.
Philadelphia, Pa.
Mfg. or Activity Charged with Development

577-90
Expenditure Order No.

None
Classified Project No.

None
Contract Number

DESCRIPTION: This is a study of the properties of resin bonded, non-impregnated, laminated compressed wood and its suitability for propeller blade material. This is similar to the Jablo wood used by the British. Preliminary data show that the higher density materials have moisture resistance comparable to resin impregnated, laminated compressed woods with a much higher notched izod impact strength.

PURPOSE: To determine the suitability of this material for propeller blade construction. If suitable, it will permit substantial savings of phenolic resin to be required in the production of the present resin impregnated laminated compressed wood.

AUTHORITY: This project is authorized by CTI 734.

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REMARKS: Preliminary tests indicate that this material has superior strength properties, particularly impact strength, with moderately good moisture resistance. Blade blocks of this material are being prepared to be carved into propeller blades to determine their suitability under actual flight and weathering conditions.

The Resinous Products representative called to state that they have succeeded in producing satisfactory blanks from their Tego bonded non-impregnated, compressed wood and are ready to have these carved if the Propeller Laboratory desires to test them. They have been notified that Propeller Laboratory will test the blades as soon as test facilities become available. This will complete this project and if the blades pass the test satisfactorily this will be an additional material to fall back on in the event of any change in the present supply of dural or blade forgings for trainer planes.

LARGE DIAMETER BLADES OF WOOD AND METAL CONSTRUCTION

583-46	Laminated Process Company Portage, Wisconsin
Expenditure Order No.	Mfg. or Activity Charged with Development
None	PO 43-32739-E
Classified Project No.	Contract Number

DESCRIPTION: Experimental blades, designed by Propeller Laboratory, are being procured which will have a wood core completely covered with sheet metal. The metal will serve both as a protective and as a structural part of the blade. The metal is to be aluminum alloy and will be cemented to the wood by a plastic metal to wood adhesive.

PURPOSE: The weight of either aluminum alloy or hollow steel propeller blades for high altitude and high power airplanes in accord with present design criteria is considered excessive. This project was initiated in order to develop a high altitude propeller blade which will have a metal skin attached to a wood core. The weight will be considerably less than a comparable all metal blade.

AUTHORITY: Chief, Engineering Division.

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REMARKS: The most effective location of metal in a propeller blade is on the outer surface. A blade having a wood core and a metal skin incorporates the advantages of both metal and wood. By completely covering the wood the effect of climatic changes on the wood is minimized.

Samples of the Laminated Process Company metal-to-wood adhesive have been submitted and it is thought that it will be satisfactory for attaching the metal skin to the wood core of the blade.

Construction of two 8'6" blades has been attempted and some difficulty was encountered with trapping air between the metal and wood. Thermo-setting cement was used and an attempt is to be made to remove the metal and to try to use a different technique with a thermoplastic cement.

PAPER COMPREG COVERED WOOD BLADE

577-88 Expenditure Order No.	Heath Corporation, Benton Harbor, Michigan Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: To conduct an engineering study to include mold design and manufacturing variables necessary to produce a natural wood propeller with a molded covering of low pressure resin-impregnated, high strength laminating paper.

PURPOSE: To produce a propeller combining the light weight of the natural uncompressed wood core with the high strength property of newly developed laminating papers to produce a covering having a good resistance to abrasion and moisture absorption.

AUTHORITY: This project is authorized by CTI 734.

REMARKS: This project was initiated in an attempt to find some means of utilizing the high strength properties of newly developed low pressure molding papers for the surfaces of propeller blades without sacrificing the light weight of the uncompressed wood propeller.

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The Heath Corporation has pressing and molding facilities suitable for this study and is believed to be qualified to determine the practicability of this type of construction.

It has been several months since this project was started and no reports have been received from the Heath Corp. Steps have been taken to obtain full details on development which has been accomplished. If this does not indicate that this type construction is feasible the project will probably be discontinued.

COMPOSITE RUBBER AND ALUMINUM BLADE

583-44 Expenditure Order No.	Hamilton Standard Propeller Div. East Hartford, Conn. Mfg. or Activity Charged With Development
None Classified Project No.	AC-17707 Contract Number

DESCRIPTION: These blades are to be fabricated from hard aluminum alloy structural cores and solid tips. The metal core supports a molded rubber material from the shank region to about 30 inches from the tip, forming the inboard airfoil sections. The blades are intended for use in 17 ft. diameter propeller installations having "E" shanks and absorbing about 2000 hp. in installations such as on high altitude bombers.

PURPOSE: This project was initiated to obtain a light, large diameter propeller blade, having wide shanks to simulate cuffs, and outer material sufficiently tough to withstand wear encountered during operation of the propeller.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was originally one for 12'-6" diameter blades for use on the B-25 type airplane. However, due to the lack of a need for this type blade for this airplane the project was changed into one having 17' diameter blades and based on the design characteristics required for the B-29 type airplane.

Propeller blades have been delivered and a complete type test is in progress. During the course of the test a transverse crack appeared in the rubber portion of the blade. Damage, however, was not sufficient to cause discontinuance of the test. It is expected that tests will be completed approximately February 1944.

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HOLLOW ALUMINUM PROPELLER BLADE

588-60	Aeroproducts Div., G.M.C. Vandalia, Ohio.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	Pending
Classified Project No.	Contract Number

DESCRIPTION: Hollow aluminum propeller blades consisting of a thrust face machined from a forging and a camber sheet which will be brazed to the machined thrust face forging. These blades are to be similar to the Aeroproducts design No. D20-156, 13'-0" diameter, with AAF No. 2 shank. The blades are to be installed in a Curtiss type constant speed hub. Aeroproducts Div. is to investigate the application and characteristics of aluminum brazing cooperating with the Aluminum Company of America. This project is to progress in three phases. The first phase of the work will cover an investigation of the characteristics of the aluminum braze and the brazing technique. If positive results are obtained from this investigation blades will then be made and subjected to static tests. Following tests, the final phase of the work will be the fabrication of blades for type and flight tests.

PURPOSE: The purpose of this project is to determine the possibilities of utilizing new brazing technique in the fabrication of hollow aluminum alloy propeller blades and as a consequence to attempt to appreciably lighten propellers in the extra large diameters being considered for high altitude airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Representatives of the Aluminum Company of America visited various propeller blade manufacturers in July, 1943, in order to determine which, if any, of the present blade manufacturing processes was suitable for experimental fabrication of a brazed hollow aluminum propeller blade. The Aeroproducts process was considered most suitable.

The Aluminum Company of America has improved brazing technique of aluminum alloys and considers the brazing of aluminum alloy sheets to aluminum forgings for fabrication of hollow aluminum propeller blades feasible.

If this project is successful the result will be the possibility of a considerably lighter propeller especially of the type required for high altitude, high-powered airplanes.

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INVESTIGATION OF ENGINE COOLING FAN DESIGN

581-185	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: With the development of high horsepower engines the need is arising for auxiliary cooling means. In many instances a fan will be provided by the engine manufacturer; in others a suitable fan attached to the propeller or propeller spinner may be very desirable. A thorough study of cooling fan design is involved, with particular emphasis on what can be accomplished by incorporating cooling means of this type in the propeller construction.

PURPOSE: To thoroughly investigate what assistance to engine cooling can be obtained from devices attached to propellers and to accomplish certain fundamental designs.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project has only recently been started since numerous problems related to engine cooling have arisen and the need for more definite data on what can be accomplished by cooling fans attached to propeller is quite urgent.

Detail study of fundamental cooling fan characteristics is being accomplished and from this the feasibility of using fans attached to a propeller can be predicted. It is expected that numerous tests will be accomplished in the laboratory to investigate such variables as blade angle, blade shape, characteristics, and various types of cowling. Due consideration will be given to structural problems.

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SECTION 8

AERODYNAMICS PROJECTS

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PROPELLER BALANCE TUNNEL

584-63	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development
None	None
Classified Project No.	Contract Number

DESCRIPTION: The aerodynamic propeller balancing unit consists of a thru-flow type tunnel giving a varying velocity distribution across its throat similar to that velocity distribution which exists over the propeller blade at a particular flight climb condition. The individual blades of the propeller are placed across the throat of the tunnel in this varying velocity field and their aerodynamic characteristics determined by means of an appropriate measuring system over a range of blade angles.

PURPOSE: This tunnel is intended to be used to aerodynamically balance propellers; expressly, for the purpose of eliminating the aerodynamic propeller unbalance reportedly existing in the P-39 airplane. If successful, it is intended as a production method for aerodynamically balancing blades for other type airplanes as well.

AUTHORITY: Chief, Engineering Division.

REMARKS: Status - The above method of balancing propellers is now being evaluated in flight tests.

Development - A thru-flow type tunnel was designed and built. The tunnel converged from a circular section at the fan plane, to a rectangular exit throat of 2' x 5'. Over this rectangular throat was placed a screen of varying solidity such as to give a linear velocity gradient across the throat (i.e. 90 ft./sec. to 45 ft./sec.) Individual blades were mounted in a special hub supported by means of an arbor on an Anderson balance. Then by means of a lever arm coming out from this hub and acting against a scale, the aerodynamic loading of the blades were obtained over a range of blade angles. Blades were then calibrated in this tunnel. The intention being, that, for any number of blades assembled in a single hub, the individual blades could be so indexed with respect to one another as to compensate for any aerodynamic differences indicated by the tunnel blade calibration.

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SECTION 9

VIBRATION AND SPECIAL PROJECTS

FATIGUE RESEARCH PROJECTS

VIBRATION PROJECTS

MISCELLANEOUS PROJECTS

VIBRATION & SPECIAL PROJ.

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FATIGUE TESTS OF FULL SIZE WOOD PROPELLER BLADE SHANKS AND RETENTION SYSTEMS

591-39	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The type test of a propeller does not yield sufficient data that may be used to completely evaluate the relative strengths of differen propeller blade assemblies under combined loading conditions or furnish information as to the maximum working loads and stresses that propeller blades, hubs and component parts may withstand. The Propeller Laboratory has under construction a blade retention fatigue machine that will test full size models of blade shanks and retention systems under controlled steady and alternating loads of predetermined ratio. Tests made with this machine will yield data for the evaluation of the relative strengths of different wood propeller blade retention systems as well as valuable information for future development of retention systems.

PURPOSE: To determine from tests in a blade retention fatigue machine the maximum strength and structural characteristics of Air Corps and Schwarz type propeller blade retention systems under combined loads simulating service loading conditions.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated 16 December 1943.

Test	Hub	Material	Type of Blade Retention	Remarks
A	2D30	Laminated compressed maple	Schwarz	
B	2D30	Laminated compressed maple	Air Corps	
C	2D30	Laminated maple	Air Corps	
D	2D30	Laminated maple	Air Corps	Ferrule removed.
E	43K1275	Laminated maple	Air Corps	

Additional tests may be made contingent on the results obtained from the above tests.

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DAMPING OF PROPELLER-ENGINE VIBRATION

Hamilton Standard Propellers
Div.of United Aircraft Corp.
East Hartford, Connecticut
Mfg. or Activity Charged with Development

592-50
Expenditure Order No.

None
Classified Project No.

W-535-AC-38219
Contract No.

DESCRIPTION: This project consists of a series of engine torque stand test investigations to be made on five (5) different propeller blade designs installed in a Hamilton Standard hydromatic type hub. This project proposes to study the relative importance of aerodynamics and other sources of damping. The vibrations are to be excited by an external torque exciter providing known alternating torque and variable frequencies at the propeller hub. Hamilton Standard proposes to furnish the necessary propellers for these tests.

PURPOSE: To attempt to determine the changes in vibration response with air speed and thus to deduce the relative importance of aerodynamic damping forces and other damping forces incidental to the vibratory system.

AUTHORITY: Chief, Engineering Division.

REMARKS: It is believed that a considerable part of the damping for aircraft-engine-propeller vibration arises from variable air forces acting upon the propeller blades as the result of blade vibrations. If this is so, the absolute value of damping should be directly proportional to air density. With the advent of high altitude super-charged engines, a potentially serious problem is created where high engine powers and hence large vibratory excitations can be maintained at conditions of low density.

Vibration tests of a 23E50 propeller with 6179A-0 blades on a .562 geared V-1650 engine with external excitation supplied by a transitorque-driver torsional exciter have been completed. The four other tests required by this contract item will be scheduled as soon as suitable test houses and engines are available.

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PROPELLER VIBRATION DAMPER

592-51	Hamilton Standard Propellers Div. of United Aircraft Corp. East Hartford, Connecticut
Expenditure Order No.	Mfg. or Activity Charged with Development
None	W-535-AC-38219
Classified Project No.	Contract No.

DESCRIPTION: A propeller vibration damper for attachment to a Hamilton Standard hydromatic type propeller No. 33D50. This damper is designed to reduce the 4-1/2 order crankshaft torque-excited vibrations of the 6457-6 blades as used with the R-2600 engine on the XA-26A airplane. Although the device is to be built for one specific application, it is expected to be adaptable to suit other propeller-engine vibration conditions.

PURPOSE: To obtain a workable damper to be attached to propeller hubs to reduce propeller vibrations.

AUTHORITY: Chief, Engineering Division.

REMARKS: Vibration difficulties are one of the most serious problems preventing continuous satisfactory operation of the many propeller combinations used in military aircraft. Frequently one particular resonant frequency is so severe that it requires restriction on the operation of the airplane or possible complete removal of that type propeller from use on the airplane. This project attempts to develop a simple propeller damper which can be tuned to balance out this unsatisfactory condition.

This project has been successfully completed. A reduction of approximately 97% in the 4-1/2 order component of the propeller blade stress was accomplished. However, some additional development will be necessary before the device is suitable for production.

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PROPELLER-ENGINE VIBRATORY ACCELERATION TESTS

592-52
Expenditure Order No.

Hamilton Standard Propellers
Div. of United Aircraft Corp.
East Hartford, Connecticut
Mfg. or Activity charged with Development

None
Classified Project No.

W-535-ac-38219
Contract Number

DESCRIPTION: This investigation covers vibratory acceleration measurements at several significant places on propeller hubs and engine frames to determine vibration accelerations of these members at various engine speeds. It has been proposed to test five (5) different propeller-engine combinations installed in torque stands. Hamilton Standard will supply the propellers and conduct the tests and the Army will loan the engines to them.

PURPOSE: To supply information useful in the design of propeller accessories attached to the propeller and engine in order to properly design such parts to withstand these vibratory forces. Special equipment to measure vibratory accelerations for this investigation has been built. Tests have been run on three of the five engine-propeller combinations required. The engines tested were GR-1820, R-1830 and R-2800. Tests are also scheduled on the GR-2600 and the GR-3350 engines.

ELECTRONIC PROPELLER SYNCHRONIZER

593-45
Expenditure Order No.

Propeller Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This project includes development of an electronic synchronizer using the beat frequency phase rotation to determine the direction of propeller pitch change and using the absolute frequency to magnitude of the beat frequency to determine the rate of pitch change.

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The operation of most of the present engine synchronizers depends upon the differential motion obtained by the interaction of two rotating fields. Rotation of these fields may be accomplished either electrically or mechanically. The two frequencies to be compared must be at a sufficient energy level to produce a mechanical rotation proportional to the frequency difference of the two sources. This relatively high energy level requires the use of rather large alternators in most instances. The master frequency source, either engine driven or motor driven, must be powerful enough to rotate the fields of all the differential-action producing motors of the control engines.

The present type synchronizer compares two frequency sources at low energy levels and amplifies the resultant or beat frequency by an electronic means. As a master frequency it will be possible to use a low energy level source such as a vacuum tube oscillator, a mechanical oscillator, or an alternator driver by a governor controlled engine.

PURPOSE: To develop an electronic type engine synchronizer which is both light and simple and that will be suitable for use on both hydraulic and electric type controllable propellers.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project is entirely a Propeller Laboratory development with the exception of the procurement of standard parts such as vacuum tubes, wiring, etc. which are used as a part of the installation. A two-engine synchronizer was built and flight tested on an AT-11 airplane during September 1943 and found to operate satisfactorily. The two-engine model weighs approximately 9-1/2 lb. complete. The four-engine type synchronizer has been designed and present fabrication is approximately 40% completed to date. It is estimated that the synchronizer will be available for test on or about 1 March 1944.

Should this type synchronizer prove satisfactory, it is considered to have excellent production possibilities for the larger type multi-engine aircraft.

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FOUR-ENGINE TYPE PROPELLER SYNCHRONIZER

593-63
Expenditure Order No.

American Brake Shoe Co.,
Mahwah, New Jersey
Mfg. or Activity Charged with Development

None
Classified Project No.

Pending
Contract Number

DESCRIPTION: This project covers the adaptation of a synchronizing system used by the American Brake Shoe Company in the automatic braking of railway cars to synchronizing propellers of four-engine aircraft. The design is to be modified so that it will operate successfully with existing propellers and propeller controls. One of the aircraft engines will be used as a "master" source of speed and the other engines will be synchronized to it.

PURPOSE: To develop a light, simple synchronizer adaptable for use on all four-engine airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated 29 November 1943. The subject synchronizer will be similar to a twin-engine unit tested on an AT-11 airplane, during September 1943 and which operated satisfactorily. Preliminary drawings on the "four-engine" unit have been submitted by the American Brake Shoe Company. Delivery of the synchronizer is expected during the spring of 1944.

ACCELERATION SENSITIVE GOVERNOR

593-51
Expenditure Order No.

Curtiss Propeller Div.,
Curtiss-Wright Corp.,
Caldwell, New Jersey
Mfg. or Activity Charged with Development

None
Classified Project No.

W-535-ac-25996
Contract Number

DESCRIPTION: This project provides for the development and procurement of two acceleration sensitive governors (including necessary accessories) that will be used in connection with Curtiss electric type

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propellers for experimental tests on highly maneuverable airplanes. This is a new type governor which will permit elimination of cables, push rods, mechanical linkages, etc., and will be sufficiently responsive to allow high rates of pitch change without hunting or overspeeding of the engine.

PURPOSE: To improve the constant speed operation of electrically controlled propellers and to prevent engine overspeeding during rapidly changing airplane maneuvers.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Curtiss Propeller Division, Curtiss-Wright Corporation has undertaken the theoretical design of a governor that would be both speed and acceleration sensitive. The characteristics of the governor proposed would eliminate a considerable portion of the "off-on" operation of the electric pitch change motor as well as eliminate cables, push-rods, etc. A speed responsive governor can operate only when there is a deviation from the governing speed and its operation is identical regardless of the rate of change of the speed deviation. If experimental tests prove this new design to be satisfactory, a service test of a large quantity will be arranged. Delivery of the first experimental model is expected about 1 March 1944.

PRE-SELECTED SPEED GOVERNOR

593-53 Expenditure Order No.	Propeller Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: A governor having pre-selected speed settings. This device offers the advantage of pre-setting anticipated constant speed settings with propeller engine combinations. It is used in a manner similar to push button tuning on a radio. It would have a distinct advantage for use on airplanes which are radio controlled such as "flying bombs". This governor should be satisfactory for use on multi-engine airplanes.

PURPOSE: To develop a governor that will permit the selection of any one of several engine speeds.

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AUTHORITY: Chief, Engineering Division.

REMARKS: Two experimental governors of this type have been fabricated and tested by the Propeller Laboratory. Their operation was found to be satisfactory. Future plans will require the adaptation of the basic single engine model to multi-engine aircraft. Primary work on the design of the master speed source is to be accomplished by commercial organizations. The basic governing unit has been fabricated by the Propeller Laboratory and has been tested on an experimental propeller such as would be used on a "flying bomb". Subject tests were conducted in a test stand. This device will be satisfactory for use on any electric controlled propeller.

ELECTRIC REMOTE CONTROL FOR SUPERHYDROMATIC PROPELLERS

593-64 Expenditure Order No.	Hamilton Standard Propellers, East Hartford, Connecticut. Mfg. or Activity Charged with Development
None Classified Project No.	Pending Contract Number

DESCRIPTION: A control unit consisting of equipment to provide for adjustment of the constant speed governor of the superhydromatic propeller from an airplane cockpit by electrical means. The control unit will be so designed that each position or setting of the unit will correspond to some specific governor speed setting. The cockpit unit of the control will be suitable for use with either a quadrant lever or cable pulley actuating system. The propeller unit of the control will provide for a rate of constant speed control adjustment.

PURPOSE: To develop a control unit for use on propellers which will simplify the cockpit installation in operation and at the same time will provide approximate synchronization of all engines on a multi-engine airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated 8 December 1943 as a result of a proposal from Hamilton Standard Propellers, reference Hamilton Standard Propellers Proposal No. 2669. Delivery is scheduled by 1 September 1944.

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PROPELLER GOVERNOR TEST EQUIPMENT

584-45	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Propeller governor test device capable of checking the operation of propeller pitch control mechanisms incorporating reverse pitch and high rates of pitch change. With the addition of other types of speed or pressure responsive control elements such as turbo-supercharger control to the aircraft power plant system, the operation of the propeller pitch control mechanism becomes much more critical. To study propeller control problems, high-speed recording equipment is a necessity.

PURPOSE: To develop test equipment to record continuously and simultaneously, during flight, propeller variables such as pressure, speed, pitch, etc.

AUTHORITY: Chief, Engineering Division.

REMARKS: Propeller auxiliary test equipment has been designed and fabricated by the Propeller Laboratory to record the following variables as a function of time:

a. Propeller rotational speed
b. Propeller pitch
c. Oil pressure (engine, governor, and propeller)
d. Engine torque
e. Manifold pressure
f. Voltage and current of propeller electrical system
g. Position of engine controls

At the present time while the above equipment is being used experimentally, it is satisfactory for use on all but the smaller fighter aircraft. Tests are being made on propeller-governor-engine combinations to be used on experimental airplanes to determine conditions of response and stability of the governing systems during actual or simulated flight.

Refinement of the test equipment to adapt it to fighter type aircraft is approximately 70% complete.

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METHODS OF CORRECTING PROPELLER AERODYNAMIC UNBALANCE

591-34	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: A test program is being conducted to determine if propellers with blades that are barely within present tolerances can be satisfactorily dynamically balanced by "field" balancing equipment. Considerable unbalance in propellers occurs due to the blades in a given propeller being slightly different in dimensions. This unbalance causes a roughness or vibration to occur which is transmitted back into the airplane. It is desired to determine whether this unbalance condition can be corrected in the field with suitable equipment. It is thought possible that the aerodynamic unbalance can be reduced by making small adjustments in the individual blade angles (each blade will be set at an angle slightly different from the others -- an amount necessary to correct the dynamic unbalance). At the present time it is desired to increase the blade tolerances in order to speed up production. This cannot be done unless a means of rapidly correcting unbalance is found. An excessive number of man-hours is now spent on fabricating propeller blades to close tolerances. This is required to assure a propeller which will be in proper balance when assembled.

PURPOSE: To develop a method to quickly correct aerodynamic unbalance in propellers in order to permit wider tolerances in their manufacture and thereby to increase the capacity of present production facilities.

AUTHORITY: Chief, Engineering Division.

REMARKS: From past experience the Propeller Laboratory has found that in many instances supposed aerodynamic unbalance could be corrected by slightly unbalancing the propeller. The present test program has determined the maximum amount of tolerance that can be allowed in fabrication of propeller blades to avoid serious dynamic or aerodynamic unbalance. This information is to be compiled into a report.

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EFFECT OF RATE OF PITCH CHANGE
ON PROPELLER PERFORMANCE

580-215
Expenditure Order No.

Hamilton Standard Propellers,
East Hartford, Connecticut.
Mfg. or Activity Charged
with Development

None
Classified Project No.

Pending
Contract Number

DESCRIPTION: Flight test program to observe the detailed effects of rate of propeller blade angle change on propeller performance over a range of blade angle change rates from approximately 5 degrees per second to approximately 30 degrees per second. Flight tests will include execution of normal take-offs, normal and abrupt changes from level flight, normal and abrupt governor setting changes in flight, normal and abrupt throttle openings in gliding and diving flight from the closed throttle position, and airplane speed changes with fixed throttle and governor settings.

The above tests are to be conducted through use of the YA-19B airplane now in possession of the contractor. The power plant installation will consist of an R-1830 engine and a new superhydromatic type propeller model 3250. The airplane will be instrumented to include either a camera recorder or an oscillograph recorder of engine r.p.m., airplane speed, governor and throttle position, time and propeller blade angle.

PURPOSE: To obtain data with which to adjust and evaluate new propellers with rates of pitch change as high as 30 degrees per second.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated 20 December 1943. The new superhydromatic type propeller will be capable of operating over the entire range covered by these tests and necessary data will be obtained to determine the best adjustment for service airplanes. The tests shall be conducted by the use of standardized propeller operational procedures at various rates of pitch change with measurements of resultant overspeeding from the constant speed control setting.

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PROPELLER STATIC TEST EQUIPMENT

584-51
Expenditure Order No.

Propeller Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

Miscellaneous
Contract Number

DESCRIPTION: Test equipment consists of electro-magnetic means of vibrating propeller blades; a vibrating beam for vibrating parts not having sharp resonant characteristics; indicating and recording electrical equipment for vibratory stress measurements and optical equipment for measuring displacements. Equipment is mounted in sound-proof test cells.

PURPOSE: To develop laboratory static test equipment to reproduce propeller blade stresses encountered under service conditions.

AUTHORITY: Chief, Engineering Division.

REMARKS: Laboratory endurance tests of propeller blades cannot supplant testing in actual service. Neither can the results of a single laboratory test or series of tests constitute conclusive evidence as to the qualities of a particular designed blade. Factors such as surface defects, subsurface flaws, internal stresses, and stress raisers can produce such wide variations in apparent fatigue strength that definite conclusions can be reached only on a single propeller basis. Nevertheless, properly interpreted endurance tests, even of single specimens are of definite value particularly when reproduceable service conditions are simulated such as is made possible by use of this test equipment.

This equipment permits testing under controlled and reproduceable conditions which, subject to the limitations noted above, permits comparisons to be made of the relative advantages of the different blade designs. Stress distribution along the blade can be obtained on both the thrust and camber faces. These data in conjunction with information obtained from endurance tests will permit establishment of allowable stress limits at various points on different blades.

The greater part of this equipment has been received and is being operated with temporary connections. Work on the sound proof test cells and permanent wiring is progressing satisfactorily. This latter work is being done under contract.

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PROPELLER BLADE TEMPERATURE MEASUREMENT EQUIPMENT

584-68	Propeller Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Equipment will be developed that will measure and record the surface temperature of propeller blades during rotation and while the blades are being electrically heated with resistance elements used in connection with anti-icing of propeller blades. This project will include the development of a multi-position selector switch to be mounted on the propeller hub and a group of temperature sensitive resistance elements that can be mounted on the propeller blades. This equipment will be suitable for flight tests.

PURPOSE: To design, fabricate, and test equipment to measure temperature distribution on electrically heated propeller blades.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated 29 November 1943. It is expected that this equipment will aid in the design of resistance elements for anti-icing of propeller blades. Preliminary laboratory tests have shown that the accurate measurement of a small temperature rise of the blade surface resulting from the electrical and aerodynamic heating is entirely possible.

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SECTION 1

BOMBING PROJECTS

BOMB CONTROL PROJECTS

BOMB RACK PROJECTS

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TRUE AIRSPEED INDICATOR

556-301	Kollsman Inst. Company Elmhurst, N. Y.
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: A true airspeed meter is a velocity indicating instrument similar in appearance to the standard indicated airspeed meter except that it indicates true Airspeed (relative velocity between air and airplane) instead of indicated airspeed (impact pressure on pitot tube). One meter now under development is a direct reading device that has temperature, impact pressure, and static pressure inputs from which the function of true airspeed is obtained. Other true airspeed units are under development which produce torque proportional to true airspeed. The torque is either an r.p.m. function or a displacement function in order that it may be fed into automatic computing devices as aids to navigation, radar, and bombing equipment.

PURPOSE: The purpose of true airspeed meters is as follows:

(1) Provide the bombardier with the function of true airspeed and eliminate true airspeed computations.

(2) Provide the function of true airspeed to the bombardier as an aid to shorter bombing approaches.

(3) Develop true airspeed torque producing devices for automatic inputs to bombing, navigation, and radar equipment.

AUTHORITY: Chief, Engineering Division.

REMARKS: All bomb ballistic tables are based on true airspeed and true altitude. The bombardier at present must compute true airspeed and true altitude from indicated airspeed and indicated altitude before he can obtain the necessary ballistic data for dropping a bomb.

All work on instrumentation is being accomplished in close cooperation with Equipment Laboratory.

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SONIC BOMB SCORING APPARATUS

556-264 Expenditure Order No.	Engineering Laboratories, Inc., Tulsa, Okla. Mfg. or Activity charged with Development
None Classified Project No.	W 535 96-29795 Contract No.

DESCRIPTION: This apparatus consists of a number of seismometers and microphones laid out in a definite pattern in a practice bombing target area. Seismic impulses resulting from the bomb's impact activate the seismometers to start a recorder. Sonic impulses from the explosion of the bomb's spotting charge activate the various microphone in turn. The time differentials between the receipt of microphone impulses at the recorder permit accurate computation of the location of the bomb hit.

PURPOSE: To develop and standardize an accurate method for scoring of bomb hits which will have general application and which will eliminate the necessity for using the present visual and photographic methods.

AUTHORITY: This project is authorized by CTI-786 dated 15 July 1942.

REMARKS: An Experimental installation was made at Midland Bombardier's School, Midland, Texas, and has been in successful operation for a year. This land target has been standardized for planned quantity procurement. A similar water target carrier system for remote recording and a completely automatic scoring system are being installed at Eglin Field by Engineering Laboratories, Inc., under the above contract.

FULLY AUTOMATIC SONIC BOMB SCORING SYSTEM

556-289 Expenditure Order No.	Engineering Laboratories, Inc., Tulsa, Okla. Mfg. or Activity charged with Development
None Classified Project No.	W 535 AC-39745 Contract No.

DESCRIPTION: A study is being conducted by Engineering Laboratories, Inc., Tulsa, Oklahoma, to develop a completely automatic sonic bomb scoring system which would operate in conjunction with the

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basic Type E-1 Sonic Target. This equipment, when developed, would enable the receipt in final form of individual bomb scores, at a base remote from the target area. Several alternative designs are being developed on paper and evaluated against each other. Models will be constructed of the one or two best designs which will later be tested.

PURPOSE: To eliminate need for work by personnel in focusing, analyzing and interpreting sonic bomb scoring records by making available a completely self-scoring device.

AUTHORITY: CTI-786, dated 15 July 1942.

REMARKS: Engineering Laboratories, Inc., submits quarterly reports on the progress of this study which are evaluated by Armament Laboratory personnel. It is estimated that the study is about twenty-five percent complete.

TYPE T-1 BOMBSIGHT (BRITISH MARK XIV)

556-210 Expenditure Order No.	A. C. Spark Plug Division General Motors Corporation Flint, Michigan Mfg. or Activity charged with Development
MX-177 Classified Project No.	None Contract No.

DESCRIPTION: The Type T-1 Bombsight is an automatic bombsight of British design, impact predicting type, that solves horizontal, glide and climb bombing problems with automatic compensation for altitude, air speed, angle of glide or climb, altitude and airspeed variation of ballistics. The optics of the sight utilize reflex collimator principles providing maximum field of vision and night vision. Stabilization is provided about roll and pitch axes. The sight consists of two major units, i. e., sighting head and computer, interconnected by means of flexible cables. Continuously up-to-date values of dropping angle and drift angle are sent from the computer to position the sighting head when the wind vector is stabilized.

Stabilization of wind vector is obtained in two ways, first by connection of bombsight to gyro flux gate compass or British DR Compass, or second, by manual control. Interconnection of bombsight and gyro compass required magnesyn amplifier and torque repeater motor; manual controls for wind vector stabilization are supplied as a part of the bombsight. A third means of wind vector stabilization presently under development is to connect the bombsight with

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directional gyro AN-5755 modified with magnesyn transmitter by utilizing magnesyn simplifier and torque unit.

Air pressure to the computer and suction to the gyros in the computer and sighting head are supplied by a combination pressure vacuum pump with electric motor drive.

The T-1 Bombsight sighting head is usable as a manual preset device for low altitude bombing.

PURPOSE: To make provisions for installing the Type T-1 Bombsight in American Aircraft, to test the bombsights, and to develop all equipment required to insure satisfactory operation for best ability.

AUTHORITY: Chief, Engineering Division.

REMARKS: Many production changes were incorporated in the T-1 Bombsight in 1943; these changes improved accuracy, reduced cost and eliminated certain field maintenance requirements. An experimental project for further improvement of the accuracy of the T-1 Bombsight is the use of electric gyroscopes instead of the air-driven type. If this development proves to be advantageous, it will be incorporated in the production bombsight.

AUTOMATIC BOMBING COMPUTER

556-257 Expenditure Order No.	Frigidaire Division General Motors Corp. Dayton, Ohio Mfg. or Activity charged with Development
None Classified Project No.	(33-038) 44-3896-E Contract No.

DESCRIPTION: The Computer is an attachment designed for the M-Series Bombsight which solves for drift and dropping angle and automatically keeps the correct drift preset until the start of the synchronous portion of the bombing run. The device eliminates the use of detachable scales, thus saving space and making the task of the bombardier easier.

PURPOSE: To provide the bombardier with accurate preset information thus making possible a shorter bombing.

AUTHORITY: CTI-586, Add. 7, dated 14 August 1943.

REMARKS: Fabrication of the computer is nearly complete and it is expected that a model will be ready for testing in February, 1944.

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TANGENT SCALES FOR M-SERIES LOW ALTITUDE ATTACHMENT

556-257 Amend. 1	Crowe Nameplate Company Chicago, Illinois
Expenditure Order No.	Mfg. or Activity charged with Development
None	44-3899-E
Classified Project No.	Contract No.

DESCRIPTION: This project was initiated for the purpose of developing tangent scales for use with the M-Series Bombsight Low Altitude Attachment. The scales show the tangent of the dropping angle for various altitudes and various types of bombs. On the reverse side of the scales is shown values of trail for various true airspeeds, and the correct disc speed setting.

PURPOSE: To provide a means of using the low altitude attachment now in service for obtaining pre-set information at high altitudes.

AUTHORITY: CTI-586, Add. 7, dated 14 October 1943.

REMARKS: The subject scales have been subjected to Service Test and approved and are now being procured for quantity distribution. It should be noted that these scales for high altitude use are in addition to the ones now in use for low and medium altitude bombing.

SAFETY CUT-OUT FOR FLIGHT GYRO

556-240	Minneapolis-Honeywell Reg. Co., Minneapolis, Minn.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-169	(W-535-AC-28969)
Classified Project No.	Contract No.

DESCRIPTION: This item is an attachment to the vertical flight gyro used with the C-1 Automatic Pilot. It functions to electrically disconnect the entire automatic pilot whenever the attitude of the airplane in which this equipment is installed exceeds a pitch or roll angle of 45 degrees.

PURPOSE: To provide the standard Type C-1 Automatic Pilot with an additional safety feature.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated in March, 1942. One experimental article has been fabricated and it is anticipated that results of contractors tests will be available sometime in January, 1944.

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INTERCONNECTION OF C-1 AUTOMATIC PILOT AND HOMING DEVICE

556-265
Expenditure Order No.

Minneapolis-Honeywell Regulator Company, Minneapolis, Minnesota
Mfg. or Activity Charged With Development

MX-169
Classified Project No.

None
Contract No.

DESCRIPTION: This project deals with the development of a device to be used in conjunction with the Type C-1 automatic pilot, which will guide an airplane to its station. Directing signals from the ship's radio compass are transmitted to the C-1 automatic pilot which will fly the ship along the homing course as shown on the radio compass indicator.

PURPOSE: To develop a device which will automatically guide a plane to a station.

AUTHORITY: Request of Commanding General, Air Service Command.

REMARKS: One item has been installed and flight-checked in an AT-11 airplane, with very successful results. Further testing is contemplated after which the unit will be returned to Minneapolis-Honeywell for evaluation and further development.

AUTOMATIC PREDICTING PILOT'S BOMBSIGHT

556-292
Expenditure Order No.

Armament Laboratory. Massachusetts Institute of Technology, Cambridge, Massachusetts.
Mfg. or Activity Charged With Development.

MX-402

None
Contract No.

DESCRIPTION: This project aims at the development of an automatic pilot's bombsight based on the use of rate gyros similar to those used on Mark XIV and Mark XV anti-aircraft directors, used by the U. S. Navy. The sight is fully automatic and all that is required of the pilot is to keep the cross hairs on the target until the initial sighting error is corrected, then drop the bomb.

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A Mark XIV sight was modified to make a test bombsight, but the size and arrangement of parts are not suitable for airplane use and are not indicative of the final shape of a sight based on the principles tested.

PURPOSE: To develop an automatic type of pilot's bombsight.

AUTHORITY: Chief, Engineering Division.

REMARKS: This test sight was used to drop a total of 60 bombs, eighty percent of which have fallen within five mils short and fifteen mils over the target. The errors within this range are systematic and are dependent upon second order corrections of attacker's air speed and in the case of moving targets, slant range. The service of Dr. Draper, a member of the Aeronautics Branch, Division of Industrial Corporation, Massachusetts Institute of Technology, have been obtained for development work on the sight and work is now in progress to determine optimum form of packaging of said sight and methods of installation.

HORIZONTAL GLIDE BOMBSIGHT

556-266
Expenditure Order No.

Specialties Company,
Locust Valley, Long Island, N.Y.
Mfg. or Activity Charged With Development.

MX-437
Classified Project No.

NXS-11968
Contract No.

DESCRIPTION: This project covers the development and testing of a gyro-stabilized, impact predicting automatic type of bombsight. Automatic features include an altitude computer, true airspeed indicator and directional gyro device, all of which are separate units connected to the bombsight proper by torque tubing drive. Operation of the sight requires that wind speed, wind velocity and trail be set into the sight manually but other data including airspeed and altitude are set in automatically by their respective mechanism.

PURPOSE: To develop an automatic type of bombsight which may be used for horizontal, glide and night bombing.

AUTHORITY: Purchase Order was negotiated under Authority of first War Powers Act 1941 and Executive Order No. 9001, dated 27 December 1941.

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REMARKS: One item was delivered in June 1943 along with two similar types which are to be operated manually. The automatic sight is now being installed in a B-17 airplane and flight tests will follow as soon as the installation is completed.

AUTOMATIC GYRO LEVELING DEVICE

556-286 Expenditure Order No.	Minneapolis-Honeywell Regulator Company, Minneapolis, Minnesota Mfg. or Activity Charged With Development.
None Classified Project No.	None Contract No.

DESCRIPTION: The Minneapolis-Honeywell Regulator Company automatic type gyro leveling system consists primarily of two (2) mercury switches, one (1) each on the fore and aft lateral axes of the sight. Movement of the sight from the level position in any direction causes the mercury to flow and make a contact, initiating a correction of the gyro which continues until the mercury returns to level, thus breaking the contact. The system is put into operation by uncaging the gyro in level flight at the outset of the bombing run and turning on the high rate switch for three or four seconds until the sight is nearly level. The high rate switch is then released and operation is automatic thereafter. The system cuts out automatically when the P.D.I. needle goes more than three-fourths of a degree off-center or it may be cut out entirely by a manual switch.

PURPOSE: To develop a device to provide a fast, automatic leveling of the M-series bombsight vertical gyro.

AUTHORITY: C.T.I. 1263 dated 2 April 1943.

REMARKS: This item has been service-tested by the Second Air Force, the Naval Proving Ground, the Eighth Air Force and the Air Forces Proving Ground Command. Results of these tests in all cases indicate that the A.G.L.D. is somewhat unsatisfactory in that it causes the gyro to "hunt", thus making accurate synchronization difficult. In spite of this unsatisfactory characteristic, the Eighth Air Force has ordered a considerable number of bombsights equipped with this item, apparently to utilize the fast erection rate. Further development work is still in progress in an effort to eliminate undesirable characteristics.

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SERVO UNIT FOR C SERIES AUTOMATIC PILOT

556-242
Expenditure Order No.

Minneapolis-Honeywell Regulator Company, Minneapolis, Minnesota
Mfg. or Activity Charged With Development.

MX-169
Classified Project No.

W-535-ac-29578
Contract No.

DESCRIPTION: Design of this equipment will be similar to the Servo units now used with the Type C-1 automatic pilot. The added features will include the following:

a. Units will be operable in any position.

b. Will be dust and moisture proof.

c. Operable throughout temperature range from minus 60 to plus 170°F. and at atmospheric pressures from sea-level to 40,000 feet.

d. An automatic disconnector device between the pilot drive gear and the cable drum.

e. Increase of cable pull to two-hundred and twenty-five (225) lbs.

PURPOSE: To obtain a servo motor capable of meeting both current and future aircraft requirements.

AUTHORITY: Chief, Engineering Division.

REMARKS: An Authority for Purchase was initiated in April 1943. Progress on this equipment has proceeded rather slowly, due partly to the fact that work has been held up in favor of projects holding a higher priority. However, delivery of this item has been promised for January, and, in addition, a larger servo capable of a pull not exceeding four-hundred (400) lbs. for use as a rudder servo for future large airplanes, has been promised for the same date.

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SPIRAL GLIDE BOMBING STUDY

556-283	Sperry Gyroscope Co., Brooklyn, New York.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-371	W-535-ac-38861
Classified Project No.	Contract No.

DESCRIPTION: Spiral glide bombing is the technique whereby a pilot flies a controlled path by keeping the sight line on the target. The sight is depressed some predetermined angle from the flight line. This angle in the airspeed defines the altitude (above target) of the proper point of bombing release. It is anticipated that the automatic bomb release computer which will release bombs automatically at the proper release point may be used in conjunction with this system of bombing. It is anticipated that a variable type reflector bomb and gunsight may be used in this technique.

PURPOSE: To provide the most simple and efficient means of accomplishing the purpose as outlined in the description above and to prepare letters of instruction covering this type of bombing.

AUTHORITY: Chief, Engineering Division.

REMARKS: The subject technique appears to have much greater flexibility of operation than either dive or minimum altitude bombing, and was first investigated by the First Composite Squadron at Key Field, Meridian, Mississippi, in April 1942. This bombing system may be applicable to pursuit and fighter airplanes and light bombardment aircraft. The pilot combination bomb and gun sight was developed in August 1942 for possible application to this type of bombing.

Preliminary designs were investigated by the Armament Laboratory, and the problem was discussed with representatives of the Minneapolis-Honeywell Regulator Company and the Sperry Gyroscope Company in October 1942. This discussion covered the automatic bomb release computer also. Final arrangements for production of prototype units were made with the Sperry Gyroscope Company in March 1943 with expected delivery during January 1944. The Minneapolis-Honeywell Regulator declined to go into this development work because of other activities. The Pioneer Instrument Division of Bendix Aviation Company have expressed an interest in developing equipment along this line, and have brought forth some promising ideas on the subject. At present, no action is being taken on this project pending results of tests on Project MX-402, the Automatic Predicting Pilot's Bombsight.

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DIVE BOMBING STUDY

556-295 Expenditure Order No.	Specialties Company, Locust Valley, New York. Mfg. or Activity Charged With Development.
MX-246 Classified Project No.	None Contract No.

DESCRIPTION: This project covers primarily, the development of special automatic sighting and/or automatic bomb release devices for dive bombing, consistent with the tactics and technique involved.

PURPOSE: To develop facilities for improving dive bombing accuracy and range of application.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was initiated in July 1942. A study was made of the principles involved, special corrections for bomb trail and relative effect of vertical and horizontal velocities resulting from the pull-out operation. Tests were initiated to obtain the basic data relative to dive bombing as a result of a conference between representatives of the Armament Laboratory, Aircraft Laboratory, and the Ordnance Department and Aberdeen Proving Grounds in December 1942. These tests are now nearly one hundred percent complete and confirm the validity of the underlying principles of dive sights.

TIME UNTIL RELEASE INDICATOR

556-257, Amend. 1 Expenditure Order No.	Leland Electric Co., Dayton, Ohio. Mfg. or Activity Charged With Development.
None Classified Project No.	None Contract Number

DESCRIPTION: This item is an electrical bridge installation with two microvoltmeters calibrated in units of time. It attaches to the M-series bombsight and operates automatically to show the amount of time left in the bombing run before bomb release. Such a device is needed for the proper planning of the bombing run and for utilization of evasive action.

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PURPOSE: To provide the pilot and bombardier with an indicator which will show the amount of time remaining in the bombing run just prior to the instant of bomb release.

AUTHORITY: Chief, Engineering Division.

REMARKS: A timing attachment conforming to the above description is now being developed by the Leland Electric Company, and a model is expected for service test some time in February, 1944.

BOMB LIFT FOR FIGHTER AIRCRAFT

552-513 Expenditure Order No.	Acme Pattern & Tool Co., Dayton, Ohio. Oliver Farm Equip. Mfg. Co., Springfield, Ohio. Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-27321-E (33-038) 44-1279-E Contract No.

DESCRIPTION: A bomb lift is being developed to raise standard AN bombs to the wing and belly racks of fighter aircraft. The bomb lift will also be capable of raising bombs, up to and including the four thousand pound size, and torpedoes to the wing racks of large bombardment type airplanes. The design includes a means of obtaining fore and aft inclination of the bomb to compensate for the inclination of the shackle hooks and a means of raising the bomb directly from the ground.

PURPOSE: To provide a means of raising bombs to both the wing and belly carrying positions on fighter and bombardment type aircraft.

AUTHORITY: The project was initiated in accordance with CTI-1038, dated 21 November 1943.

REMARKS: At the present time there is in the process of fabrication both a hydraulic and manually operated unit. The hydraulic unit manufactured by the Acme Pattern and Tool Company has undergone some experimental tests and returned to the company for modifications. The manually operated lift manufactured by the Oliver Farm Equipment Company is nearing completion and tests are expected to be conducted in the near future.

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REDUCTION IN WEIGHT OF BOMBING EQUIPMENT

552-514	Armament Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
MX-345	None
Classified Project No.	Contract No.

DESCRIPTION: Bomb rack equipment of lighter weight is desirable from many standpoints. Investigation is in progress to determine whether weight reductions in bomb racks and related equipment will result if safety factors are reduced from the present value of seven to a factor of four. Bomb rack rails, carrying hooks, latches, and mounting bolts are being studied with a view to arriving at reduced weights of each individual item as a result of the reduced load factors.

PURPOSE: To investigate the possibility of carrying bombs in Army Air Forces airplanes with the expenditure of the least possible dead weight equipment when load factors are reduced from seven to four.

AUTHORITY: Chief, Engineering Division.

REMARKS: The bomb racks of the various bombardment airplanes will be individually investigated from the structural standpoint, and new designs on the basis of the new factors will be developed. Upon fabrication of the bomb racks they will be subjected to static test with a view to structurally proving the feasibility of the new designs. The B-24 airplane bomb racks are now in process of investigation. Others will follow shortly.

AN-MK51 BOMB RACK MODIFIED FOR WEIGHT REDUCTION

552-526	See REMARKS
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The desired rack is one similar in function and application to the present standard AN-MK51 bomb rack but of lower factors and lighter weight. Two distinct designs are being developed, one

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with factors of 12g, 5g, and 3g and the other of 17,000 pounds maximum, respectively. The designs will be investigated for possible saving in weight resulting from deletion of bomb hoist brackets which are at present integral with the AN-MK51 bomb rack.

PURPOSE: To develop a bomb rack of adaptability equal to that of the AN-MK51 bomb rack but of lighter weight in order to provide for bomb rack installations with the least expenditure of dead weight.

AUTHORITY: Chief, Engineering Division.

REMARKS: To date three designs have been submitted for test. One design each from the Pollack Mfg. Company, International Register Company and the National Machine Products Company. Drawings of the designs by George H. Leland and the Ainsworth Mfg. Company have been received and the racks are in the process of fabrication. After receipt of all samples from the several contractors and required testing is accomplished comparisons will be made between these designs and the present standard AN-MK51 bomb rack. A recommendation for the adoption of the most satisfactory design will be made.

The manufacturers interested in this development are:

G. H. Leland, Dayton, Ohio.
Ainsworth Mfg. Company, Detroit, Michigan.
Pollack Mfg. Company, Arlington, New Jersey.
International Register Company, Chicago, Illinois.
National Mach. Prod. Company, Los Angeles, California.

ALL-ELECTRIC BOMB RACK SYSTEM

552-1-479 Expenditure Order No.	See REMARKS Mfg. or Activity charged with Development
None Classified Project No.	W-535-ac-34913 (535) 43-11268-E W-535-ac-35075 (535) 43-21990-E (535) 43-24513-E Contract No.

DESCRIPTION: The all-electric bomb rack system is based upon the use of the Type A-4 bomb rack release, which is operated one hundred

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percent electrically. The release is designed to withstand all types of shock and vibration so that the locking of the individual units is not necessary. Normal selective release is obtained in a manner comparable to that now existent for the semi-electrical bombing system dependent upon A-2 releases. Salvo release is obtained through an external circuit separate from that utilized for selective release. The indicator light circuit in the A-4 release is used as a means of control during salvo to insure safe release for the tail fuze of the bomb. Nose arming is accomplished with an A-2 bomb arming control.

PURPOSE: To provide a bomb rack system which is dependable, sturdy, and free from constant maintenance.

AUTHORITY: Chief, Engineering Division.

REMARKS: A B-24E and B-25H airplane have been equipped with the all-electric bomb rack system including A-4 releases of the latest development and sent to Eglin Field for tests. Results of these tests plus tests conducted by the Armament Laboratory indicated that the all-electric bomb rack system offers a more satisfactory method for efficient bombing. Coordination to the extent of incorporating this system in production airplanes is now in progress. At present the B-24E airplane mentioned above is undergoing winterization tests.

The manufacturers interested in this development are:

George H. Leland, Dayton, Ohio.
P. R. Mallory & Co., Indianapolis, Indiana
Crosley Corporation, Cincinnati, Ohio
Sparks Withington Company, Jackson, Michigan

BOMB RACKS FOR RELEASING PARACHUTE FRAGMENTATION BOMBS

552-508 Expenditure Order No.	See "REMARKS" Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-32098-E (535) 43-32097-E (535) 43-31371-E Contract Nos.

DESCRIPTION: Parachute fragmentation bomb racks are for use in all types of airplanes. Three designs are necessary and are designated as

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Type R-1, Type R-2, and the third which has not yet been assigned a type number. The Type R-1 rack carries eight bombs (parachute or stabilized) in a horizontal position and is applicable to airplanes with shallow bomb bays, such as the A-30C, A-20G, A-20H and A-26B. The Type R-2 rack which carries 12 bombs (parachute only) in the vertical position is for deep bomb bays such as that in the B-25, B-26 and larger bombardment airplanes. The third design which is for external installation on fighter airplanes carries eighteen bombs (parachute or stabilized) in a horizontal position. The Type R-1 rack is supported in the bomb bay by means of an adapter bolted to the bomb bay structure. The Type R-2 rack is hung from the conventional bomb rack stations. The fighter rack is carried externally on any station which can accommodate a 500 pound bomb. One short impulse will release any length of train until the bomb bay is empty. The fighter rack is designed to result in a short impulse releasing six bombs in train or delayed impulse releasing all eighteen bombs from the rack.

PURPOSE: To develop bomb racks for various type airplanes which will satisfactorily release parachute fragmentation bombs from fifty-foot altitude and flying at speeds of 350-400 m.p.h.

AUTHORITY: This project was authorized by CTI-953, dated 9 October 1942.

REMARKS: Service test quantities of the three racks have been fabricated and tested at Eglin Field. Certain modifications are being made to the Type R-1 rack and the fighter racks and additional tests will be conducted at both Wright and Eglin Fields to evaluate these improvements.

The manufacturers interested in this development are:

Variety Aircraft Corporation, Dayton, Ohio
Acme Pattern & Tool Company, Dayton, Ohio
Frigidaire Corporation, Dayton, Ohio
Brunhoff Mfg. Company, Cincinnati, Ohio

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SECTION 2

FIRE CONTROL PROJECTS

FIRE CONTROL

GUN PROJECTS

ACCESSORIES PROJECTS

GUNSIGHT PROJECTS

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SECTION 2

FIRE CONTROL PROJECTS

GUN SIGHT PROJECTS (continued)

TURRET PROJECTS

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SECTION 2

FIRE CONTROL PROJECTS

(Continued)

GUN MOUNT PROJECTS

REMOTE CONTROL PROJECTS

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AUTOMATIC GUN COMPENSATOR INSTALLATION IN A-20A AIRPLANE

554-120
Expenditure Order No.

L.A.B. Corporation,
Summit, New Jersey
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: An automatic compensating sight for forward firing guns which incorporates a stadia line range approximator and from the range thus determined elevates gun the required amount. Also includes compensation for a change in angle of attack of the airplane due to a change in indicated air speed. Being installed in A-20A airplane No. 39-725 for control of M9 gun.

PURPOSE: The purpose is to determine the suitability of a compensating gun sight of this nature for forward firing guns of the larger calibers in providing accurate fire at aerial and ground targets at extended ranges.

AUTHORITY: Chief, Engineering Division.

REMARKS: The automatic gun compensator was originally installed in A-20A airplane No. 39-725 and A-20B airplane No. 42-2672. While under tests in the latter airplane at Eglin Field the ship was crash landed and placed in Class 26. The results of the tests so far conducted indicate that the sight has a number of advantages and the resumption of the tests was requested by the testing personnel.

L.A.B. No. 5 SIGHT

554-187
Expenditure Order No.

L.A.B. Corporation,
Summit, New Jersey.
Mfg. or Activity Charged with Development

None
Classified Project No.

W-535-AC-20111
Contract No.

DESCRIPTION: The L.A.B. No. 5 sight covered by this project has been designed for use in B-25G and A-26B airplanes with the 75 mm. gun. The computer calculates and deflects the sight line the correct amount to compensate for ballistic deflection.

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PURPOSE: The sight was designed to provide fire control for the 75 mm. gun.

AUTHORITY: Chief, Engineering Division.

REMARKS: Delivery of first experimental item is expected by 6 January 1944. It is to be installed in a B-25G and suitable tests are to be run.

CALIBER .60 AIRCRAFT GUN DEVELOPMENT

555-543	Ordnance
Expenditure Order No.	Mfr. or Activity Charged with Development
MX-440	None
Classified Project No.	Contract No.

DESCRIPTION: The caliber .60 weapon is designed specifically for aircraft installation. Due to its 1200 grain projectile being driven at velocities in excess of 3400 feet per second its use should effectively extend the present combat range for both bomber defense and fighter type aircraft. The gun mechanism is based on the Mauser action and the caliber and velocity of the projectile are logical improvements over the present caliber .50 weapon.

PURPOSE: To study the problems attendant to the installation of the caliber .60 weapon in aircraft and to disseminate information regarding the weapon and its installation to the industry. Also to provide a universal mount for the weapon in the form of an adjustable cradle which can be made as part of the gun.

AUTHORITY: Chief, Engineering Division.

REMARKS: The caliber .60 gun in its present form will weight approximately 120 pounds. A small weight increase will result from the installation of the built-in automatic charger, alternate stand by charger, solenoid, and gun heater. The overall length of the gun is 89 inches with a barrel length of approximately 50 inches. Bore cooling attachments are under development as are flexible feed chuting and ammunition boosters. In order to provide a more satisfactory aircraft mount an attachment to the gun in the form of an adjustable type cradle with conveniently located bolting facilities so that to install the gun it may be merely bolted in place.

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AUTOMATIC GUN COMPENSATOR INSTALLATION IN A-20A AIRPLANE

554-120 Expenditure Order No.	L.A.B. Corporation, Summit, New Jersey Mfg. or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: An automatic compensating sight for forward firing guns which incorporates a stadia line range approximator and from the range thus determined elevates gun the required amount. Also includes compensation for a change in angle of attack of the airplane due to a change in indicated air speed. Being installed in A-20A airplane No. 39-725 for control of M9 gun.

PURPOSE: The purpose is to determine the suitability of a compensating gun sight of this nature for forward firing guns of the larger calibers in providing accurate fire at aerial and ground targets at extended ranges.

AUTHORITY: Chief, Engineering Division.

REMARKS: The automatic gun compensator was originally installed in A-20A airplane No. 39-725 and A-20B airplane No. 42-2672. While under tests in the latter airplane at Eglin Field the ship was crash landed and placed in Class 26. The results of the tests so far conducted indicate that the sight has a number of advantages and the resumption of the tests was requested by the testing personnel.

L.A.B. No. 5 SIGHT

554-187 Expenditure Order No.	L.A.B. Corporation, Summit, New Jersey. Mfg. or Activity Charged with Development
None Classified Project No.	W-535-AC-20111 Contract No.

DESCRIPTION: The L.A.B. No. 5 sight covered by this project has been designed for use in B-25G and A-26B airplanes with the 75 mm. gun. The computer calculates and deflects the sight line the correct amount to compensate for ballistic deflection.

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INSTALLATION OF A 105 MM CANNON IN
MEDIUM BOMBARDMENT AIRPLANES

427-33
Expenditure Order No.

Armament Laboratory
Mfg. or Activity Charged with Development

MX-470
Classified Project No.

None
Contract Number

DESCRIPTION: To accomplish the installation and tests of a 105 mm. gun in a medium or light bombardment airplane.

PURPOSE: To determine the practicability of the 105 mm. gun as an aircraft weapon.

AUTHORITY: CTI 1053 dated 1 December 1943.

REMARKS: Preliminary investigation of the B-25 and A-26 airplanes indicates that the latter is preferable from the standpoint of space available for the gun and ammunition. The Ordnance Department is developing a lightweight 105 mm. gun, which will be delivered in the early part of 1944.

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20 MM GUN INSTALLATION in P-51 TYPE AIRPLANES

553-566
Expenditure Order No.

Armament Laboratory
Mfg. or Activity Charged with Development

MX-454
Classified Project No.

None
Contract Number

DESCRIPTION: Engineering and installation of four caliber .50 guns interchangeable with four light weight 20 mm. guns in the wings of a P-51 type aircraft.

PURPOSE: To obtain a satisfactory interchangeable installation of 20 mm. and .50 caliber guns.

AUTHORITY: Assistant Chief of Staff "E" by letter to Chief, Engineering Division, Materiel Command dated 26 March 1943.

REMARKS: North American Aviation, Inc., has completed a design study of such an installation in both the P-51D and P-51H type airplanes. These studies have not been approved owing to the fact that the contractor feels it necessary to employ feed chutes of fanwise character which are generally conducive to poor functioning of

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the feeders. Firing tests are scheduled at an early date using a mock wing section to evaluate feed chutes and mounts after which necessary modifications will be incorporated in the wing sections of XP-51F and possibly P-51D airplanes.

T20E1 GUN IN NOSE OF A-20 AIRPLANE

553-492
Expenditure Order No.

Armament Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Installation and testing of T20E1 (M-9) gun in the nose of an A-20A airplane.

PURPOSE: To provide an airplane installation for the purpose of permitting air firing of the T20E1 gun as a basis for its standardization.

AUTHORITY: Chief, Engineering Division.

REMARKS: Following initial test at Eglin Field the T20E1 gun was replaced by a production M9 gun and minor modifications were made to the installation. The airplane was then returned to Eglin Field for final tests.

PACKAGE .50 CALIBER GUNS FOR B-24 AIRPLANES

553-605
Expenditure Order No.

Armament Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: To study the possibilities and if necessary the installation of four caliber .50 package guns on B-24 type aircraft.

[redacted]

[redacted]

PURPOSE: To provide fixed forward firing caliber .50 machine guns on the B-24 type airplanes.

AUTHORITY: CTI-1479, dated 22 October 1943 from Deputy Chief of Staff.

REMARKS: Prototype installation is being coordinated with Miscellaneous Equipment Branch, Air Service Command at Patterson Field.

EIGHT .50 CALIBER GUN INTERCHANGEABLE NOSE
for B-25 AIRPLANES

553-609
Expenditure Order No.

North American Aviation, Inc., Inglewood, California
Mfg. or Activity Charged with Development

None
Classified Project No.

W-535-AC-30478
Contract Number

DESCRIPTION: To develop, test and approve an eight caliber .50 nose gun installation which is interchangeable on B-25C, D, G, H, and J airplanes in accordance with TI-1571.

PURPOSE: To provide an alternate armament nose for B-25 series airplanes.

AUTHORITY: Letter dated 15 November 1943 from Chief, Development Engineering Branch, AC/AS-M.M. and D.

REMARKS: The North American Aviation is proceeding with engineering and fabrication of the first installation.

A-20G MODIFICATION for NIGHT FIGHTER

553-588
Expenditure Order No.

Armament Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: The installation of six forward firing caliber .50 machine guns on modified A-20G type aircraft to be used as night fighter airplanes.

[redacted]

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PURPOSE: To provide an armament installation in accordance with CTI-1406 as the nose compartment forward of Station Zero was needed for other equipment.

AUTHORITY: CTI-1406, dated 24 July 1943 from Deputy Chief of Staff.

REMARKS: Prototype installation was accomplished on A-20G-10 airplane No. 42-54053 and satisfactory test results are reported in Eglin Field Report No. 2-43-109 dated 26 November 1943. The airplane type was established as P-70B airplane. Additional modifications are being accomplished at Chicago and Southern Modification Center, Memphis, Tennessee.

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37 MM AUTOMATIC GUN CHARGER

553-413	Bendix Aviation Corp., South Bend, Indiana
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(535) 42-13050
Classified Project No.	Contract Number

DESCRIPTION: An automatic hydraulically operated charging and loading mechanism for the M-4, 37 mm. gun. This charger is to operate automatically when the trigger switch is depressed. If the gun fails to fire the charger will operate and firing will continue provided that the stoppage is such that it can be cleared by a charger.

PURPOSE: To increase the available fire power of the 37 mm. gun.

AUTHORITY: Chief, Engineering Division.

REMARKS: A Bendix automatic hydraulic charger for 37 mm., M-9 gun has been delivered and is to be tested at Eglin Field on an M-9 gun installed in an A-20C airplane to determine its functional characteristics and to determine its suitability for use in other installations.

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DEVELOPMENT OF FLEXIBLE CASE EJECTION

CHUTE AND ADAPTER

553-415 — Expenditure Order No.

Seeger Refrigerator Co., — Mfg. or Activity Charged with Development

None — Classified Project No.

(33-096) 44-1639E — Contract Number

DESCRIPTION: Flexible case ejection chuting and adapters are being developed to direct ejected cases into boxes or containers in bombardment aircraft to avoid spilling them onto the floor or into vital machine parts. The chuting consists of octagonal articulated sections with eight stainless steel leaf springs per section placed on the interior to provide a smooth flow of cases from the gun to the box when the gun is at any attitude. This chuting is such that the cases will pass when the chute is flexed to any shape within its physical limits providing a slight slope downward is maintained.

PURPOSE: To develop equipment to aid in the collection of cases and links in bombardment aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Eight versions of adapters have been tested in connection with the flexible case ejection chuting. The last tested showed very promising results and was forwarded to Army Air Forces Proving Ground for acceptance tests.

UNIVERSAL LINK CHUTE

553-465 — Expenditure Order No.

Armament Laboratory — Mfg. or Activity Charged with Development

None — Classified Project No.

None — Contract Number.

DESCRIPTION: A chute assembly in four parts consisting of chute mouth (incorporating the front lip of the chute, stripper and rear stop), chute of varying radii, flexible chute flange and American Brass Company Type CE-2 flexible link ejection chute.

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PURPOSE: To provide a standard chute of known performance in order to eliminate the jams and troubles being caused by variations in manufacturing of fabricated chutes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Models were made up and forwarded to Chief, Ordnance, but were refused on grounds that a short round device (right near cartridge stop) could not be used. In order to expedite the project, an adapter not including the stripper was designed, tested and standardized but since the former type had features not practicable in the type standardized (Type M-1), work is continuing on the incorporation of a short round device in the adapter which has the link stripper as an integral part.

FAIRCHILD 37 MM COMPUTER

554-206 Expenditure Order No.	Fairchild Aviation Corp., New York, New York. Mfg. or Activity Charged with Development
MX-326 Classified Project No.	(535) 43-13125-E Contract Number

DESCRIPTION: This project covers the development of a 37 mm. compensating sight similar to the K-8 sight. Shaft connections and gearing will be supplied as required to adapt the sight to "aided tracking".

Compensation will be provided for the following conditions of fire:

Altitude	3,000 to 40,000 feet
IAS	175 to 325 m.p.h.
Range	200 to 1600 yards
All azimuth and zenith distances	
Relative velocity	0 to 150 m.p.h. in any direction with a maximum tracking rate of 20° per second. The maximum deflection of the sight provided will be 15°.

PURPOSE: To obtain a compensating sight for a 37 mm. upper turret.

AUTHORITY: Chief, Engineering Division.

[redacted]

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REMARKS: A change has been made in the method of computing lead. Lead is to be derived from precession of gyroscopes from sight line. Original method was from velocity generators. Construction is approximately 25 per cent completed.

K-9 COMPUTING SIGHT

554-217
Expenditure Order No.

Sperry Gyroscope Co., Inc., Garden City, N.Y.
Mfg. or Activity Charged with Development

M-91-40
Classified Project No.

W-535-AC-37870
Contract Number

DESCRIPTION: The K-9 sight is similar to a K-3 sight with the sight head separated from the computing mechanism and actuated by a servo mechanism.

PURPOSE: This sight was designed to provide a compensating sight which can be installed where space limitations prohibit the use of a K-3 gun sight.

AUTHORITY: Chief, Engineering Division.

REMARKS: The K-9 sight has been installed in a Type A-3E Martin upper turret and production installations are to start early in 1944.

The Bendix upper turret is being experimentally redesigned to accept either the K-9 or British Mark IIC gyro gun sight.

K-10 and K-11 SIGHTS

554-219
Expenditure Order No.

Sperry Gyroscope Co., Inc. Brooklyn, New York
Mfg. or Activity Charged with Development.

MX-359
Classified Project No.

W-535-AC-38339
Contract Number

DESCRIPTION: The K-10 and K-11 gun sights are slightly smaller than a six inch cube less the reflector glass. The solution is

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based upon the "Own-speed" principle with a special allowance made for an average curve of a pursuit. The proper gravity drop for 600 yards range is set into the sights and this value varies with the cosine of the angle of elevation of the guns. The K-10 sight was designed for a nose cone. Both sights compute the proper lead based upon the above principle within a 120° included cone with the flight path of the airplane as axis.

PURPOSE: To provide small compensating sights for use in nose and tail positions where there is not sufficient room for a fully compensating sight. The K-11 sight is especially useful in the nose cone since no angular rates are required because the solution is based upon gun position and speed of the gunner's own airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: A K-11 sight mounted in an Emerson Nose Turret has been tested by the Army Air Forces Proving Ground Command and the latest information from that Command indicates that the sight operates satisfactorily. The first production K-11 sight will be delivered to the Army Air Forces in January 1944.

K-12 SIGHT

554-217	Sperry Gyroscope Co., Brooklyn, New York.
Expenditure Order No.	Mfg. or Activity Charged with Development
191-40	AFP 374-050 (No Contract)
Classified Project No.	Contract Number

DESCRIPTION: The K-12 gun sight is an automatic mechanical computing sight for turrets utilizing indicated air speed, altitude, range, gun azimuth, gun elevation, in computing ballistic deflection and time of flight, altitude and tracking rate for prediction deflection. It is lighter, smaller and should be more accurate than the K-3 and K-9 sights.

PURPOSE: To replace the K-3 and K-9 sights with an accurate stop gap until a gyro computing sight is available for use in turrets.

AUTHORITY: Assistant Chief of Staff, O.C. and R.

[redacted]

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REMARKS: Procurement of this sight has been initiated by direction of O. C. and R. even though a test article has not yet been approved.

LIGHT WEIGHT GYRO GUN SIGHT

554-251
Expenditure Order No.

Fairchild Aviation Corp.,
New York, New York
Mfg. or Activity Charged with Development

MX-429
Classified Project No.

(W3-038) 44-2422E
Contract Number

DESCRIPTION: The Light Weight Gyro Sight is an outgrowth of the Fairchild K-8 computer. It computes ballistic deflections electrically and is much lighter and simpler than the K-8. The gyro is utilized to calculate the tracking rate for prediction and to stabilize the turret in which the sight is installed.

PURPOSE: To develop a compensating sight which computes lead from rate of movement of sight line in space operating from 400 cycle alternating current source to reduce weight.

AUTHORITY: Chief, Engineering Division.

REMARKS: The sight has provision for automatic range input and will incorporate a method of stabilizing the Martin A-3D turret. Construction 95 per cent complete October 1943. Delivery schedule on or about 1 January 1944.

MODIFICATIONS OF BRITISH MK. IIC GYRO GUN SIGHT

554-1-166
Expenditure Order No.

Sperry Gyroscope Co.,
Garden City, New York.
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: The British Mk IIC gyro gun sight is a deflection type type turret compensating sight which computes lead by use

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of a dome type gyroscope and computes ballistic corrections electrically. Corrections are varied as functions of indicated air speed, altitude, range and direction of fire. The sight utilized a collimating optical sight head which allows binocular vision of the target. This sight as built for the Navy is known as the Mk 18. The Mk 18 sight with modifications can be used as a pursuit sight.

PURPOSE: To provide alternate or standard turret and pursuit sights of increased accuracy to ranges of 800 yards.

AUTHORITY: CTI-938, dated October 4, 1942.

REMARKS: The Mk IIC was designed by the British for Caliber .303 ballistics and was modified by them to give satisfactory ballistic compensation for caliber .50 machine guns. It was tested using cal. .50 ballistics at Eglin Field in comparison with K-3 and K-4 sights during August and September 1943 with results favorable to the Mk IIC sight. Laboratory tests were required and these are being conducted at Sperry; gyroscope deflections using various current values and rates of turn are being determined. The Navy Mk 18 sight is now in production for the Navy and six units have been procured for the Air Force tests. Trial installation of one Mk 18 sight in a Martin A-11-S turret is underway at the Glenn L. Martin Company and an installation in a Bendix upper turret will be made by Bendix Products Division. Installation of the Mk 18 with modifications in Army pursuit aircraft is being engineered and quantity procurement has been initiated. A prototype Mk 18 pursuit installation will be tested in the near future.

The British have made several hand-made models of the Mk IIA fixed pursuit sight which embodies the features of the MK IIC except that azimuth and elevation potentiometers are not required and all control units are built into the sight head. It is planned to test a prototype model MK IIA sight in a pursuit installation.

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COMPUTING SIGHT FOR HAND HELD GUNS

554-259 Expenditure Order No.	Sperry Gyroscope Company Brooklyn, New York. Mfg. or Activity Charged with Development
MX-459 Classified Project No.	None Contract Number

DESCRIPTION: This sight which has been designated the Type K-13 Gun Sight is being designed for use on hand held caliber .50 guns. The solution is based upon the same "Own-Speed" principle that the K-10 and K-11 sights are based upon. The K-13 sight will be usable within the entire sphere of fire.

PURPOSE: To provide a compensating sight for use with hand held guns.

AUTHORITY: T.I. 1562 dated 7 October 1943.

REMARKS: It is expected that the first model of this sight will be delivered to the Army Air Forces for test by February 1944.

SHOCK MOUNT FOR REFLEX SIGHTS ON FLEXIBLE GUNS

554-228 Expenditure Order No.	Armament Laboratory Mfg. or Activity Charged with Development
MX-390 Classified Project No.	None Contract No.

DESCRIPTION: This is a mount for installing an illuminated reflex sight Type N-8A or other suitable type on a hand held flexible gun. Mount is adjustable to provide boresight alignment in elevation and azimuth.

PURPOSE: To prevent breakage of gun sight lamps when installing reflex sights on flexible guns.

AUTHORITY: CTI -1308 dated 21 April 1943.

REMARKS: One model of the shock mount with tilt top has been standardized because of the immediate requirements in the field. This model is not entirely satisfactory and development is being continued to obtain a better mount.

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SIGHTING PANELS

Rohm & Hass, Philadelphia, Pa.
Libbey-Owens-Ford Glass Co., Toledo, Ohio
Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Mfg. or Activity Charged with Development.

554-203
Expenditure Order No.

None
Contract No.

None
Classified Project No.

DESCRIPTION: Sighting errors may be introduced when the line of sight intersects a curved transparent enclosure at various positions. This error depends upon the type of material of which the enclosure is made, the radius of curvature, the thickness and the angle of incidence of the sight line on the enclosure. If any of these factors change in one installation then the deviation of the sight line will change thereby causing a sighting error.

PURPOSE: To reduce or eliminate the variation in the sight line deviation for various gun sight installations.

AUTHORITY: Chief, Engineering Division.

REMARKS: The designs of the Sperry, Martin and Bendix turret domes have been changed so that the variation in the sight line deviations are at a minimum. These new domes are in production at the present time. A redesigned dome for the Emerson Nose Turret is expected from that company for test by January 1944. The designs for the Emerson and Martin 20 mm. turret domes are being calculated in order to eliminate this cause of sighting errors from these turrets. A study has been made of the sighting errors through the B-17 nose section when the Bendix Chin Turret Sight is installed. These errors cannot be reduced unless there is a radical change in the design of the nose of this airplane, therefore, the position of average deviation is being determined so that harmonization may be accomplished with the sight in this position.

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NIGHT SIGHTS

554-172
Expenditure Order No.

Armament Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This expenditure order was initiated in order to develop a gun sight which is satisfactory for use under night combat conditions. During this investigation, it was found that the present reflex sights could be used at night provided the following conditions were met:

a. With the rheostat set for minimum intensity of the lamp bulb, but not turned off, the reticle image cannot be seen by an observer whose eyes are completely dark adapted.

b. The intensity of illumination of the reticle image must be constant for all eye positions for a given setting of the rheostat.

The Type C-1C rheostat was developed for use with the Mazda 84A bulb which is used in most Army Air Forces gun sights. This combination meets the above requirements in the sights. The electrical systems of the other sights have been changed to meet the same requirements.

PURPOSE: To develop a gun sight which can be used or means of using the present gun sights under night combat conditions.

AUTHORITY: TI - 363 dated 12 September 1941.

REMARKS: It has been shown that with proper electrical systems well designed reflex sights can be used at night. Further investigations are being conducted to determine whether or not it is advisable to cut off the top and bottom of the reticle ring as some observers claim that even under very low illumination, the target can be lost as it appears to cross the ring. One N-9 sight with the above features is being procured.

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70 - 140 MIL RING AND BEAD SIGHTS

554-198	Armament Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: An iron ring and bead sight for use on hand held guns which provides, by various sets of fastening holes, a series of separations of the sight and the bore axis of the .50 caliber machine gun. The ring diameters are 70 and 140 mils with an eye to ring distance of 22 inches.

PURPOSE: The purpose of this project is to provide a sight which, by slight alterations, would be usable in various hand held flexible gun installations in bomber aircraft.

AUTHORITY: CTI - 194 dated 22 September 1943.

REMARKS: This item was approved by the Army Air Forces Proving Ground Command for production. Later it was suggested that the post be made more rigid. Accordingly, a post embodying this suggestion has been designed and forwarded to the Proving Ground Command for test.

2-1/2" SIGHT

554-246	Bell and Howell Co., Chicago, Ill.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(33-096) 44-1605-E
Classified Project No.	Contract Number

DESCRIPTION: The gun sight designated as Type N-10 is similar to the N-9 sight and contains all of the features of the N-9. The only difference is the lens diameter, which is 2-1/2" instead of 3-1/2". All other dimensions of the N-10 have been scaled down in the same proportions. This results in a much smaller sight.

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PURPOSE: It was found that in certain airplanes, it was impossible to mount the N-9 sight because of its size. The N-10 was designed as a miniature model of the N-9 for use only in the airplanes where the N-9 cannot be used. The N-9 will be used wherever possible since the larger lens diameter results in a longer eye to sight distance thereby decreasing the crash hazard.

AUTHORITY: Chief, Engineering Division.

REMARKS: The N-10 sight is now undergoing final tests at the Army Air Forces Proving Ground Command.

GUN SIGHT OPTICAL SYSTEMS

554-202 Expenditure Order No.	Nat'l. Bureau of Standards Washington, D.C. Mfg. or Activity Charged with Development
MX-374 Classified Project No.	None Contract Number

DESCRIPTION: The Bureau of Standards has been asked to design various types of optical systems, specifications, optical testing equipment, etc., for use by the Army Air Forces. Among the material furnished by the Bureau of Standards are the following:

a. Design and manufacture of a lens system for use in the N-6 series sights.
b. Design and manufacture of suitable testing equipment to check gun sights for parallax errors, recticle design, etc.
c. Design and manufacture of an optical relay and projection system to be used in the gyro version of the K-8 gun sight.
d. Check of lens design of foreign equipment.

At the present time the Bureau of Standards is designing a 3-power monocular for use with long range fire control instruments.

PURPOSE: To secure the services of the National Bureau of Standards in solving optical problems for the Army Air Forces.

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AUTHORITY: Chief, Engineering Division.

REMARKS: The testing equipment designed by the Bureau of Standards has been made part of the N-8 and N-9 specifications. This equipment has been recommended for use by various gun sight manufacturers and by the Army Air Forces Inspection Division. The K-3 lens design has been forwarded to the Fairchild Aviation Corporation who will install the pilot system into one of the gyro sights which they are making under an experimental contract. The N-6 lens design has been recommended for use by K-8 sight manufacturers for use in the present production K-8 sights.

DESIGN STUDY OF AUTOMATIC COMPENSATING GUN SIGHT

554-257	Frigidaire Div. General Motors Corp., Dayton, O.
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-458	W-33-038 ac/334
Classified Project No.	Contract Number

DESCRIPTION: The Frigidaire automatic compensating gun sight will be a deflection type of turret sight for Caliber .50 machine guns, combining an electrical computing network with a reflector type optical sight head containing a gyro. The computer solves for lead and windage and gravity corrections. The free dome type gyro spins in a magnetic field which causes eddy currents in the gyro dome. This results in a precession of the gyro through an angle proportional to the lead angle, when the current in the range coil is kept proportional to the square root of the time of flight. The sight line is deflected by a mirror mounted on the gyro. The sight head allows binocular observations of the target.

PURPOSE: The purpose of this gun sight study is to ascertain the possibility of combining the electrical ballistic computer, of the type designed by Kendall Clark, with the type of gyro unit and optical system used in the British Mark IIC sight.

AUTHORITY: Chief, Engineering Division.

REMARKS: Frigidaire contracted to make a design study of this sight and to submit drawings of the complete sight and wiring diagrams of the computer. The computer is to employ the ballistic data for the A.P. M-2 projectiles. The sight is substantially a combination of the electrical computer developed previously by Mr. Kendall Clark

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with the sight head used in the British Mark IIC sight. The design layout has been completed, including design of an electrically controlled shutter. The mathematical analysis of the computer is complete. It is estimated that this contract will be completed by 1 January 1944. Fabrication of a prototype sight is contemplated upon receipt of the completed design study.

MARTIN TWO GUN 20 MM UPPER TURRET

553-597	Glenn L. Martin Co., Baltimore, Maryland
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-100	None
Classified Project No.	Contract Number

DESCRIPTION: Twin 20 mm. upper cylindrical turret, AC type A-20.

PURPOSE: To develop twin 20 mm. upper cylindrical turret which may be made interchangeable with standard upper turrets Type A-3C and subsequent.

AUTHORITY: CTI - 1365, Addendum 2, dated 5 October 1943.

REMARKS: This development was initiated to see whether a suitable turret for two 20 mm. guns could be built to fit inside the Martin Type A-3C turret ring. It now appears that this project is entirely practicable and the first such turret will be delivered to the AAF approximately April 1944.

EMERSON TWO GUN 20 MM TURRET

553-568	Emerson Electric Mfg. Co., St. Louis, Missouri
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-100	None
Classified Project No.	Contract Number

DESCRIPTION: Two gun 20 mm. upper-stabilized unpressurized turret, AC Type A-21.

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PURPOSE: To develop an upper cylindrical turret which will have provisions for interchangeable twin 20 mm. guns or twin caliber .60 guns.

AUTHORITY: CTI-1365, Addendum 2, dated 5 October 1943.

REMARKS: This turret design was initiated to procure a more satisfactory solution for cylindrical upper twin 20 mm. turret. This turret may be applied to B-32 airplanes or larger bombers. It will be delivered approximately April 1944.

TWO GUN 20 MM NOSE AND TAIL TURRET

553-592	Sperry Gyroscope Co., Brooklyn, New York.
Expenditure Order No.	Mfg. or Activity Charged with Development.
MX-100	None
Classified Project No.	Contract Number

DESCRIPTION: Two gun 20 mm. ball type unpressurized locally controlled turret, AC Type A-22.

PURPOSE: To develop and procure a turret assembly for two 20 mm. guns which may be used in the nose of B-32 airplane.

AUTHORITY: CTI-1365, Addendum 2, dated 5 October 1943.

REMARKS: This turret is a modification of the Type A-17 turret for two .50 caliber guns by Sperry Gyroscope Company and can be used in the nose and tail of the B-32 airplane. First such turret will be delivered to the Army Air Forces in April of 1944.

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TWO GUN 20 MM. BALL UPPER AND LOWER TURRETS

553-593	Sperry Gyroscope Company, Brooklyn, New York
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-100	None
Classified Project No.	Contract Number

DESCRIPTION: Twin 20 mm. upper and lower ball pressurized stabilized turret, Types A-23 and A-24.

PURPOSE: To develop and procure a turret assembly which may be used in the B-32 upper and lower turret position.

AUTHORITY: CTI-1365, Addendum 2, dated 5 October 1943.

REMARKS: The 20 mm. upper and lower turrets are modifications of the Types A-18 and A-19 four gun .50 caliber turrets being procured under E. O. 553-509. This turret will permit alternate installation in B-32 with 20 mm. guns or .50 caliber guns without any alterations to the airplane. These 20 mm. turrets can be interchangeable with the four gun .50 caliber turrets. First such turret will be ready approximately 15 January 1944.

TWO GUN .50 CALIBER NOSE AND TAIL TURRET

553-574	Sperry Gyroscope Co., Brooklyn, New York
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-339	W30-053 AC-408
Classified Project No.	Contract Number

DESCRIPTION: This turret is normally a 46" sphere incorporating mounts for two caliber .50 M-2 machine guns and a K-10 or K-11 own speed computer.

PURPOSE: To provide suitable protection for the nose and tail of the B-32 airplane.

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AUTHORITY: Chief, Engineering Division.

REMARKS: This turret is being procured for use in the nose and tail of the B-32 airplane. The first turret is 90 per cent complete and will be delivered to the Army Air Forces by 15 January 1944, after which it will be installed in B-17 nose for test. The turret is of ball type incorporating the new Vickers four horse-power drive and the K-10 or K-11 Own Speed computer. Future development program on this turret envisages installation of the drive stabilization and eventually stabilization of sight computation and automatic gun laying.

UPPER CALIBER .50 TWO GUN PRESSURIZED TURRET

553-396	Steel Products Engr. Co., Springfield, O.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(535) 42-4606
Classified Project No.	Contract Number

DESCRIPTION: Development of a two gun cylindrical caliber .50 pressurized turret.

PURPOSE: To develop and procure a turret assembly which may be used to defend bombardment type airplanes at high altitude.

AUTHORITY: Chief, Engineering Division.

REMARKS: The turret has been delivered to the Armament Laboratory and is being tested for proper operation. It is far heavier than allowable but preliminary tests indicate that it will hold pressure satisfactorily. This turret positions the gunner in a capsule with the guns and ammunition outside the capsule. Control is of the Maxson electric type drive. No production program is contamplated for this turret.

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GYRO STABILIZED UPPER AND LOWER TURRETS

553-509	Sperry Gyroscope Co., Brooklyn, New York
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-339	W-535-AC-36132
Classified Project No.	Contract Number

DESCRIPTION: The turrets being developed are to be spherical in shape mounting four .50 caliber guns and are equipped with a sight designed to permit the turret to automatically maintain a fixed rate with respect to space regardless of the motion of the airplane.

The sight designed for this turret incorporates a gyroscope, which when processed through springs by the gunner, moves at a fixed rate with respect to space. An electrical pickup attached to the turret sends a signal to the turret controls when the gyro begins its precessing. The controls are so arranged that the turret drives to bring the pickup back into line with the gyro. In this way the turret follows the gyro accurately within the limits of the control system. The control motion, which when accurately measured, is the rate of the turret is fed to the computer, which then computes lead angles accurately with respect to fixed space rather than with respect to the airplane which may be turning or rolling or pitching.

PURPOSE: To design turrets which include computing sights that compute lead more accurately.

AUTHORITY: Chief, Engineering Division.

REMARKS: First upper turret is now being ground tested at Sperry after which it will be shipped to the Army Air Forces for installation in B-24H airplane for test. A go-ahead for production tools and drawings has been given the Sperry Gyroscope Company for an unpressurized version of this turret. The first lower turret will be ready approximately 1 February 1944 for installation in an airplane now being modified.

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K-6 GUN MOUNT

553-595
Expenditure Order No.

Ainsworth Mfg. Company
Detroit, Michigan
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: Design and development of a gun mount for inclosed waist window of bombardment airplanes. This gun mount incorporates the counter-balance for the gun within the mount itself.

PURPOSE: To fulfill need for a mount to be used with the inclosed waist window of bombardment airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: To inclose waist window position of bombardment airplanes necessitates mounting the gun in an unbalanced position. The conventional method at present when mounting a gun in an unbalanced position is to use cables and bungee cord to counter-balance the gun. These cables greatly restrict the movement of the gun and hamper the gunners. The K-6 was designed to incorporate the counter-balance in the gun mounting and leave the gun free. The K-6 is an outgrowth of the K-5 mount in that the outer section is made larger and torsion springs are mounted on either side of the center section. A post has been added to the lower extremity of the mount so that the mount can be easily installed in a socket. These mounts have been tested at Eglin Field and received enthusiastically. Recommendations have been made that they be used in all bombardment airplanes.

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FIRE CUT-OUT

553-601	Armament Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: To design a fire cut-out device to be used in waist window mounts of bombardment airplanes.

PURPOSE: To design a mechanism to fulfill the need of the European Theater of Operations for this device.

AUTHORITY: Chief, Engineering Division.

REMARKS: In past years training organizations have requested that fire cut-out devices be placed on the waist guns of the bombardment airplanes. Until Fall 1943 combat organizations said they definitely did not want such a device, however, a recount was made and it was found that a large per cent of the damage done to our aircraft was coming from our own guns. As a result of this the 8th Air Force requested that a fire cut-out device be designed for the waist windows of the B-17 airplane. Such a device has been designed and the first article has been fabricated in the Armament Laboratory. At this time it is foreseen that some refinements will be necessary before this article is ready for manufacture.

INSTALLATION OF K-5 MOUNT IN B-17

553-590	Armament Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The design and development of an inclosed gun emplacement in the radio hatch of B-17 Airplane.

PURPOSE: To inclose the gun installation in the radio hatch of the B-17.

AUTHORITY: CTI-1417 dated 11 August 1943.

[redacted]

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REMARKS: Authority in CTI called for the use of a K-5 Mount to inclose radio hatch gun emplacement. Preliminary studies by the Armament Laboratory proved that a counter-balance was required and that this could be more easily provided with the K-6 Gun Mount. A design was made by the Armament Laboratory that was as simple as possible and can be easily removed so that the window can be removed for ditching purposes. One mount was fabricated and installed in an airplane at Eglin Field. Tests are to be made at Eglin Field in the near future.

JETTISONING WINDOWS

553-596
Expenditure Order No.

Armament Laboratory
Mfg. or Activity Charged With Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Design and development of quick releases for windows of gun emplacement to be jettisoned outboard.

PURPOSE: To procure designs to be used by aircraft contractors in installing windows in aircraft so that they may be jettisoned outboard for ditching purposes.

AUTHORITY: Chief, Engineering Division.

REMARKS: For some time the Armament Laboratory has been receiving requests from the European Theater of Operations for inclosed window installations. In conjunction with these requests the Armament Laboratory was informed that closed windows must be made jettisonable outboard for ditching purposes. This project was initiated to investigate all quick releasing devices to determine whether the standard jettisonable window should be acquired by Army Air Forces.

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G. E. CENTRAL STATION FIRE CONTROL

554-231
554-232
554-235
Expenditure Order No.

General Electric Company,
Schenectady, New York
Mfg. or Activity Charged
With Development

W535-AC-40718
W535-AC-34468
Contract Number

MX-27
Classified Project No.

DESCRIPTION: This equipment is a flexible all-electric remote fire control system with computers and parallax correctors. Turrets designed for two and four-gun upper and lower installations and two-gun tail mounts can be directed by electrical azimuth and elevation position signals from a computer which corrects for ballistic and prediction deflection and difference in position of guns and sight. Many combinations of turrets and types of sighting stations may be employed either with or without computers.

PURPOSE: To develop fire control equipment for heavy bombardment airplanes whose cabins are pressurized and to provide equipment which will result in the greatest possible fire power available from any one position.

AUTHORITY: Chief, Engineering Division.

REMARKS: The General Electric Company has undertaken the design of remotely controlled turrets to arm pressurized bombardment airplanes, the sighting to be accomplished by means of reflector type sights manually oriented by the gunner, the turrets to be power operated and designed to follow the sight exactly, and a computer interposed in the electrical connection from the sight to the turret, and so arranged mechanically to advance or retard the position of the turret in accordance with the ballistic deflections imposed on the bullet, due to its angular position with respect to the airplane, and due to the angular rates of the line of sight with respect to space. This development has been carried to the point where equipment is being procured in quantity for the B-29 airplane, which equipment is identical with the development project except for the manner in which the sighting stations and turrets are electrically connected.

The General Electric Company is now undertaking the development of modifications to this system to be driven from alternating current for the XB-35 and XB-36 airplanes. The system will be modified only to the extent that the main drive motors for the turret electrical system will be alternating current in place of direct current.

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Tests of computer and modified sighting stations are continuing in B-24E and B-29 airplanes. Production of remaining equipment is being expedited to meet all B-29 production.

An attempt is being made to stabilize the sighting stations, change from position to rate control, and provide a more accurate means of obtaining range.

WESTINGHOUSE STABILIZED FIRE CONTROL SYSTEM

554-218
Expenditure Order No.

Westinghouse Electric & Mfg Co.
East Pittsburgh, Penn.
Mfg. or Activity Charged With Development

MX-358
Classified Project No.

W 535 AC-37877
Contract Number

DESCRIPTION: The Westinghouse Electric and Manufacturing Company is developing a stabilized sighting station designed to transmit stabilized line of sight data from the sighting station to a computer, and then to remotely operated turrets properly corrected to enable them to more accurately fire at the target. The sighting station consists of a ring mounted reflector type sight, a seat for a gunner, and a control arrangement which enables the gunner to orient the sight with respect to space, and to permit him to follow a target and supply data to a computer. The sight will be driven by an electric motor receiving current from a variable voltage source whose voltage is controlled by the output of a gyro. The control handles of the sighting station are operated to precess the gyro by means of electric pickups and the variable gyro. A measurement of the precession rate is for lead computation purposes supplied electrically to a computer which, in turn, operates the turret.

PURPOSE: The purpose of this development is to provide the gunner with remote control sight with the following characteristics:

a. Power operation.
b. Accurately measured rate data which does not contain instantaneous variation of an appreciable magnitude.
c. Computation of gun rates with respect to space rather than with respect to the airplane.
d. A sight which will remain fixed in space regardless of the roll, pitch, or yaw of the airplane.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Separate components of the sighting station have been tested and the assembly of the sighting station is practically complete. It is expected that the computer will provide a high degree of accuracy and will be ready for laboratory tests in March. It is expected that the sighting station and the computer will be installed in an airplane for aerial tests, if laboratory tests indicate that these components are suitable for such an installation.

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SECTION 3

SPECIAL PROJECTS

SPEC-IAL PRO-JECTS

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AUTOMATIC 4.5" ROCKET LAUNCHER

555-495 555-473 Expenditure Order No.	See remarks Mfg. or Activity charged with development
	(535) 43-13126-E
MX-241 Classified Project No.	(535) 43-29332-E Contract No.

DESCRIPTION: The Frigidaire Design utilizes a clam shell door with electrically driven conveyor mechanism to feed and fire 4.5" rockets at 30 rounds per minute. The length and shape of the magazine will depend upon the aircraft installation contemplated.

The United Shoe Machinery Corporation design utilized an electrically driven conveyor mechanism which carries the rockets in expendable plastic tube chambers.

PURPOSE: To provide an automatic 4.5" rocket launcher of light weight and high rate of fire,

AUTHORITY: CTI-717, Addendum No.4, dated 6 January 1943.

REMARKS: The barrel and breech assembly of the initial Frigidaire Launcher design was delivered in August. The design incorporated clam shell doors made of aluminum castings. Upon tests these doors did not stand firing pressures and ruptures. The doors were re-designed and fabricated of high strength steel alloy castings. This improved design was delivered in December 1943 and is being tested.

The United Shoe Machinery Corporation launcher has been delivered and extensively tested using a semi-automatic control and a simplified drive. With this design a firing rate of 45 rounds per minute was obtained. A full automatic operation was incorporated and an increased speed drive added with the result that successful tests have been run at a cyclic rate of 100-800 rounds per minute. Curvedexhaust tubes are being fabricated to permit a test installation of this launcher in an airplane.

The manufacturers interested in this development are: Frigidaire Division., General Motors, Dayton, Ohio; United Shoe Machinery Corporation; Boston, Massachusetts.

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4.5" PLASTIC TUBE CLUSTERS T-30, FOR LAUNCHERS.

555-452
Expenditure Order No.

General Electric Company
Schenectady, New York
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Light weight, plastic, triple-tube cluster designed to be externally mounted on fighter and attack aircraft and capable of being jettisoned in flight.

PURPOSE: To develop and test light weight jettisonable clusters for launching 4.5" rockets from aircraft in flight.

AUTHORITY: CTI-717, Addendum No. 4, dated 8 January 1943.

REMARKS: Tests have been successfully carried out of installations on P-38, P-39, P-40, P-47, P-51 and A-36 airplanes. Upon completion of development by the Armament Laboratory, this item was turned over to the Ordnance Department for production. Production in limited quantities is now under way.

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4 1/2" ROCKET LAUNCHER INSTALLATION ON THE A-20 AIRPLANE

555-458
Expenditure Order No.

Armament Laboratory
Mfg. or Activity charged with Development

MX-241
Classified Project No.

None
Contract Number

DESCRIPTION: Four 4 1/2" rocket launchers have been installed in an A-20 Airplane to permit vertical, downward firing. The launcher tubes are inclined from the vertical to compensate for the forward speed of the airplane in order to obtain true vertical fire.

PURPOSE: To obtain vertical rocket fire for attacks against surface vessels and submarines.

AUTHORITY: This project is authorized by CTI-717, Addendum No. 4 dated 8 January 1943.

REMARKS: Tests are being conducted at Eglin Field and tests have been run at Aberdeen Proving Ground to obtain required ballistic data.

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FORWARD FIRING OF 4 1/2" ROCKET INSTALLATION ON B-25H AIRPLANE.

555-452 Expenditure Order No.	Armament Laboratory Mfg. or Activity Charged with Development
MX-241 Classified Project No.	None Contract Number

DESCRIPTION: An installation consisting of two reloadable rocket launchers in the gun tunnel in the nose of the B-25H airplane is now being designed.

PURPOSE: To provide forward fire of 4.5" rockets from the B-25H airplane in order to provide a substitute weapon for the 75 MM cannon or to replace the 75 MM cannon with a light weight, rapid fire rocket launcher.

AUTHORITY: This project is authorized by CTI-1430, Addendum 1, dated 27 August 1943.

REMARKS: The twin reloadable launchers will permit a moderately high rate of fire and will still allow the airplane to carry a full bomb load.

UPWARD FIRING OF 4 1/2" ROCKETS FROM B-17 AIRCRAFT

555-452 Expenditure Order No.	Armament Laboratory Mfg. or Activity Charged with Development
MX-241 Classified Project No.	None Contract Number

DESCRIPTION: To install a reloadable 4.5" launcher in a B-17F airplane arranged for upward firing.

PURPOSE: To fire 4 1/2" rockets against attacking enemy aircraft vertically overhead attempting air to air bombing.

AUTHORITY: CTI-717, Addendum No. 4, dated 8 January 1943.

REMARKS: Successful firing tests of a reloadable launcher have been completed at Aberdeen Proving Ground and necessary ballistic data from that station are now being awaited. The fabrication of the double loading mechanism is proceeding and installation will be made as soon as practicable.

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3 1/4" ROCKET FLARE

555-494	Armament Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
MX-241	None
Classified Project No.	Contract No.

DESCRIPTION: 3 1/4" Rocket propelled flare is launched forward from an aircraft during sea search to identify surface vessels and submarines on the surface. The flare is expelled from the rocket body approximately 6000 feet in front of the airplane and is suspended by a conventional flare parachute.

PURPOSE: To allow nocturnal identification of surfaced vessels, including submarines, before the aircraft passes the bomb release line.

AUTHORITY: This project is authorized by CTI-717, Add. No. 4, dated 8 January 1943.

REMARKS: Installation of reloadable launchers have been made in B-18 and B-24 Airplanes. The rocket ammunition is furnished by N. D. R. C. Service tests on the projects that are now being undertaken at Army Air Forces School of Applied Tactics, Orlando, Florida.

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SECTION 4

TRAINING PROJECTS

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PHOTO-ELECTRIC FIXED GUNNERY TRAINER

554-224 Expenditure Order No.	Phoebus Corporation, Chicago, Illinois. Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-27182-B Contract No.

DESCRIPTION: This trainer consists essentially of a track, a target carrier and target, and a cockpit. The track and target are built to a scale of 1:72 and represent ranges from 700 to 100 yards. The target is rotatable as it proceeds along the track to simulate the change in the approach angle for a given attack. The cockpit consists of a Type C-3 Navigation Trainer less instruments and containing a Type N-3 Gun Sight. Scoring is accomplished by means of a photocell whose position from the axis of the track is proportional to the lead for the attitude, and which is energized by a light beam projected from the cockpit. The speed of the target carrier is controlled automatically to correctly simulate the closing speed.

PURPOSE: To develop a device with which to practice fixed gunnery sighting and aiming.

AUTHORITY: Chief, Engineering Division.

REMARKS: The original device constructed by Craig Field Single Engine Flying School in 1941-42 did not present correct illusion and scoring. Redesign outlined by Armament Laboratory, and track, target carrier, and electronic scoring equipment procured from the Phoebus Corporation on Purchase Order No. 43-27182-E. Design and fabrication of target carrier speed control, target rotater, and photocell positioners being done by the Armament Laboratory.

TURRET TRAINER

554-143 Expenditure Order No.	Lion Manufacturing Co., Chicago, Illinois. Mfg. or Activity charged with Development
None Classified Project No.	W 535 AC-24566 Contract No.

DESCRIPTION: The apparatus consists of the azimuth ring and amplidyne

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drive of a Martin Turret on which is mounted a turntable which supports a turret for firing practice. The turntable is rotated by means of the amplidyne drive and the operator of the turret is required to manipulate the turret in order to keep the guns pointed at a stationary target. A moving carriage supporting a model airplane is linked to the turntable in such a manner as to closely simulate an attacking airplane when in a true pursuit curve.

PURPOSE: To provide a suitable means of training gunners in turret manipulation and sighting.

AUTHORITY: Chief, Engineering Division.

REMARKS: It is expected that this device will replace the jeep range which is now used for turret firing and which in addition to being very expensive to build, does not approximate the problem involved in flexible gunnery.

BOMBING TRAINER

556-296 Expenditure Order No.	George H. Leland, Dayton, Ohio. Mfg. or Activity charged with Development
MX-417 Classified Project No.	(33-038) 44-3272-E Contract No.

DESCRIPTION: A mock-up of a bombardier's compartment is mounted directly above and in front of a screen. The mock-up contains controls and indicators normally used by a bombardier in actual bombing problems. A moving picture of a terrain area is projected onto the screen. The direction of travel and speed of the image simulates the travel of the bomber across the ground. Means are provided for taking new course corrections so that the bombardier may bomb an image. Means are also provided for scoring the bombardier's results.

PURPOSE: To provide an improved and realistic bombing trainer, thereby reducing requirements for actual flights.

AUTHORITY: Chief, Engineering Division.

REMARKS: Tests with one crude prototype model indicate that this trainer is basically sound in design and may be expected to gain wide use in

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the Training Command upon production. The George H. Leland Manufacturing Company, Dayton, Ohio, expect completion of the model and drawings about 1 February 1944.

BOMBING TRAINER - ADVANCED

556-311	Link Aviation Devices, Inc., Binghamton, N.Y.
Expenditure Order No.	Mfg. or Activity charged with Development
MX-417	None
Classified Project No.	Contract No.

DESCRIPTION: There is provided a fuselage which is free to bank and pitch mounted upon a tower which is capable of rotation in any direction upon the base of the trainer. All the motions of a bomber in actual flight may therefore be simulated. A screen and terrain mechanism is also provided which produces means of projecting an accurate representation of a portion of the earth's surface--apparently moving. This imparts an impression of traveling over a terrain to members of the crew within the fuselage. Means are provided for controlling the apparent rate and direction of travel over the image. Controls and indicators normally required for bombing problems are installed. Within the fuselage are four stations for an Instructor, Pilot, Bombardier, and Observer. Means for setting in various bombing problems are provided as are means of scoring the bombardier's results.

PURPOSE: To produce an advanced type Bombing Trainer which may also be used for pilot and Bombardier coordination training and dead reconing navigation training.

AUTHORITY: Chief, Engineering Division.

REMARKS: Specifications are being prepared for the advanced type trainer. Wide and valuable use may be expected of the trainer in the advance training stations, O.T.U.s, R.T.U.s, and B-29 stations.

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C-1 AUTOMATIC PILOT TRAINER

556-243 Expenditure Order No.	Link Aviation Devices, Inc., Binghampton, N.Y. Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The device consists essentially of a fuselage capable of simulating the climb, dive, and bank movements of an airplane with a C-1 Automatic Pilot installed in it. The essential instruments are mounted in the cockpit.

PURPOSE: The device affords a means of instructing pilots and maintenance men in the proper flight checking of the automatic pilot as well as a means of teaching the maintenance of the C-1 Automatic Pilot.

AUTHORITY: Chief, Engineering Division.

REMARKS: The project originally was started as a simple device to demonstrate maintenance of the C-1 pilot but subsequent information indicated a need for broadening the use of the device to include a pilot trainer to assist in demonstrating the proper method of setting up an automatic pilot in flight.

CAMERA GUN

554-252 Expenditure Order No.	Industrial Specialties Co., Detroit, Michigan. Mfg. or Activity charged with Development
None Classified Project No.	(35-038) P.O. 44-1758-E Contract No.

DESCRIPTION: This device consists essentially of a standard gun camera mounted in a framework approximating in size and appearance, a .50 Caliber Flexible Machine Gun and so arranged to move the axis of the camera with respect to that of the gun mock-up an amount equal to the lead angle for the guns' orientation. The camera may be fixed with respect to the gun and a sight placed in front of camera arranged with a moving reticule or lamp to attain the desired result.

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Student gunner tracks target applying lead. If lead is correct, movable spot in sight appears on target when film is projected.

PURPOSE: To provide a means of accurately scoring gun camera missions for flexible gunnery training.

AUTHORITY: Chief, Engineering Division.

REMARKS: The first experimental item to be used in the waist window positions of the B-17 and B-24 airplanes is expected to be delivered approximately 20 January 1944. Tests are to be conducted at the Central Instructors School, Buckingham Army Air Base, Fort Myer, Florida. Studies are now in progress on modifications to adapt the gun to turrets.

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Equipment
Lab. Projects

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SECTION I

INSTRUMENT AND NAVIGATION PROJECTS

ENGINE INSTRUMENTS

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SECTION I

INSTRUMENT AND NAVIGATION PROJECTS
(continued)

ENGINE INSTRUMENTS

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SECTION I

INSTRUMENT AND NAVIGATION PROJECTS
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SECTION I

INSTRUMENT AND NAVIGATION PROJECTS
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DUAL FUEL AND OIL PRESSURE GAGES

655-1191, 655-1208, 655-1213	See Remarks
Expenditure Order No.	Mfg. or Activity charged with Development
None	See Remarks
Classified Project No.	Contract Number

DESCRIPTION: Dual fuel, oil, and manifold pressure gages of improved readability are covered by this development. The improvements consist in locating the pointer mechanisms at the side of the case in order that the pointers travel down through the center part of the scale. This arrangement is intended to provide a simpler instrument construction by eliminating concentric pointers now used in instruments of this general type and improve readability by keeping the pointers separated.

PURPOSE: To provide improved gages which will enable the pilot to more easily distinguish the instrument readings.

AUTHORITY: Chief, Engineering Division.

REMARKS: This development is being undertaken by practically all gage manufacturers. In the case of fuel and oil pressure gages, development is practically completed. Samples were received from:

Motometer Gage and Equipment Division of
Electric Autolite Corp.,
La Crosse, Wisconsin.

Manning, Maxwell and Moore Inc.,
Bridgeport, Connecticut.

Ranco, Incorporated,
Columbus, Ohio.

The new design has been included in the latest revision of Spec. AN-G-2.

In the case of Manifold Pressure gages, development is proceding more slowly and there is some question regarding pilot reaction to the new type scale due to the reduction in scale length. One design incorporates a sub dial for "fine" readings. Sample instruments are being obtained from the following companies:

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Manning, Maxwell and Moore Inc.,
Bridgeport, Conn.

Pioneer Instrument Division,
Bendix Aviation Corp.,
Teterboro, New Jersey.

Ranco Incorporated,
Columbus, Ohio.

Kollsman Instrument Division of
Square "D" Corp.,
Elmhurst, New York.

SENSITIVE TYPE MANIFOLD PRESSURE GAGE

655-1162, 655-1148 Expenditure Order No.	See Remarks Mfg. or Activity charged with Development
None Classified Project No.	W-535-AC-43-27046-E Contract No.

DESCRIPTION: This manifold pressure gage consists of a two-pointer sensitive type instrument for use in engine testing and on flight engineer panels where an instrument of greater accuracy than the standard manifold pressure gage is required.

PURPOSE: To develop a manifold pressure gage which is more accurate than the present type.

AUTHORITY: Chief, Engineering Division.

REMARKS: Instruments for test use are being obtained from the following manufacturers:

Pioneer Instrument Division,
Bendix Aviation Corp.,
Teterboro, New York.

Kollsman Instrument Division,
Square "D" Corp.,
Elmhurst, New York.

Instruments have not yet been received for test.

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HYDRAULIC TYPE PRESSURE GAGE TRANSMITTING SYSTEMS

655-1161, 655-1193	Equipment Laboratory
Expenditure Order No.	Mfg, or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The hydraulic pressure transmitting system consists primarily of a transmitter mounted at the engine nacelle on aircraft and connected by means of tubing to a conventional pressure gage indicator on the instrument panel. A diaphragm is used to separate the engine oil or fuel from the transmitting liquid thus providing a safety factor in the event the line is broken or shot away. The transmitting liquid also reduces the possibility of gage failures arising from oil congealing in direct connected gage lines.

PURPOSE: To develop and improve the hydraulic type pressure transmitter systems and equipment required for testing and maintenance of these systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: A considerable number of the Type A-1 pressure transmitter systems have been installed on aircraft. The device has not been entirely satisfactory, however, due to difficulty experienced in maintaining completely leak free connecting lines. Present efforts have been directed toward reducing the leak possibilities by developing better fittings, reducing the number of fittings required and insisting on more careful installation and maintenance practices. Upon completion of development of a simplified electrical remote indicating system it is anticipated that the hydraulic transmitter method will no longer be used for the gage application.

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OIL PRESSURE GAGES-CAPILLARY TYPE

655-1174, 655-1176
Expenditure Order No.

See Remarks
Mfg. or Activity charged with Development

None
Classified Project No.

(33-096) 44-1009-E
(4027) 44-218-E
(33-096) 44-2252-E
Contract Number

DESCRIPTION: The capillary type-oil pressure gage consists of a conventional type bourdon tube oil pressure element connected by capillary tubing to a small transmitting cell counted directly on the engine. The tubing and cell are filled with a low viscosity liquid and the complete assembly is soldered together to form an integral unit.

PURPOSE: To develop a device which will eliminate oil pressure gage failures resulting from oil congealing in the lines under cold temperature conditions.

AUTHORITY: Chief, Engineering Division.

REMARKS: Two types of units were obtained- (a) A conventional type panel mounting oil pressure gages connected by means of the capillary to the transmitting cell on the engine. (b) A conventional autosyn remote indicating type transmitter with the capillary system added to eliminate the non-winterized line extending from the transmitter to the engine.

The units were installed on winterized airplanes and are now undergoing tests at Ladd Field.

The units were procured from:

United States Gage Company,
Sellersville, Pennsylvania.

Pioneer Instrument Division of
Bendix Aviation Corp.,
Teterboro, New York.

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VALVE, MANIFOLD PRESSURE GAGE, DRAIN

655-1172	See Remarks
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This project covers the development of a valve to purge (or drain) the manifold pressure gage line of condensate or other foreign matter. In operation the engine is run at idleing speed so as to create a partial vacuum in the blower housing, at which time the valve may be opened to allow the in-rushing air to clear the line.

PURPOSE: To provide a simple and suitable means of purging the manifold pressure gage line at the time of pre-flight inspection or in flight, if necessary.

AUTHORITY: Chief, Engineering Division.

REMARKS: Samples have been received from the W.R. Whittaker Company, Ltd., and also from The Weatherhead Company: These valves are now undergoing tests.

The following companies are working on this project:

Parker Appliance Company
Cleveland, Ohio

The Weatherhead Company,
Cleveland, Ohio.

W.R. Whittaker Company, Ltd.,
Los Angeles, California.

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LIQUID QUANTITY GAGES (FUEL, OIL, ETC.)

655-1186, 655-1188 655-1201, 655-1207 903-1567	See Remarks
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This project covers the development of liquid quantity gages of improved accuracy and reliability, the more effective application of liquid level gage designs to new aircraft and the correction of liquid level gage troubles on existing aircraft.

PURPOSE: Development of more accurate and more reliable systems of liquid quantity measurement.

AUTHORITY: Chief, Engineering Division and T.I.-1289.

REMARKS: A real demand exists for a liquid quantity gage which under service operating conditions will give accurate indications of liquid (fuel, oil, etc.) tank contents unaffected by reasonable changes in the attitude of the aircraft. The problem is particularly difficult due to the shifting and changing characteristics of bullet proof cells, the particular liquid (fuel, oil, etc.) tank shapes often times used, and the changes in flight attitude which occur.

In addition to improving the existing gages in accordance with specification AN-G-19 several new methods of approach are being followed. These methods include a thorough investigation of electronic methods utilizing condenser plates in the liquid.

Manufacturers working on these developments are as follows:

Liquidometer Corp.,
Long Island City, New York.

General Electric Company,
West Lynn, Mass.

Minneapolis-Honeywell Regulator Co.
Minneapolis, Minn.

Fairchild Aviation Corporation,
Jamaica, New York.

Boston Auto Gage Company,
Pittsfield, Mass.

Eclipse-Pionner Division of
Bendix Aviation Corporation
Teterboro, New Jersey.

Consolidated Aircraft Corp.
San Diego 12, California

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TORQUEMETER GAGE

655-1179
Expenditure Order No.

Manning, Maxwell & Moore, Inc.
Bridgeport, Connecticut
Mfg. or Activity charged with Development

None
Classified Project No.

(33-096) 44-1226-E
Contract Number

DESCRIPTION: The torquemeter gage consists of a temperature compensated bourdon tube pressure gage which indicates directly torque pressure from which the brake horsepower can be computed.

PURPOSE: To provide an instrument indication from which pilots or flight engineers can readily compute brake horsepower.

AUTHORITY: Chief, Engineering Division.

REMARKS: These instruments have not as yet been received from the manufacturer.

ENGINE GAGE UNIT WITH ELECTRIC THERMOMETER

655-1190
Expenditure Order No.

See Remarks
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This instrument is a combination unit comprising an electric ratio meter type oil temperature thermometer, an oil pressure gage and a vented type fuel pressure gage.

PURPOSE: To provide an engine gage unit with an electrical thermometer and vented type fuel pressure gage.

AUTHORITY: Chief, Engineering Division.

REMARKS: Samples submitted by Electric Autolite Company, Motometer Gage and Equipment Division, La Cross, Wisconsin, General Electric Company, West Lynn, Massachusetts, and United States Gauge Company, Sellersville, Pennsylvania have been examined, of these the Motometer design has been tested and approved. The General Electric model has been given tentative approval but requires minor correction. The United States Gauge design has not yet been tested.

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ELECTRICAL REMOTE INDICATING PRESSURE GAGES

655-1008, 655-1077	See Remarks
Expenditure Order No.	Mfr. or Activity charged with Development
None	(535) AC-3022-E
Classified Project No.	Contract Number

DESCRIPTION: This project comprises development of instruments for indicating the engine fuel and oil pressure at remote positions from the engine without the necessity of running tubing from the engine area to the instrument panel. The transmitting units are intended for mounting directly on the engine, and connection with a minimum of wiring to simple light indicators at the instrument panel.

PURPOSE: To develop a method of remote indication which will permit the installation of pressure transmitters as an integral part of the engines and thus eliminate the frequently reported difficulty of engine lubricating oil congealing in the short lengths of tubing connecting the present transmitters to the oil pressure connection of the engine. To reduce the weight of aircraft instrumentation and simplify maintenance.

AUTHORITY: Chief, Engineering Division.

REMARKS: A general letter of inquiry was sent to all of the domestic manufacturers of instruments, soliciting their assistance in this development program. As a result, the following companies are engaged in the preparation of a sample instrument for test at the Materiel Command:

Rochester Manufacturing Company, Rochester, New York
Thomas A. Edison, Inc., East Orange, New Jersey
A. C. Spark Plug Corporation, Flint, Michigan
Electric Auto Lite Corporation, LaCrosse, Wisconsin
Westinghouse Electric & Manufacturing Company, Newark, N.J.
Stewart-Warner Corporation, Chicago, Illinois.
Weston Electric Instrument Company, Newark, N. J.
Pioneer Instrument Division, Bendix Corporation, Teterboro, New Jersey
General Electric Company, West Lynn, Massachusetts
Auto Flight Corporation, Los Angeles, California

In addition, a number of novel ideas have been developed and tested by the personnel of the Materiel Command. Of the latter, the liquid potentiometer principle appears to offer the most promise.

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Most of the samples tested to date have failed on engine test. Only one type of instrument was sufficiently far along for Winterization Tests at Ladd Field. This was the "Magnesyn" developed by Pioneer Division of Bendix Aviation Corporation, Teterboro, New Jersey. An additional quantity of these instruments are being obtained for proof testing at Eglin Field. Manufacturers are being encouraged to continue their work on this project as a sufficiently simple solution to the problem has not yet been obtained.

PRESSURE GAGES-GENERAL

655-1162 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This project covers development of pressure gages to meet new requirements, the test of qualification samples submitted by manufacturers and the investigation of unsatisfactory gage reports.

PURPOSE: To provide suitable gages for service use.

AUTHORITY: Chief, Engineering Division.

REMARKS: Under this project a 0 to 5000 lbs./sq.in. range hydraulic pressure gage is currently being standardized. Also a manifold pressure gage with increased range of 15 to 100 in. Hg. is being developed to meet new war emergency power requirements established by the Power Plant Laboratory.

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TURBO-SUPERCHARGER TACHOMETER AND
OVERSPEED WARNING SIGNAL

655-1124
655-1134, 655-1168
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity charged
with Development.

None
Classified Project No.

(2119) 43-1119
(555) 43-25799-E
Contract Number

DESCRIPTION: A tachometer, an overspeed warning unit, and a tachometer with a built-in warning unit has each been considered for use with turbo-supercharger. The overspeed warning unit is a centrifugally operated governor type switch built to mount directly on the turbo tachometer drive. The tachometer with the built-in warning unit is a modified dual E-14 tachometer. The instrument consists of two synchronous motors in parallel, one of which drives a pointer to indicate turbo R.P.M. while the other drives a contact arm which closes at a preset speed to light a warning light which calls the pilot's attention to the fact that the turbo supercharger has reached its rated speed. The contacts are adjustable to from 16,000 to 26,000 indicated R.P.M. to allow its use with various types of turbo-superchargers.

PURPOSE: To develop a suitable tachometer and overspeed warning system for turbo-superchargers.

AUTHORITY: Chief, Engineering Division and TI 1919.

REMARKS: The tachometer with built-in contacts was specifically required for the P-47 type airplane but has been constructed so that it may be used on any type plane using a turbo-supercharger. This instrument has been designated Type E-15. The E-15 tachometer is considered superior to the tachometer and separate warning unit as it embodies both in one unit thus effecting space and weight economy.

The following companies have supplied the following equipment:

Tachometer only-Chicago, Electric Tachometer Company,
Chicago, Illinois

Turbo Overspeed Switch-Rochester Manufacturing Company,
Rochester, New York

Type E-15 tachometer with built-in warning unit-
Chicago Flexible Shaft Company,
Chicago, Illinois.

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FUEL SYSTEM WARNING SIGNAL

655-955, 655-1045
Expenditure Order No.

See Remarks
Mfg. or Activity charged with Development

None
Classified Project No.

(535) 42-12989
(535) 42-20166
Contract Number

DESCRIPTION: This item consists of a pressure operated switch which can be used in the airplane fuel system for the purpose of automatically operating an auxiliary fuel pump motor in the event that one of the fuel tanks should become dry. The operation of the switch is such that a pressure drop in the fuel system will cause the switch to close and "cut-in" the auxiliary fuel pump motor on a reserve tank in such a way that the pressure is raised to the proper value. If a switch-over to a different fuel tank is made, the signal will then cease operating. However, if no switch-over is made, the signal will continue to cut in and out, flashing a warning light and providing an operating source of fuel until the switch-over is accomplished. The signal switch is also intended for use in automatic fuel systems.

PURPOSE: To develop a signal switch for the application described above.

AUTHORITY: Chief, Engineering Division.

REMARKS: Several signals have been developed and service test quantities are under procurement from both of the above companies. The Manning, Maxwell & Moore signals have been delivered and approved. The Minneapolis-Honeywell signal is still under development. The following companies are working on this project:

Manning, Maxwell & Moore,
Bridgeport, Conn.

Minneapolis-Honeywell Col.,
Minneapolis, Minn.

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ALTITUDE WARNING SIGNAL

655-985
Expenditure Order No.

Minneapolis-Honeywell Regulator Company, Minneapolis, Minneapolis
Mfg. or Activity charged with Development

None
Classified Project No.

(535) 42-14484
Contract Number

DESCRIPTION: This signal assembly consists of a pressure switch for installation in pressurized cabin type airplanes.

PURPOSE: (1) To develop a device which will sound a warning horn in case pressure in the cabin falls below a predetermined value. (2) To obtain an additional source for Type H-2 Altitude Warning Signals.

AUTHORITY: Chief, Engineering Division.

REMARKS: Laboratory tests have been completed on 10 each switches. One each switch has been installed on an XB-28 Airplane for Flight Test purposes.

ENGINE SYNCHRONISM INDICATOR (SYNCHROSCOPE)

655-1084
Expenditure Order No.

Kollsman Instrument Div. Of Square D Co., Elmhurst, New York.
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: The engine synchronism indicator is built in two sizes. A 1-7/8 inches instrument containing 3 synchroscope elements for use on four-engine aircraft, and a 2-3/4 inches instrument containing 5 synchroscope elements for use on six-engine aircraft. Each individual synchroscope element consists of a three-phase stator, and either a single or three-phase rotor which carries a pointer on the end of its shaft.

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The synchroscope is wired into the tachometer system in such a way that the pointer for a given engine rotates in one direction if the engine is slow, in the other direction if it is fast, and remains stationary if the engine is synchronized with the master.

PURPOSE: To develop a suitable synchroscope for multi-engine aircraft that will give continuous indication for all engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: The individual synchroscope element used in the above instruments has also been built into the dual tachometer (AN5530-3) for use on two-engine aircraft where a synchroscope is required. The four and six-engine synchroscope has been standardized as AN5532-1 and AN5532-2 respectively.

By addition of very little weight to the airplane these instruments enable close control of the engines and may be suitable for use in place of automatic synchronizing devices. Tests to determine the extent of their application possibilities are to be conducted at Eglin Field.

POSITION INDICATORS

655-1169, 655-1200	See Remarks
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Position indicators are divided into two groups- (1) Wheel and flap position indicators, which consolidate into one instrument four elements to indicate the position of each landing wheel and the landing flaps, and (2) Flap Indicators which indicate, with single or dual elements, the position of various flaps on the aircraft such as landing, cowl, and oil-cooler flaps, and trim tabs.

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The wheel and flap position indicator operates from the wheel lock switches and from a position transmitter connected by mechanical linkage to the wing flaps. This indicator, designated AN 5780-3, is an improvement over previous types in that wheel transmitters with their attendant installation and maintenance difficulties are eliminated. The wheels are indicated in three positions, namely, up-locked, unlocked, and down locked.

The flap indicator shows angular position of the flaps by means of a pointer actuated by a potentiometer type transmitter. Both types of instruments use 24 volt direct current systems.

PURPOSE: To provide suitable combined wheel and flap, and separate flap position indicating systems for aircraft use.

AUTHORITY: Chief, Engineering Division.

REMARKS: Position indicating systems of similar types have been used commercially. This development consists chiefly of modifications and improvements to obtain satisfactory standard systems.

The following companies have been charged with required development:

General Electric Company,
West Lynn, Mass.

Weston Electric Instrument Company,
Newark, New York.

A new wing flap indicator using a degree scale and an adjustable cover plate on the dial in order that various degrees of down flap travel can be indicated is currently being standardized.

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CARBON MONOXIDE INDICATORS

655-1196
Expenditure Order No.

See Remarks
Mfg. on Activity charged with Development

None
Classified Project No.

AC (535) M-405-E
Contract Number

DESCRIPTION: The problem has been broken down into two distinct parts, i.e. the development of a satisfactory instrument for "spot testing" proto-type airplane, periodic examination of service aircraft and a second type of device intended for permanent installation in aircraft to operate a warning signal or to automatically adjust ventilation dampers in the event that the concentration of exhaust gases in the interior of airplanes becomes excessive.

PURPOSE: To develop a satisfactory instrument for detecting the concentration of carbon monoxide in military aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: This development program was initiated 4 October 1940. A large number of instrument manufacturers, research laboratories, and governmental agencies were contacted for advice and assistance in this program. In the meantime, it was learned that the Fransborough Laboratories of the British Air Ministry had developed a colorimetric detector intended for "spot testing", this was examined and found lacking in several respects. Subsequently the National Bureau of Standards improved the original device and plans are now underway to standardize this new development as one part of the answer to this problem.

Indicators or signal assemblies of the continuous operating type designed by Stewart Warner Corp., Chicago, Ill., Frigidaire Division of General Motors Corp., Dayton, Ohio, and Mine Safety Appliance Co., Pittsburgh, Pa., have been laboratory and flight tested. Of these the M.S.A. instruments proved satisfactory and a service test quantity were procured. Some of the service tests instruments have been installed on Winterization airplanes and are at present undergoing tests at Ladd Field.

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ICE WARNING INDICATORS

655-974
Expenditure Order No.

See Remarks and
Equipment Laboratory
Mfg. or Activity charged

None
Classified Project No.

(535) 43-17487
(535) 42-11155
(535) 43-17200-E
(4027) 43-203E
(535) 43-10247-E
Contract Number

DESCRIPTION: This equipment consists of electronic and mechanical devices to give an indication of ice formation on wings and carburetor induction systems.

PURPOSE: To provide an indication of dangerous ice formations on wings and carburetors.

AUTHORITY: Chief, Engineering Division.

REMARKS: An indicator was developed by the Muter Company, Chicago, Illinois, for carburetor ice using a lamp and photo-cell. This device was found to be unsatisfactory due to failure of photo tubes under vibration and formation of ice at points other than at the photo-cell. The Minneapolis-Honeywell Regulator Co., Minneapolis, Minnesota, has delivered samples of wing ice indicators based on capacity change due to the high dielectric constant of ice. Six of these indicators are being service tested at Ladd Field, Alaska.

Relative Humidity Indicators are being investigated as a means of indicating probable icing conditions. Samples based on surface conductivity and contraction of organic substances are being laboratory tested.

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OIL DILUTION INDICATOR

655-1151
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

W33-038-ac-401
(535) 43-31340-E
Contract Number

DESCRIPTION: The equipment consists of an oil dilution indicator which will show the percentage of engine oil dilution and an oil dilution control to close the oil dilution solenoid when a pre-set percentage is reached. The indicator dial will indicate oil dilution from 0 to 40%.

PURPOSE: To develop a device that will definitely indicate or control the per cent of engine oil dilution, particularly during the dilution period.

AUTHORITY: Chief, Engineering Division.

REMARKS: A control based on viscosity controlled flow with temperature compensation, acting as a sampling device, has been found to be unsatisfactory because of poor calibration at low temperatures and congealing of oil sampling lines. Installations designed to overcome congealing of oil in the lines will be made, and service tests conducted at Ladd Field.

Experimental work is being conducted to develop an indicator, since an indicator provides cockpit control and continuous indication. The indicator transmitter should be mounted in the main oil line to avoid congealing of oil.

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CYLINDER TEMPERATURE INDICATOR-RATIO METER

655-1015
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

(535) 42-16432
(535) 43-25929-E
(535) 43-11076-E
(535) 43-24735-E
Contract Number

DESCRIPTION: This indicator is a standard meter thermometer indicator with a range of 0 to 300 deg. C. and is used in conjunction with a minature resistance bulb screwed into the cylinder head of air-cooled engines.

PURPOSE: To develop a more accurate and reliable means of indicating cylinder head temperature than the present standard thermocouple method.

AUTHORITY: Chief, Engineering Division.

REMARKS: This new method will result in an approximate saving of 10 tons of nickel per year now used in the iron constantan thermocouple leads. This project has been delayed due to the difficulty in designing a satisfactory resistance bulb which would be interchangeable with the plug-in type thermocouple. If the bulbs are satisfactory, then a cylinder temperature indicator of the ratio meter type and bulb will be standardized.

BRAKE HORSEPOWER AND BMEP INDICATORS

655-1064
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

(535)43-1485-E
Contract Number

DESCRIPTION: The torque pressure which is in direct proportion to the propeller torque is transmitted to the instrument panel by oil

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pressure through the torquemeter located integral with the engine itself. The torque pressure of the oil is transferred to the instrument which is fundamentally a pressure gage. By setting off the engine speed on the instrument dial with the knob provided, the dial pointer will measure, instead of the torque pressure, the actual brake horsepower and BMEP directly on two previously calibrated scales on the face of the same dial.

PURPOSE: To develop a device that will measure engine power in flight directly and consequently enable pilots and flight engineers to operate the power plant more efficiently.

AUTHORITY: Chief, Engineering Division.

REMARKS: Six of the direct reading BHP and BMEP indicators were procured from the Kollsman Instrument Division of Square D Company, Elmhurst, N. Y., and passed all laboratory tests. Flight tests are now being conducted on a B-17E Airplane at Flight Section, Wright Field.

MILES PER GALLON-INDICATOR

655-1063	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: The miles per gallon indicator embodies the components of an air speed indicator and fuel flowmeter. The instrument which combines the two readings is a ratio-meter consisting of two coils opposing each other. A resistor arrangement on the air speed indicator controls the electrical current passing to one coil on the ratio-meter in accordance with the air speed. The fuel flowmeter is provided with a commutator that supplies the current for the other coil on the miles per gallon indicator, the magnetic strength on the coil varying as the rate of fuel flow. The indicator on the instrument panel will not measure the miles per gallon directly but the pilot, while flying at a constant speed, can adjust his controls so that the dial pointer reaches a maximum on the scale. Under these conditions, the aircraft will operate with maximum economy.

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For different conditions (weather, speed, etc.) the pilot may readily determine if the aircraft is operating with peak economy of fuel by watching this instrument and adjusting his controls so that the instrument indicates a maximum.

PURPOSE: To develop a miles per gallon indicator, for use on long range aircraft, that will facilitate optimum cruising efficiency under all conditions of load, with a minimum of recourse to charts.

AUTHORITY: Chief, Engineering Division.

REMARKS: The General Electric Co., Schenectady, N. Y., miles per gallon indicator has been flight tested and was not satisfactory, due to excessive oscillation of the pointer. The Eclipse-Pioneer Division, Teterboro, New Jersey type has operated satisfactorily during flight tests in an A-29 Airplane and long range flights in a B-17F Airplane will be made in the near future to check operation and usefulness of this miles per gallon indicator.

POSITIVE DISPLACEMENT PUMP FOR HIGH ALTITUDE

655-1083 Expenditure Order No.	Chandler-Evans Corp., South Meriden, Conn. Mfr. or Activity charged with Development
None Classified Project No.	(535) 43-11508 Contract Number

DESCRIPTION: This system consists of positive displacement fuel pump arranged in such a way that extremely high altitude operation is possible.

PURPOSE: To develop a pump which will furnish fuel to the carburetor at high altitudes under normal required pressures.

AUTHORITY: Chief, Engineering Division.

REMARKS: In connection with automatic fuel system development, it appeared necessary to provide modifications to gain high altitude operation. Experimental test with a modified fuel pump arrangement was made and indicated that extremely high altitude operation could be obtained by re-designing the pumping system. This preliminary study resulted in negotiations with Chandler-Evans Corporation for this development. Two of the pumps covered by this development have been delivered and are at the present time being tested with satisfactory results.

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OIL FROTHING AT HIGH ALTITUDE

655-1069
Expenditure Order No.

Aro Equipment Company,
Bryan, Ohio
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: The equipment consists of a gear pump and an air eliminator to separate air and foam before the oil is pumped back to the engine.

PURPOSE: To provide a system to eliminate the frothing of the oil at high altitude, thereby providing solid oil under normal pressure to the engine.

AUTHORITY: Chief, Engineering Division.

REMARKS: The experimental models have been completed and an improved model for further tests and installation in an airplane has been procured.

FLOWMETER-PUMP-COMBINATION

655-775
Expenditure Order No.

See Remarks
Mfg. or Activity charged with Development

None
Classified Project No.

(535) 43-5514-E
(535) 43-10246-E

DESCRIPTION: This project consists of the development of a fuel pump to act concurrently as a flowmeter. Two systems are being developed as follows: The Steel Products system consisting of an electrically operated positive displacement pump for use as a booster pump and to indicate the fuel consumption in gallons. The Chandler Evans system consisting of a pump, the RPM of which is controlled by the fuel flow and by a hydraulic system using the engine oil pressure. The hydraulic features eliminate pressure drop across the meter thus resulting in more accurate indication and reduced possibility of failure.

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PURPOSE: (1) To provide an accurate flowmeter of high capacity and minimum weight. (2) To provide fuel flowmeter readings in combination with a booster pump.

AUTHORITY: Chief, Engineering Division.

REMARKS: Systems for test have been procured from
Steel Products Engineering Company,
Springfield, Ohio.

Chandler Evans Corporation,
South Meriden, Connecticut.

The Steel Products system has been laboratory tested and has operated over a period of 1800 hours with minor difficulties. A preliminary Chandler Evans system indicated very satisfactory results and an improved model is being procured.

FLOWMETER, FUEL (3000 LBS. PER HOUR)

655-1204 Expenditure Order No.	Eclipse-Pioneer Division of Bendix Aviation Corporation Teterboro, New Jersey Mfg. or activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This instrument indicates the rate of fuel flow to an aircraft engine in pounds per hour. It is for use on Pratt and Whitney R-4360 series engines. The transmitter is located in the fuel line between the engine-driven fuel pump and the carburetor. The rate of flow is measured by the movement of a small balanced vane in a spirally cut metering chamber.

PURPOSE: To develop a fuel flowmeter of sufficient range for R-4360 engines.

AUTHORITY: Chief, Engineering Division.

REMARKS: Laboratory tests have been completed with satisfactory results. Flight tests will be made as soon as an airplane with R-4360 engines is available.

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FUEL FLOWMETER, (ORIFICE TYPE)

655-1202
Expenditure Order No.

Westinghouse Electric & Mfg.
Pittsburgh, Pennsylvania
Mfg. or Activity charged with Development

NONE
Classified Project No.

None
Contract Number

DESCRIPTION: This equipment consists of an orifice type flowmeter (thin plate type) with an especially designed electric differential pressure transmitter operating a milliameter type indicator.

PURPOSE: To develop a simpler and lighter weight fuel flowmeter.

AUTHORITY: Chief, Engineering Division

REMARKS: Laboratory tests indicate that errors due to fuel specific gravity and viscosity are too large. The indicator scale range is also limited. Westinghouse is now attempting to correct these difficulties.

FUEL FLOWMETER (ROTATING VANE)

655-1177
Expenditure Order No.

See Remarks
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: The rotating vane meter measures rate of flow of fuel and amount of fuel consumed in gallons instead of pounds. The r.p.m. of the rotating vanes is proportional to the rate of flow of fuel in gallons per hour. A D.C. "selsyn" system transmits the r.p.m. to an indicator similar to a tachometer, which is graduated in gallons per hour and fuel consumed.

PURPOSE: To develop a volumetric fuel flowmeter of lighter weight and simpler construction.

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AUTHORITY: Chief, Engineering Division.

REMARKS: One meter has been submitted by each of the following manufacturers:

Smith Meter Co.
Los Angeles, California

Pittsburgh, Equitable Meter Co.
Pittsburgh, Pennsylvania.

The Smith meter has passed laboratory tests satisfactorily. Installation on an airplane will be accomplished in the near future. The Pittsburgh meter failed on scale error test and has been returned to the manufacturer for reworking.

FUEL FLOWMETER ("MAGNA-BOND" ROTAMETER TYPE)

655-1123 Expenditure Order No.	Fischer & Porter Co. Hatboro, Pennsylvania. Mfg. or activity charged with Development
None Classified Project No.	(535) 43-18963-E (4027) 43-359-E Contract Number

DESCRIPTION: The Fischer & Porter meter consists of a vertical tapered Pyrex glass tube in a metal case. A "float" or follow metal cylinder takes a definite position in the glass tube for every rate of flow in pounds per hour. This position is transmitted to the indicator by means of a magnetic coupling and an "autosyn" remote reading system.

PURPOSE: To develop a more accurate fuel flowmeter.

AUTHORITY: Chief, Engineering Division.

REMARKS: Laboratory tests on two each of the Fischer & Porter instruments indicate that improved accuracy is obtained with a wide range of fuel specific gravities. Flight tests are now being conducted on one meter on a B-17F Airplane.

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COMMUTATOR TRANSMITTER FOR ELECTRIC TACHOMETERS

655-944 655-998	See Remarks:
Expenditure Order No.	Mfg. or Activity charged with Development
None	(535) 42-14571
Classified Project No.	Contract Number

DESCRIPTION: The commutator transmitter is a device designed to commutate direct current from the aircraft electrical system in such a manner as to produce a simulated three phase alternating current which will drive the synchronous motor in the standard electric tachometer indicator.

PURPOSE: To reduce the weight and increase the performance of the standard tachometer system.

AUTHORITY: Chief, Engineering Division.

REMARKS: The commutator has not proven satisfactory as yet due to the large amount of radio interference which it generates. Means of reducing the interference are being studied.

The following Companies have been charged with development of this equipment:

Kollsman Instrument Division,
Square "D" Company,
Elmhurst, New York.

General Electric Company,
West Lynn, Mass.

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DUAL ELECTRIC TACHOMETER

655-1163
655-1215
Expenditure Order No.

See "Remarks"
Mfg. or Activity Charged with Development

None
Classified Project No.

(535) 43-31135
Contract Number

DESCRIPTION: The dual electric tachometer is a dual indicator designed to operate from the same generators as used with the single electric indicators. The instrument consists of two synchronous motors, each driving a magnetic drag assembly which produces a pointer torque against a hair spring to give an indication of speed in Revolutions Per Minute. The instruments as made by the various manufacturers differ only in the design of the magnetic drag assemblies. This tachometer has been built with a built-in synchroscope element to indicate the degree of synchronism between the two engines. This instrument has also been modified to indicate engine and rotor speeds for helicopters.

PURPOSE: To develop a suitable dual electric tachometer for use on multi-engine aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: The dual engine tachometer was designated Type E-14 when procured. It has since been standardized by the Army and Navy and designated AN5530-2 and AN5530-3 for the dual with built-in synchroscope.

The following manufacturers were charged with the development of this instrument:

Pioneer Instrument Division,
Bendix Aviation Corp.,
Teterboro, New Jersey.

Kollsman Instrument Division,
Square "D" Company,
Elmhurst, New York.

General Electric Company,
West Lynn, Mass.

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PRESSURE GAGE SNUBBER DEVICES

665-1109
Expenditure Order No.

Rochester Mfg. Company
Rochester, New York
Mfg. or Activity Charged with Development

None
Classified Project No.

W-535-AC-43-12222-E
Contract Number

DESCRIPTION: Snubbers and anti-vibration devices are required on some pressure gage applications to prevent excessive pointer oscillation. This device consists of a self-cleaning type of restrictor fitting for use in the gage line.

PURPOSE: This study has been opened to investigate the various snubbers with a view of obtaining the most suitable means for preventing gage oscillation.

AUTHORITY: Chief, Engineering Division.

REMARKS: Samples from several sources have been obtained. In addition, several laboratory samples have been fabricated. Development is not yet completed.

MULTIPLE FUEL TANK SHUT-OFF VALVE

664-498
Expenditure Order No.

Buckeye Iron & Brass Works,
Dayton, Ohio
Mfg. or Activity Charged with Development

None
Classified Project No.

(535) 43-10511-E
Contract Number

DESCRIPTION: This device is a manifold for multiple refueling of all wing tanks on large aircraft simultaneously. On each outlet of the manifold an automatic shut-off valve is provided to stop fuel flow when the tank is full. The capacity of each shut-off valve is 110 gallons per minute. This manifold is fed by a single fuel line leading from a fuel truck or trailer.

PURPOSE: To develop a device to speed servicing of large aircraft and eliminate fire hazards.

AUTHORITY: Chief, Engineering Division.

REMARKS: Experimental quantities have been procured from Buckeye Iron and Brass Works, Dayton, Ohio, and have been satisfactorily tested. An improved design is being procured for further test.

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PIPE LINE PUMP

658-135
Expenditure Order No.

Leyman Mfg. Corp.
Cincinnati, Ohio
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: The pump is a vane type variable displacement pump, rated to deliver 200 gallons per minute against a 100 p.s.i. pressure head. It is equipped with a pressure controlled device which will automatically cut the output of the pump as required.

PURPOSE: To develop a portable pipe line booster pump for servicing aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Leyman Manufacturing Corporation, Cincinnati, Ohio, has been contacted for the development of this pump.

IMPROVED BIMETAL THERMOMETERS FOR FREE AIR

655-1143
Expenditure Order No.

See "Remarks"
Mfg. or Activity Charged with Development

None
Classified Project No.

(535) 43-26415-E
(535) 43-25942-E
(535) 43-32176-E
Contract Number

DESCRIPTION: Bimetal Free Air Thermometers with range of -70°C. to +50°C, -80°F. to +120°F. -70°C. to +150°C and dual scale -70°C. to +56°C. and -94°F. to +152.8°F. The dual scale thermometer will have a 2-3/4" case and a 3" stem length in lieu of the present 5" stem on the C-13A bimetal thermometer.

PURPOSE: To develop thermometers requested by the service as a result of operations in Alaska.

AUTHORITY: Chief, Engineering Division.

REMARKS: Development has been discontinued on the dual scale bimetal thermometer as reports from the service have indicated that it is not desirable for use as a free air thermometer. A -70°C. to +50°C. in a 1-3/4" case and a 3" stem length is being developed

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to replace the standard C-13A thermometer. This thermometer is to be designated as Type C-18. Samples are being submitted by the following manufacturers:

Ohio Thermometer Co.
Springfield, Ohio

Rochester Mfg. Co.
Rochester, New York

QUICK DISCONNECT FITTINGS

655-995	Machined Products Company Louisville, Kentucky
Expenditure Order No.	Mfg. or Activity charged with Development
None	(535) 42-19930
Classified Project No.	Contract No.

DESCRIPTION: The fitting consists of a plug and socket assembly to quickly connect or disconnect pressure or vacuum lines from the source to an instrument in the cockpit.

PURPOSE: To eliminate the special fittings and tools for connecting and disconnecting the lines and speed up the installation of the equipment.

AUTHORITY: Chief, Engineering Division.

REMARKS: Experimental quantities have been procured and tested. Some experimental tests are being made on airplanes. Improved models are being procured for the same purpose from the Machined Products Company of Louisville, Kentucky.

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DRAIN COCK

655-800 Expenditure Order No.	Machined Products Company Louisville, Kentucky Mfg. or Activity charged with Development
None Classified Project No.	(535) 42-19996 Contract No.

DESCRIPTION: This device consists of a drain cock for use on fuel, oil and Prestone tanks and lines for the purpose of providing a readily accessible drain. It incorporates a self-locking feature and thus eliminates the safety wire required on the present drain cocks. This is considered very desirable under extremely cold weather conditions where it becomes very difficult to drain and re-safety the cocks.

PURPOSE: To provide a readily accessible drain cock for fuel, oil and Prestone tanks.

AUTHORITY: Chief, Engineering Division.

REMARKS: A number of these cocks are at the present time being tested on Winterized airplanes at Ladd Field. Air Forces drawings have been prepared and are being released to standard.

AUTOMATIC FUEL SYSTEM

655-800 Expenditure Order No.	Aro Equipment Company Bryan, Ohio Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-4172-E Contract No.

DESCRIPTION: This device operates on a pressure drop in the fuel system. When fuel pressure drops to a pre-determined value, a pressure switch makes contact, thus operating an electric motor to revolve the fuel cock handle to another tank containing fuel. When the pressure in the system reaches normal, the device automatically stops at a tank containing fuel. Furthermore, if a

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succeeding fuel tank is empty, the device passes the empty tank and stops at a full tank. Means have been incorporated in the system to assure satisfactory high altitude operation. Safety means have been provided to eliminate unintentional use of the fuel reserve prior to its need.

PURPOSE: To provide an automatic means of changing from an empty tank to a full tank in a fuel system of an aircraft in flight.

AUTHORITY: Chief, Engineering Division.
Also Teletype dated 27 Nov 1943 from ACAS, MM & D.

REMARKS: This type of automatic fuel system has been tested on two different type airplanes, and an improved design has been procured and is being tested now for installation on a new type of airplane. These automatic fuel systems have been procured from the Aro Equipment Company, Bryan, Ohio.

An installation is currently being made on a P-47B airplane for Service Test at Eglin Field. Procurement of systems for test installations on P-38 and P-51 series airplanes have also been initiated.

INSTRUMENT MOUNTING NUTS

655-1171	(See Remarks)
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This project comprises development of a self-locking type instrument mounting nut in order to facilitate "front mounting" of aircraft instruments.

PURPOSE: To simplify instrument mounting problems.

AUTHORITY: Chief, Engineering Division.

REMARKS: Self-locking type nuts commonly available were not entirely suitable for instrument mounting in that they were difficult to

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install and would sometimes turn in the panel. A nut made of non-magnetic materials that could be installed on the instrument panel without the use of special tools was required. The following manufacturers were requested to work on the project:

Tinnerman Products Inc.,
Cleveland, Ohio.

Elastic Stop Nut Corp.,
Union, New Jersey.

Boots Aircraft Nut Corp.,
New Canaan, Connecticut.

Of the samples submitted to date the Tinnerman Nut #6939 has proved most satisfactory, and has been approved.

SIMPLIFICATION STUDY OF ENGINE INSTRUMENT PANEL

655-1182	Equipment Laboratory
Expenditure Order No.	Lab. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This project covers the development of new indicating means or arrangements of aircraft instruments to make them more quickly and easily read than the present gages. Systems being considered for use are vertical or horizontal scale instruments grouped by types, clusters of small individual instruments with circular scales, and "opposed pointer" type scale instruments arranged to reduce indication interpretation effort to a minimum. Complete unit panel installations arranged for rapid installation and servicing are also being studied.

PURPOSE: To provide a simplified instrument system to reduce possibility of aircrew errors due to misinterpretation of instrument readings.

AUTHORITY: Chief, Engineering Division.

REMARKS: Aside from the basic study, action has been initiated to

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improve the readability of current instruments with concentric pointers marked "L" and "R" (L and R for Left engines, and "L" and "R" for Right engines in the case of 4-engine airplanes) by remarking them 1, 2, 3, and 4. Action has also been taken to adopt "opposed pointer" type gages for fuel pressure, oil pressure, temperature, and fuel quantity indications in lieu of the confusing concentric pointer type instruments.

PORTABLE FILLER GUN

655-1078 Expenditure Order No.	Buckeye Iron and Brass Works, Dayton, Ohio. Mfg. or Activity charged with Development
None Classified Project No.	W-535-AC-43-31046-E (33-096) 44-960-E Contract No.

DESCRIPTION: This device consists of a cylinder and piston arrangement for use in filling the Type A-1 fuel and oil pressure transmitter system with compass liquid.

PURPOSE: To develop a device for servicing the pressure transmitter lines and also for servicing oil pressure gage lines to obtain more satisfactory operation under cold temperature condition.

AUTHORITY: Chief, Engineering Division.

REMARKS: Two samples are undergoing Winterization Tests at Ladd Field. Three additional articles have been sent to Eglin Field for Service Test. If the filler guns are satisfactory for the purpose intended, they will be made standard.

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RATE OF CLIMB INDICATOR

655-1128 Expenditure Order No.	John Robinson Company Altadena, California Mfg. or Activity charged with Development
None Classified Project No.	43-467 Contract No.

DESCRIPTION: This instrument is a sensitive pellet-type vertical speed indicator for use on gliders. The position of the pellet in a verticle plane with respect to reference marks on the tapered tube gives a visual indication of rate of climb or descent. The position of the pellet is determined by the static pressure introduced from the airplane static tube.

PURPOSE: To develop a more sensitive rate of climb indicator for use on gliders.

AUTHORITY: Chief, Engineering Division.

REMARKS: It is expected that comparative tests with standard instruments will show these to be more suitable for use on Army Air Forces' gliders, due to increased sensitivity. Delivery of the 10 instruments has been made. Laboratory tests have been completed with satisfactory results and the indicators are now undergoing flight tests.

RATE OF ROLL INDICATOR

655-1195 Expenditure Order No.	L. M. Schwien Engin. Co. Los Angeles, California Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: This instrument is designed to give an indication of the rate of roll of an aircraft about the longitudinal axis.

PURPOSE: To provide a test instrument to determine the rate of roll of new designs of aircraft.

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AUTHORITY: Chief, Engineering Division.

REMARKS: Two instruments have been delivered and will be subjected to laboratory and flight tests.

TRUE AIRSPEED INDICATOR

655-949 655-938	(See Remarks)
Expenditure Order No.	Mfg. or activity charged with Development
None	W-535-AC-25438 W-535-AC-24035
Classified Project No.	Contract No.

DESCRIPTION: An indicator which incorporates an indicated airspeed meter, an altimeter and a free air thermometer so arranged that the true airspeed is given directly by a single pointer on a dial calibrated in mph from 100 to 500. The indicator fits in a standard size instrument cut out and weighs slightly over 2 pounds.

PURPOSE: To develop an instrument which will indicate true airspeed.

AUTHORITY: Chief, Engineering Division.

REMARKS: The present contract was initiated 26 November 1941. A sample indicator was delivered December 1942, but returned for reworking. Complete delivery was made in March 1943 of the Kollsman instruments, and laboratory tests have been carried on to date with satisfactory results. Flight tests are under way and laboratory tests have been completed with satisfactory results. Three indicators have been sent to Eglin Field for service tests. A fourth has been sent to Aberdeen Proving Ground for testing with the aid of the Camera obscure. The following companies are engaged in the development:

Kollsman Instrument Division,
Elmhurst, New York.

Schwien Engineering Company,
Los Angeles, California.

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BANK & TURN INDICATORS

655-1183	See "Remarks"
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: The A-14 Bank & Turn Indicator is designed to give twice the deflection of the needle, for a given rate of turn, as obtained with standard types A-11 and AN-5820 Bank and Turn Indicators.

The A-15 Bank & Turn Indicator is designed to give the same indication of the needle as the Type A-14, up to turns of 270° per minute. At turns of a higher rate than 270° per minute the deflection of the needle increases rapidly reaching full scale deflection of one inch at a rate of turn of 360° per minute.

PURPOSE: To provide an instrument which will be more sensitive to turns about the vertical axis for high performance aircraft.

AUTHORITY: Paragraph 1 of a letter from the Assistant Chief of Air Staff (MM&D) to the Materiel Command, Engineering Division, dated 20 July 1943, subject "Turn and Bank Indicator in High Performance Aircraft".

REMARKS: At the request of ACAS/MM&D two each of the Type A-11, A-14 and A-15 bank and turn indicators have been delivered to Eglin Field for comparative tests in various types of aircraft. The following companies are engaged in the development:

Burton Manufacturing Co.
Chicago, Illinois

Pioneer Instrument Div. of Bendix Aviation Corp.
Teterboro, New Jersey.

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MACHMETER

655-1205	See "Remarks"
Expenditure Order No.	Activity or Mfg. Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This meter consists of an indicator which incorporates the elements of an altimeter on an airspeed indicator so arranged as to give an indication of Mach numbers. The dial will be graduated from approximately .4 to 1.0 and indications will be directly in Mach numbers.

PURPOSE: To develop an indicator to indicate a maximum speed for high performance aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Experimental models are being made by the Kollsman Instrument Division, Elmhurst, N. Y. and the Schwien Engineering Company, Los Angeles, California.

Delivery is expected approximately 1 May 1944.

BAROGRAPH, TYPE B-2

655-1147	American Industries, Cincinnati, Ohio
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(2119) 43-1402
Classified Project No.	Contract Number

DESCRIPTION: The barograph consists of an aneroid mechanism actuated by pressure changes to record altitude vs. time. It has a range of -1000 feet to 50,000 feet and a duration of 12 hours. Records are made in ink on a ruled chart wrapped around a drum which is driven by a clock mechanism.

PURPOSE: To furnish barographs for use at training centers to provide for a permanent record of flights at altitude.

AUTHORITY: Chief, Engineering Division.

REMARKS: A service test quantity of 10 instruments has been delivered and is undergoing laboratory and flight tests of final approval.

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ELECTRICAL AIR POSITION INDICATOR

655-1149 Expenditure Order No.	Fairchild Aviation Corp. Jamaica, New York Mfg. or Activity Charged with Development
None Classified Project No.	W-535- 45-30548-E Contract Number

DESCRIPTION: This indicator is an instrument which will continuously indicate in flight, the air position of the aircraft in degrees, latitude, and longitude. Further provision is made to put in wind velocity and direction in order that ground position will also be registered. The input for air position is the compass heading corrected for deviation and variation, and true air speed obtained from a newly-developed true air speed indicator. The intergration into latitude and longitude is then performed electrically and the reading registered on the counters. Its principle of operation is based on that of the two-phase induction watt-hour meter.

PURPOSE: To develop automatic dead-reckoning navigation to aid the navigator on long flights, on flights involving evasive action, and on flights during which neither the sky nor ground can be seen.

AUTHORITY: Chief, Engineering Division.

REMARKS: In September 1942, intensive work was begun by personnel of the Instrument and Navigation Branch to study all possible methods by which the air position indicator could operate, and to determine as nearly as possible which methods would be best. Accuracy of the instrument is important; the highest possible accuracy is desired. With the development of the new true air speed indicator, from which the speed of rotation of a shaft is made proportional to true air speed, and with the accurate compass indication which is now available, the air position indicator is a logical and promising step in instrument development. Experimental models have been tested and have provided a great deal of valuable information concerning future development. Preliminary tests have borne out all expectations of the equipment.

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AUTOMATIC AVERAGER FOR SEXTANTS

655-1199
Expenditure Order No.

Demeulenaere Bros.,
New York, New York
Mfg. or Activity Charged
with Development

None
Classified Project No.

W-535-AC-15050
Contract Number

DESCRIPTION: A mechanical intergrating device containing a pair of totalizing members, one totalizing readings, and the other totalizing time. They are arranged so that the average of any number of observations extending over periods from 30 seconds to 2 minutes can be read directly on the counter of the sextant.

PURPOSE: To develop an instrument that will automatically average a series of observations.

AUTHORITY: Chief, Engineering Division.

REMARKS: An experimental article has been tested. This device ~~is unique~~ among averaging devices in that no predetermined period of observation is required. The observer may stop and read the average with full accuracy at any time exceeding 30 seconds. Procurement has been initiated for a quantity of five for test by service activities.

AUTOMATIC AVERAGING SEXTANT

655-1074
Expenditure Order No.

Fairchild Aviation Co.,
Jamaica, Long Island, N.Y.
Mfg. or Activity Charged
with Development.

None
Classified Project No.

None
Contract Number

DESCRIPTION: This instrument will automatically average the observations taken by a navigator for a predetermined period - usually two minutes. The navigator is required to maintain collimation for the period determined by the design. The average is then read directly.

PURPOSE: To devlop a chronometric type of averaging device to be fitted to the A-10 sextant.

AUTHORITY: Chief, Engineering Division.

REMARKS: One instrument has been delivered by the Fairchild Aviation Company, and is undergoing experimental test.

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PERISCOPIC SEXTANT

Fairchild Aviation Company
Jamaica, Long Island, N.Y.
Eclipse-Pioneer Division
Bendix Aviation Corp., Teterboro,
New Jersey.
Mfg. or Activity Charged with Development.

655-715
Expenditure Order No.

None
Classified Project No.

(535) 40-3285 (535) 42-2184
Contract Number

DESCRIPTION: This is a sextant built in the form of a periscopic telescope in which the viewing prism projects through a hole in the top of the aircraft and is used by the observer inside. This type of instrument does not require windows or a dome.

PURPOSE: To develop an instrument which will permit celestial observation without requirement of a dome.

AUTHORITY: Chief, Engineering Division.

REMARKS: Two instruments have been previously tested with unsatisfactory optical performance. A new and simpler design by Kollsman Instrument Division, is being investigated. The following companies are interested in the development:

Kollsman Instrument Division
Square "D" Company
Elmhurst, New York.

Fairchild Aviation Company
Jamaica, Long Island, N. Y.

Eclipse-pioneer Division
Bendix Aviation Corp., Teterboro,
New Jersey.

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SOLENOID TIMER FOR A-10 SEXTANT

655-1-968	Fairchild Aviation Co., New York, N. Y.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(535) 42-1876
Classified Project No.	Contract Number

DESCRIPTION: This is an automatic marking device designed to eliminate errors due to improper timing of observations. It is expected that this device will increase the accuracy of observations.

PURPOSE: To develop an improved averaging device and minimize errors with the sextant due to navigator fatigue and improper procedure.

AUTHORITY: Chief, Engineering Division.

REMARKS: The first model has been delivered and is now undergoing tests at Wright Field.

TEMPERATURE TESTS ON NAVIGATION EQUIPMENT

655-1146	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: These tests cover a temperature range from 140°F. to -65°F. and are being conducted to determine maintenance and operation of extreme temperatures and any redesign of the equipment necessary to permit efficient operation over the entire temperature range.

PURPOSE: To conduct high and low temperature tests on standard instruments and navigation equipment.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Cold Weather Detachment at Ladd Field is supervising these tests which are still in progress.

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NAVIGATION CARRYING CASE

655-1158	Gralnick Bros, Philadelphia, Pa.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(535) 43-30 810E
Classified Project No.	Contract Number

DESCRIPTION: The case will have dimensions 22" X 10" X 8". It will weigh about 10 pounds empty and 40 pounds when full.

PURPOSE: To develop a navigation case which will hold all the equipment required by a navigator on a mission.

AUTHORITY: Letter from the Chief Development Engineering Branch, Materiel Division, MMD to Commanding General, Wright Field, 9th April 1943, Subject: Carrying Case for Navigation Instruments.

REMARKS: In April, 1943, action was initiated to design a case of suitable size and with the necessary interior fittings for holding the equipment. Sample cases were procured from Gralnick Bros., Philadelphia, and it was decided to procure a wooden case covered with canvas and leather.

Space has been provided for the following equipment: scratch pads, log sheets, master-watch, spare batteries and bulbs for sextant, folded maps and charts, insert to hold drafting equipment, and a sextant. A satisfactory arrangement has been developed which will permit any of the sextants used by the Army Air Forces to be carried safely in this case. Procurement data have been made available and standardization will be effected in the near future.

SNOW GLASSES

655-1-1044	American Optical Co., Southbridge, Mass. - Monsanto Chemical Co., Springfield, Mass.
Expenditure Order No.	Mfg. or Activity Charged With Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Goggles of the sun glass type.

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PURPOSE: To develop goggles for protection against glare and snow blindness in arctic areas.

AUTHORITY: OCAS OC&R - MM&D.

REMARKS: A new glass so called Rose Smoke has been developed and standardized in standard flying sunglasses for pilots use. The same lens in plastic frames is used for line personnel in the arctic theater. A plastic material having the same color and light transmission characteristics has been developed and samples to fit the Type B-8 goggle are under procurement. Plastic and leather folding goggles with the same lens are also under procurement for test.

HEATING UNITS FOR B-7 GOGGLES

655-1-1097	General Electric Co., Bridgeport, Conn.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Electrical heating units for the type B-7 goggle consisting of a frame with fine heating wires held on the face of the goggle lens.

PURPOSE: To prevent fogging and ice formation on B-7 Goggles.

AUTHORITY: Chief, Engineering Division. Priority 2 O.C.&R.

REMARKS: Samples were procured which satisfactorily prevented fogging at -70°C. They were fragile, however, and restricted visual field. A new type has been developed consisting of a plastic sheet with the wires molded in. Procurement has been initiated for test quantity to fit the standard B-8 goggle.

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ANTI-SEARCHLIGHT GOGGLES

Polaroid Corporation,
Cambridge, Mass
American Optical Co.,
Southbridge, Mass
Mfg. or Activity charged with Development

655-1-1153
Expenditure Order No.

None
Classified Project No.

None
Contract No.

DESCRIPTION: Rotatable Polaroid Lenses in rubber and plastic frame.

PURPOSE: To develop goggles capable of protecting crewmen from blinding effect of searchlight beams.

AUTHORITY: Chief, Engineering Division and requests of General Kenney. Priority 1 by OC&R and MM&D.

REMARKS: A test quantity was sent to General Kenney for test. A letter has been received giving favorable reports but no further requests or statement of requirement. These goggles are of very limited value due to the extreme limitation of field of vision. Proposal of photo-electric cell system proposed by Dr. Rand is being studied. A quantity of the goggles is on procurement for test in other theatres.

EYESHADES FOR COMBAT CREWMEN

655-1-963
Expenditure Order No.

See "Remarks"
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: Covers development of goggles and goggle lenses for combat crewmen

PURPOSE: To develop eyeshades to protect eyes from glare, aid vision and protect against flash fire.

AUTHORITY: Chief, Engineering Division. Priority 1 O.C.&R.

[redacted]

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REMARKS: A new all rubber goggle, Type B-8, supplied with three colored lenses of sheet plastic has been developed and standardized. This goggle is comfortable, gives excellent vision, can be worn with or without the oxygen mask and with the new helmet. A visor attachment is under development to permit vision directly into the sun. Development of a modified metal and glass goggle based on the B-7 (now limited standard) is in progress. The following companies are engaged in the development:

American Optical Company, Southbridge, Mass.
Polaroid Corporation, Cambridge, Mass.
Bausch & Lomb, Rochester, New York.
Charles Fischer Spring Co., Brooklyn, N. Y.

DATA & DRAWINGS - INSTALLATION OF NAVIGATION EQUIPMENT

655-1112 Expenditure Order No.	Production Engineering Modification Centers Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: This project covers prototype installations of equipment in new aircraft or special installations at AAF modification centers. This includes determining the cause of instrument failure and engineering necessary to correct faults.

PURPOSE: To prepare data and drawings for installation of remote reading compasses equipment at Production Engineering Modification Centers.

AUTHORITY: Chief, Engineering Division.

REMARKS: This is a continuous project still in progress.

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FLUXGATE INSTALLATIONS DRAWING

655-1142	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	33-096 44-464E
Classified Project No.	Contract No.

DESCRIPTION: This project entails determination of the most suitable location of the master transmitter of the gyro fluxgate compass and the various elements of the Fluxgate Compass system. It covers prototype installations.

PURPOSE: To prepare installation drawings of standard fluxgate compasses in various aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: At the present time an installation for the Fluxgate Compass in the AT-18A type airplane is being accomplished.

LOAD AND BALANCE COMPUTERS

655-1-997	See "Remarks"
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Computers of various types for calculating, for various load conditions, the location of the center of gravity of the aircraft.

PURPOSE: To develop satisfactory types of load and balance computers.

AUTHORITY: Chief, Engineering Division. Priority 1 by AC/AS, OC&R and MM&D.

REMARKS: The straight slide rule type (Cox and Stevens) is now standard. A mechanical type (Librascope) is unsatisfactory due to inflexibility and slowness of manufacture. The electrical type (Air Comp) is under procurement for test in the C-54A type airplane. A graphical type known as the Comstock is now under test by Air Transport Command and a quantity for use in the B-29 is now ready for test. The

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following companies are engaged in the development:

Air Comp Ltd., Burbank, Calif.
Librascope Corporation, Burbank, Calif.
Cox & Stevens Aircraft, Mineola, N. Y.
Felsenthal & Son, Inc., Chicago, Ill.

FLUORESCENT MATERIALS

655-1-926 Expenditure Order No.	See "Remarks" Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The materials must be stable and of proper color to preserve dark adaption. In order to permit control of brightness, they must be without lag.

PURPOSE: To develop materials activated by ultra-violet light for use on instrument dials.

AUTHORITY: Chief, Engineering Division. Priority II OCR.

REMARKS: Satisfactory materials have been developed and it is expected that in a very short time the present green phosphorescent material will be replaced by the new orange fluorescent pigment. The following companies are engaged in the development:

General Luminescent Corp., Chicago, Ill.
U. S. Radium Corp., New York, N. Y.
Continental Lithograph Co., Cleveland, Ohio

LIFE RAFT NAVIGATION COMPUTERS.

655-1197 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The computer will be a circular slide rule made of plastic

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sheet with which it will be possible to compute latitude from observation of length of day.

PURPOSE: To develop a simple slide rule for use in life rafts.

AUTHORITY: Chief, Engineering Division.

REMARKS: Preliminary design and computations have been completed.

RATE SIGNAL ADAPTERS A-3 AUTOMATIC PILOT

655-1157 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: This equipment consists of a rate gyro, similar to the bank and turn instrument used for introducing a rate of displacement signal into each of the three signal systems of the present A-3 automatic pilot.

PURPOSE: 1. To eliminate the use of the follow-up cables and rigging necessary for installing the present A-3 Automatic Pilot.

2. To improve operation.

AUTHORITY: Chief, Engineering Division.

REMARKS: The introduction of a rate signal into the present automatic pilot signal system can be accomplished several different ways. At present laboratory investigation is being conducted to determine the most satisfactory method.

COLD TEMPERATURE OPERATION OF A-3 & A-3A TYPE AUTOMATIC PILOT

655-1138 Expenditure Order No.	Sperry Gyroscope, Brooklyn, N. Y. Jack & Heintz Co., Cleveland, O. Mfg. or Activity charged with Dev.
None Classified Project No.	W 535 AC-24192;AC-33359;AC-28117 Contract Nos.

DESCRIPTION: Laboratory experiments at -65 degrees F. and -31 degrees F.

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on A-3 and A-3A Type Automatic Pilot equipment.

PURPOSE: To obtain data for cold temperature requirements which will be included in the automatic pilot specifications.

AUTHORITY: Chief, Engineering Division.

REMARKS: Tests were started on 22 June 1943 at Wright Field to obtain the desired information. Sperry and Jack and Heintz, manufacturers of Type A-3 and A-3A pilot respectively, were notified of the low temperature requirements and each submitted samples from time to time. Changes were made in all units where difficulties were encountered. The present status is:

1. Reliability to -35 degrees C.

2. Low temperature tests at -35 degrees C. will be included in specification.

3. Cockpit temperature will have to be maintained at -35 degrees C. to insure proper operation of equipment. Each manufacturer has automatic pilot units at the cold weather test detachment at Ladd Field, Alaska. Information received from the tests at Ladd Field will further aid in the determination of the low temperature test requirements.

A-5 PILOT MANUALS

655-1020 Expenditure Order No.	Milprint Incorporated, Milwaukee, Wisconsin. Mfg. or Activity charged with development
None Classified Project No.	W 535 AC-28221 Contract No.

DESCRIPTION: This equipment consists of a manual containing transvision views of the two gyro controls and the servo unit for the Type A-5 Automatic Pilot, together with a descriptive narration on the principles of operation and operating instructions for the pilot. These manuals are in effect a new version of a technical order.

PURPOSE: To develop a manual to provide personnel with a thorough but

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easily understood theory of the Type A-5 Automatic Pilot as well as instructions on its use and to learn the value of this type of publication.

AUTHORITY: Chief, Engineering Division.

REMARKS: Questionnaires and an introductory sheet explaining the purpose of the manual, together with 2000 copies of the manual have been distributed to pilots. It was requested that the questionnaires be returned in order that an analysis of the future use of this type of manual could be made. Approximately 100 questionnaires have been returned and it appears that this type of manual is well liked.

A-5 PILOT TEST ANALYZER

903-1464	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The model test analyzer will make tests on any component of the type A-5 Automatic Pilot. This tester can be used by maintenance personnel for locating any malfunctions of the pilot.

PURPOSE: To develop a test analyzer to make checks and tests on each of the units of the A-5 Automatic Pilot.

AUTHORITY: Chief, Engineering Division.

REMARKS: The test analyzer was fabricated in November, 1943. Tests are being made on this analyzer with the results being compared to the results obtained with production test equipment. This tester is a small compact unit and should be of value to maintenance personnel in servicing the A-5 Automatic Pilot.

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A-6 AUTOMATIC PILOT

Sperry Gyroscope Co., Inc.
Brooklyn, New York.
Mfg. or Activity charged with Development

655-839
Expenditure Order No.

W 535 AC-19055
(535) 41-9890
W 535 AC-12552
Contract No.

None
Classified Project No.

DESCRIPTION: This equipment consists of a light-weight, completely electrically operated displacement plus rate and acceleration type automatic pilot, designed for use in any type of aircraft. Signals for control of the airplane in pitch and bank are derived from a standard electric gyro horizon. Directional signals are furnished from a standard electric turn indicator which is slaved to a fluxgate which makes the directional control a dead beat magnetic heading. Amplified signals are supplied to the servo units to actuate the control surfaces. Indicating elements are designed for installation at the pilot's instrument panel and are operable independently of the pilot control equipment. Completely coordinated banked turns can be made by the pilot at any airspeed without making any airspeed adjustment. The servos may either be self-contained electro-hydraulic or all electric, depending upon which design gives the lightest weight with equal performance.

PURPOSE: To develop a reliable, light-weight, electrical automatic pilot for use in military aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: A complete three axes experimental A-6 automatic pilot was demonstrated to the Equipment Laboratory in June, 1943, in a Lockheed airplane owned by the Sperry Gyroscope Company, Inc. The flight test made here at Wright Field with this airplane and other flights made by the Sperry Company have proven that the design and operating principles of the pilot are inherently sound. Two pilot models of this design have been delivered for tests and study. Additional studies are being made by the Sperry Gyroscope Company to provide automatic synchronization which has been added as a requirement for satisfactory operation of this pilot.

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A-10 AUTOMATIC PILOT

655-1115
Expenditure Order No.

Eclipse-Pioneer Div.
Bendix Aviation Corp.
Teterboro, New Jersey
Mfg. or Activity charged with Activity

None
Classified Project No.

W 535 AC-40076
Contract No.

DESCRIPTION: A light-weight, completely electrically operated displacement type, automatic pilot designed for use in both fighter and bombardment type airplanes. Signals for control of the airplane in pitch and bank are derived from a small gyro horizon. Directional signals are furnished by a gyro stabilized flux gate and are modified by rate signals originating at the bank and turn indicator. Amplified signals are supplied the servo units to actuate the control surfaces. Indicating elements of the pilot are designed for installation at the pilot's instrument panel and are operable independently of the pilot control equipment. Completely coordinated banked turns can be made by the pilot. Auxiliary equipment may be installed to provide for turns from remote stations, directional indications at remote stations, constant altitude control, and elevator trim tab corrections. Automatic synchronization of the rudder, elevator and aileron axes of the pilot is accomplished through a follow-up signal element geared directly to the respective servo motor.

PURPOSE: To develop a reliable, light weight, electrical, automatic pilot for use in military aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: A complete three axes experimental A-10 automatic pilot was installed in an Army Air Forces Type AT-11 airplane last February. Subsequent flight tests have proven that the design and operating principles of the pilot are inherently sound. The first production item has been received by the Equipment Laboratory, Engineering Division, and laboratory tests are being conducted to determine specification tolerances. These tests are 50% complete. It is anticipated that specifications No. 27435, Type A-10 Automatic Pilot and No. 27436, Installation, Type A-10 Automatic Pilot, will be released by 1 January 1944. The second production item is to be shipped to Vultee Field, California, for installation in an XA-41 airplane. The third production item will be delivered to the British Air Commission. The fourth production item has been delivered to Douglas Aircraft Company, Inc. for installation on the XA-42 airplane. The fifth production item will be delivered to the Materiel Command for installation in a B-17F airplane for flight tests.

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XA-11 AUTOMATIC PILOT

655-1198 Expenditure Order No.	General Electric Co. Schenectady, N. Y. Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The pilot is electrically operated and light in weight. The indicating elements conform in appearance to those presently used in the AAF Type A-10 Automatic Pilot They are designed for front mounting on the Pilot's instrument panel and are operable independently of the automatic pilot equipment. Signals for directional control are derived from a fluxgate element and are modified by rate signals supplied by a bank and turn control. For control about the bank and pitch axes, signals are furnished by a small gyro horizon. The automatic pilot provides means for executing coordinated banked turns from remote stations with automatic compensation to give proportional bank for various air-speeds and rates of turn. Remote control of pitch attitude is likewise provided. Automatic synchronization is incorporated on the three axes. Provisions are included for electrical interconnection in the devices external to the automatic pilot system for coordinating the operation of the device in the course and attitude of the airplane.

PURPOSE: To develop a reliable light-weight automatic pilot suitable for use in all types of military aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: The first experimental version of XA-11 automatic pilot will be installed and flight tested in a B-24 airplane, now based at LaGuardia Airport, New York, in the custody of the General Electric Company. The automatic pilot is still in early development stage. The manufacturer is currently engaged in an extensive study of methods of servo control and expects to have first experimental version of the pilot ready for flight tests in January, 1944.

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AUTOMATIC FLIGHT CONTROL OF HELIOCOPTER AIRCRAFT

655-1214
Expenditure Order No.

Equipment Laboratory
Sperry Gyroscope Company,
Brooklyn, New York
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: A Standard A-3 Auto-Pilot is to be installed in a Heliocopter aircraft to determine flight performance. From data obtained from such an installation, further investigation of automatic control of heliocopters will be carried out.

PURPOSE: To develop a suitable Automatic Pilot for Heliocopter Aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: On 4 October 1943, a Heliocopter, YR-4A, AAF No. 42-107236, was made available for the project. Before installation could begin, however, the aircraft was damaged and had to be returned to the factory for major repairs. At present the project awaits assignment of another aircraft which is expected approximately February, 1944.

GYRO ATTITUDE INDICATOR

655-1104
Expenditure Order No.

See "Remarks"
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: A gyro stabilized flight indicator that will have complete freedom in all axes and thus will remain uncaged at all times. It will indicate airplane attitude in both regular and inverted positions.

PURPOSE: To develop a flight indicator for night fighter airplanes that will enable the pilot to assume and recover from any attitude when no fixed references outside the airplane are visible.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Early in 1942 negotiations were begun with Sperry Gyroscope Company to develop a suitable indicator and later Pioneer Instrument Company began work on the same project. The Sperry Instrument has been flight tested by Materiel Command Personnel and is now undergoing further refinements. Instruments for flight tests are being procured from both companies and will soon be available. The following companies are engaged in this development:

Sperry Gyroscope Co., Inc., Brooklyn, N. Y.
Eclipse-Pioneer Division of Bendix Aviation, Corporation, Teterboro, N. J.

RECIRCULATING AIR SYSTEM FOR AIR OPERATED AUTOMATIC PILOT AND FLIGHT INSTRUMENTS

655-1167 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The recirculating air system consists essentially of a motor driven centrifugal air pump to operate the present types of air driven automatic pilots and flight instruments in a closed system, replacing the present engine driven vacuum pumps.

PURPOSE: To develop an air system which will enable present air driven instruments to meet increased service requirements and overcome difficulties now being encountered from dust, moisture, high altitude, and high and low temperature conditions.

AUTHORITY: Chief, Engineering Division.

REMARKS: Work was begun on this project by Sperry Gyroscope Company, Brooklyn, New York, in 1941 and is now being continued in the Equipment Laboratory. Preliminary and partially successful tests have been made. When present modifications are completed, the system will be given complete laboratory and flight tests. A study is at present under way to determine the feasibility of using the Type D-16 Auxiliary Fuel Pump to supply the air for this system.

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PORTABLE INSTRUMENT TESTERS

655-1072 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: A series of portable testers designed in two-case sizes, one 5 x 6 x 10 inches and one 5 x 10 x 10 inches, incorporating provisions for testing and maintenance of electrically operated instruments in Aircraft and at depots.

PURPOSE: To provide maintenance equipment for all types of electrically operated instruments at service activities.

AUTHORITY: Chief, Engineering Division.

REMARKS: A portable autosyn tester, magnesyn tester, and selsyn tester have been standardized and released for procurement. Drawings are now being completed on a fluxgate compass tester, a combination thermometer and thermocouple tester, and telegon tester and will be released for procurement in the near future.

THERMOMETER TEST STAND

655-1072 Expenditure Order No.	See "Remarks" Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-32459-E; 43-31249-E Contract Nos.

DESCRIPTION: The thermometer test stand consists of a self-contained unit of 12 individual temperature baths, a heating system, and mechanical refrigeration system for producing temperatures from minus 75 degrees C. to plus 155 degrees C.

PURPOSE: To provide maintenance equipment for depot use in testing and calibrating all types of aircraft thermometers.

AUTHORITY: Chief, Engineering Division.

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REMARKS: A contract was given to the York Ice Machinery Company of Cleveland, Ohio in June, 1943 and one to the Refrigeration Economics Company, Inc., Canton, Ohio, in May, 1943. Delivery from each company is expected in January, 1944.

LOW TEMPERATURE-HIGH ALTITUDE CABINET

655-1072 — Expenditure Order No.

See "Remarks" — Mfg. or Activity charged with Development

None — Classified Project No.

(535) 43-20051-E
(535) 43-32044-E — Contract Nos.

DESCRIPTION: The cabinet consists of a self-contained altitude chamber, 20 x 30 x 18 inches, and a mechanical refrigeration system and vacuum pump for producing temperatures from minus 75 degrees C. to plus 75 degrees C. and altitudes from 0 to 80,000 feet.

PURPOSE: To provide maintenance equipment for depot use in testing all types of aircraft instruments at low temperatures and high altitudes.

AUTHORITY: Chief, Engineering Division.

REMARKS: A contract was given to the Air Conditioning and Refrigeration Supplies, Inc. of Charleston, W. Va. in January, 1943 and one was given to the Kold-Hold Manufacturing Company of Lansing, Michigan in June, 1943. Delivery from the Air Conditioning and Refrigeration Supplies, Inc. is expected in January, 1944.

PORTABLE INSTRUMENT SHOP

655-1170 — Expenditure Order No.

Equipment Laboratory — Mfg. or Activity charged with Development

None — Classified Project No.

None — Contract No.

DESCRIPTION: The portable Instrument Shop consists of a series of 4 to

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6 benches capable of being mounted in a portable van (Porta-Van) trailer, glider, tent or any other available shelter. Each bench is being designed to be complete in itself to perform one or several functions required in the maintenance of instruments. The complete set of benches will enable a mechanic to perform all maintenance required in the normal understanding of 3rd echelon instrument maintenance work. Each bench is designed rigid enough to be shipped separately or can be mounted in a shelter of the Porta-Van type and shipped as a shop unit.

PURPOSE: To provide facilities for the maintenance of aircraft instruments by 3rd echelon maintenance units.

AUTHORITY: Chief, Engineering Division.

REMARKS: A Porta-Van unit, incorporating a set of benches and equipment for maintenance of aircraft instruments, was recenly forwarded to Orlando, Florida, for examination and test. As a result of these tests, the benches are now being re-designed to provide additional facilities for instrument maintenance.

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SECTION 2

ELECTRICAL PROJECTS

ELECT-RICAL

DIRECT CURRENT PROJECTS

ALTERNATING CURRENT PROJECTS

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INVERTER DEVELOPMENT

656-919	See REMARKS
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Tests on inverters consisting of operational tests such as vibration, sand, etc., electrical characteristics and life tests.

PURPOSE: To provide funds for testing experimental models of inverters developed by manufacturers at their expense.

AUTHORITY: Chief, Equipment Laboratory.

REMARKS: Tests are being conducted on experimental models of inverters submitted by:

Holtzer Cabot Electric Company Boston, Massachusetts	- MG-200 MG-202 MG-153 with special filter
The Leland Electric Company Dayton, Ohio	- 250 VA Model 800 VA Model

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AUTOMATIC CHANGEOVER INVERTER RELAYS

656-912	See REMARKS
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This equipment consists of a time delay relay, a.c. relay, and switchover mechanism. When the normal inverter in the airplane fails, the a.c. relay operates the switchover mechanism and turns on the alternate inverter.

PURPOSE: These relays are being developed to provide greater safety and provide more continuous a.c. power.

AUTHORITY: Chief, Equipment Laboratory.

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REMARKS: One experimental model has been fabricated and is being tested. Additional models are being developed by the Holtzer-Cabot Electric Company, Boston, Massachusetts: The Guardian Electric Company, Chicago, Illinois; The Square D Relay Company, Detroit, Michigan; the General Electric Company, Schenectady, New York, and the Wilcolator Company, Elizabeth, New Jersey.

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400 CYCLE ROTARY INVERTER, 100 VA, 3 PHASE

656-804 Expenditure Order No.	Leland Electric Company, Dayton, Ohio. Mfg. or Activity charged with Development
None Classified Project No.	P. O. (535) 43-2483-E Contract No.

DESCRIPTION: This inverter operates from the 24 volt D.C. system and delivers 115 volts, 100 VA, three phase, 400 cycle power at .75 Power Factor.

PURPOSE: This inverter is being developed to power three phase electric flight instruments.

AUTHORITY: Chief, Equipment Laboratory.

REMARKS: The first experimental model of this inverter has been delivered and is being tested. The weight is 8-1/2 pounds. The Leland Electric Company, Dayton, Ohio, is designing a lighter weight inverter of the same rating.

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INVERTERS, ROTARY, 350 V.A.

656-814
656-831
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

P. O. (535) 43-4466
Contract No.

DESCRIPTION: These inverters operate from the 24 volt system and produce 115 volt single phase 400 cycles at 350 V.A.

PURPOSE: To furnish the A.C. power in military aircraft where the next larger size is not feasible.

AUTHORITY: Chief, Engineering Division.

REMARKS: The original need for this inverter was for 350 V.A., subsequently changed to 450 V.A. and then to 500 V.A. as the sizes of inverters are standardized.

CLIP-ON VOLTAGE REGULATORS FOR THE MG-153F INVERTERS

656-843
Expenditure Order No.

Holtzer-Cabot Company,
Boston, Massachusetts.
Mfg. or Activity charged with Development

None
Classified Project No.

P. O. (535) 43-22027
Contract No.

DESCRIPTION: This is a small voltage regulator designed to provide regulation demanded by the A-5 automatic pilot from the standard production inverters. It can be attached to present models by the services in a very short period of time.

PURPOSE: To improve the voltage regulation of inverters made by Holtzer-Cabot Company already installed in B-24D and H airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Regulators have been received from Holtzer-Cabot Company, Boston, Massachusetts, and are being tested. Preliminary tests reveal many imperfections.

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GENERATOR, ENGINE DRIVEN, A.A.F. TYPE Q-1

656-692
Expenditure Order No.

General Electric Company,
Schenectady, New York.
Mfg. or Activity charged with Development

None
Classified Project No.

(33-096) 44-1006-E
W-33-096 AC-21
Contract No.

DESCRIPTION: The A.A.F. Type Q-1 generator is a main engine driven generator rated at 400 amperes, 30 volts, with a speed range of 4400 to 10,000 R.P.M.

PURPOSE: To develop a main engine driven D.C. generator as described above for use by the A.A.F. and to establish an approved source of supply of the generator.

AUTHORITY: Chief, Engineering Division.

REMARKS: The General Electric Company has completed the first sample generator and it is now in transit from the manufacturers plant to the Materiel Command. An immediate application for this type generator does not exist but there are several potential applications in the near future. The General Electric Company reports their tests show the sample to meet all electrical performance requirements.

GENERATOR, ENGINE DRIVEN, 100 AMPERES, 120 VOLTS

656-696
Expenditure Order No.

Eclipse Aviation,
Teterboro, New Jersey.
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: This project covers the development of a main engine driven generator which has a rating of 100 amperes, 120 volts D.C.

PURPOSE: To develop an engine driven D.C. generator of a higher voltage than any previously used by the Army Air Forces.

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AUTHORITY: Chief, Engineering Division.

REMARKS: A sample generator has been submitted by Eclipse Aviation, Teterboro, New Jersey, and is now undergoing tests at the Materiel Command.

GENERATOR CONTROL SWITCHES

656-823	See REMARKS
Expenditure Order No.	Mfg. or Activity charged with Development
None	43-11007-E 43-31137-E
Classified Project No.	Contract No.

DESCRIPTION: Small, compact contactors of 200 ampere and 400 ampere continuous current ratings with the ability to open 2500 amperes and 5000 amperes in a 24 volt circuit. These devices are to have operating characteristics which will eliminate the troubles now encountered in service because of drift of adjustments and improper design.

PURPOSE: To develop a generator control switch which will operate satisfactorily for at least 1000 hours in service without adjustment.

AUTHORITY: Chief, Engineering Division.

REMARKS: Generator control switches of a differential voltage type have been developed by the Allen-Bradley Company, Milwaukee, Wisconsin, the General Electric Company, Schenectady, New York, and the Westinghouse Electric and Manufacturing Company, Lima, Ohio. The Leece-Neville Company, Cleveland, Ohio, will also submit a sample in the near future. These control switches will close on the bus only when the generator voltage is slightly higher than the bus voltage. General Electric is now producing small quantities of this type of generator control switch but large scale production will not begin until June, 1944.

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GENERATOR VOLTAGE REGULATOR

656-698 Expenditure Order No.	See Remarks Mfg. or Activity Charged With Development
None Classified Project No.	AC-26561 AC-21072 535 AC-42-4282 Contract No.

DESCRIPTION: A universal generator voltage regulator capable of controlling all 28-1/2 volt direct current generators with an 8 ampere field rating.

PURPOSE: To develop a universal generator voltage regulator of advanced design and improved performance.

AUTHORITY: Chief, Engineering Division.

REMARKS: The trend in generator voltage regulators has been from the finger type to the carbon pile type generator voltage regulator. The carbon pile regulator has proven extremely satisfactory in service because of the infinite number of resistance steps obtained and because of the rugged construction of this type of regulator. Since June, 1942, four sources of this type of regulator have been developed. It is anticipated that the larger portion of generator voltage regulators will be of the carbon pile type in the very near future. All regulators manufactured after January 1944 will be of the carbon pile type. The manufacturers interested in this development are:

General Electric Company, Schenectady, New York
Westinghouse Electric Company, Lima, Ohio
Delco-Remy, Anderson, Indiana
Eclipse-Pioneer, Teterboro, New Jersey
Leece-Neville Company, Cleveland, Ohio

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200 AMPERE GENERATORS FOR 24 VOLT SYSTEMS

656-695 Expenditure Order No.	Equipment Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: 200 ampere generators are now used on a large variety of tactical aircraft by the Army Air Forces. This project provides

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for a continuous program of improvement in the characteristics and service performance of these generators.

PURPOSE: To provide improved 200 ampere generators for use on 24 volt systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: Improvement of the 200 ampere generators for 24 volt systems consists of providing greater service reliability by improving the mechanical design and providing improved brushes, reducing the weight and increasing the speed range over which rated load may be obtained.

CARBON PILE GENERATOR CONTROL PANELS

656-796 Expenditure Order No.	Leece-Neville Co., Cleveland, Ohio Eclipse-Pioneer, Teterboro, N.J. Mfg. or Activity Charged with Development
None Classified Project No.	42-23192-P Contract Number

DESCRIPTION: The carbon pile control panels consist of: a panel base, reverse current relay, carbon pile voltage regulator, and electrical cables.

PURPOSE: To develop a control panel which will not be influenced by the presence of dust and sand and will have a higher current carrying capacity than the present vibrating contact type control panels.

AUTHORITY: Chief, Engineering Division.

REMARKS: Carbon pile control panels of the 24 volt type have been developed by Eclipse Aviation Division of Bendix Aviation Corporation. This type of panel will replace the present vibrating contact regulator type such as the B-1A control panel used with low field current. These carbon pile control panels are now in production and satisfactory results have been obtained to date. A panel of the type is also being developed by the Leece-Neville Company of Cleveland, Ohio.

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400 AMPERE GENERATOR CONTROL SWITCH

656-740
Expenditure Order No.

General Electric Co., Schenectady, N.Y.
Westinghouse Electric Co., Lima, Ohio
Leece-Neville Co., Cleveland, Ohio
Mfg. or Activity Charged with Development

None
Classified Project No.

42-12006
Contract Number

DESCRIPTION: A generator control switch meeting the requirements of Specification 94-32278 except that it shall have a continuous rating of 400 amperes and an interrupting capacity of 5000 amperes.

PURPOSE: To develop a generator control switch which will be capable of carrying the output of the R-1 generator.

AUTHORITY: Chief, Engineering Division.

REMARKS: This relay switch is to be of the differential voltage type and will be available approximately 15 January 1944.

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800 AMPERE GENERATOR CONTROL SWITCH

656-787
Expenditure Order No.

General Electric Co., Schenectady, N.Y.
Mfg. or Activity Charged with Development

None
Classified Project No.

42-23191-P
43-7063-E
Contract Number

DESCRIPTION: A generator control switch conforming to requirements of Army Air Forces Specification 94-32278 but having an 800 ampere continuous rating.

PURPOSE: To develop a generator control switch with the capacity needed for use with 800 ampere generators.

AUTHORITY: Chief, Engineering Division.

REMARKS: Generator control switches of the subject type have been submitted for test by the General Electric Company. Inasmuch as it appears that an 800 ampere direct current generator will not be developed, these switches have not yet been tested as more urgent matters are being handled by the available laboratory personnel.

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WIND DRIVEN GENERATORS

656-760
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: These wind driven generators are for use on both 12 and 24 volt systems and they have the necessary current capacities to supply the electrical loads on the particular applications for which needed.

PURPOSE: To develop and establish approved sources of supply of such wind driven generators as may be needed for gliders and small aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: A satisfactory wind driven generator for a 12 volt system has been developed for the CG-4A glider and an approved source of supply established. Several 24 volt generators have been submitted for the XCG-13 but none has met all the requirements. Development work is continuing on these generators. Development of generators of other current and air speed ratings is also in progress.

PROTECTORS FOR AIRCRAFT ELECTRICAL SYSTEMS

656-827
Expenditure Order No.

General Electric Company
Schenectady, New York
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: A small, compact, light weight unit having the characteristics necessary for coordinated protection of the aircraft electrical systems. Protection will consist of maintenance of the electrical systems under conditions of gunfire and prevention of fires caused by hits on the electrical system.

PURPOSE: To study the size and type of protector needed in airplane electrical circuits to protect either the circuit or the entire aircraft electrical system.

[redacted]

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AUTHORITY: Chief, Engineering Division.

REMARKS: An extensive study of the magnitudes and effects of various types of fault currents caused by shorts to ground in aircraft electrical systems has been completed by the General Electric Company, Schenectady, New York. Gunfire tests have been completed at the Materiel Command, and a group organized to form a policy regarding protection of aircraft electrical systems.

DIRECTIONAL CIRCUIT BREAKER

656-872	See Remarks
Expenditure Order No.	Mfg. or Activity Charged with Development
None	43-30807-E
Classified Project No.	Contract Number

DESCRIPTION: A circuit breaker, approximately 6-3/4 inches long, 1-1/2 inches wide and 3 inches high, weighing approximately one pound, equipped with a directional trip device.

PURPOSE: To develop a directional circuit breaker for use in the generator circuit as a back-up protection for the reverse current relay.

AUTHORITY: Chief, Engineering Division.

REMARKS: In May 1942, a sample of a directional circuit breaker was submitted by the General Electric Company. This sample was found to have all the necessary characteristics for installation on military aircraft. This unit has been approved for use on the Martin B-26 and A-30 airplanes. In addition, it will be required for use in P-1 generator circuits. The G.E. Model 12XRP11A1 is now in limited production. Pierce Laboratory has submitted samples and is doing further development work. The manufacturers interested in this development are:

General Electric Company, Schenectady, New York
Struthers-Dunn, Philadelphia, Pennsylvania
Allen Bradley, Milwaukee, Wisconsin
Pierce Laboratory, Summit, New Jersey

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EXTERNAL POWER RECEPTACLE

656-885 Expenditure Order No.	Equipment Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: A polarized receptacle to provide a connection for external power to airplanes. This receptacle will be interchangeable with the present receptacle AN2552 and is designed with an automatic safety switch to prevent arcing at the pins in the event of making or breaking contact with the electrical load or because of an accidental short.

PURPOSE: To develop an external power receptacle that will eliminate the use of the safety relay and still retain the safety feature offered by the relay.

AUTHORITY: Chief, Engineering Division.

REMARKS: The present external power circuit consists of an external receptacle, AN2552 and a Type B-4 battery circuit relay. The relay is used to prevent arcing at the receptacle in the event connection is made or broken while the electrical load is on. It is anticipated that these new receptacles will provide the safety feature of the present receptacle and relay for considerably less weight. Two test models have been completed but need slight modification prior to testing.

REMOTE AND DIRECT DRIVE STARTER ASSEMBLIES

656-881 Expenditure Order No.	See Remarks Mfg. or Activity Charged with Development
None Classified Project No.	W-535 AC-40019 Contract Number

DESCRIPTION: The remote drive starting assembly consists of a gear reduction unit with a multiple friction disc type protective clutch designed to be mounted on the type 1360 engine, a portable motor, 110 volt D.C. used as a stand-by.

PURPOSE: To develop a semi-portable starting system for multi-engine airplanes that will afford considerable weight saving over the conventional starting system.

[redacted]

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AUTHORITY: Chief, Engineering Division.

REMARKS: Negotiations for the design and procurement of a semi-portable starting system for multi-engine airplanes equipped with type 4360 engine, were started with Jack & Heintz Inc., Bedford, Ohio, and Eclipse Aviation, Bendix, New Jersey, in May 1943. The contract with Jack & Heintz Inc. was approved 5 June 1943 and the contract with Eclipse Aviation was approved at a later date. This equipment is obligated for project MX-140 and MX-149, and it is anticipated that deliveries will be made by February 1944.

RECTIFIED ALTERNATING CURRENT GENERATOR

656-757 656-788
656-766 656-797
656-768 656-828
656-775
Expenditure Order No.

See Remarks
Mfg. or Activity Charged

None
Classified Project No.

AC-31-34 43-19601-E
AC-23972 42-18679
42-8758 42-14027
43-14339-E
Contract Number

DESCRIPTION: This equipment consists of an alternator, transformer and dry disk rectifier capable of supplying direct current at thirty volts to aircraft electrical equipment. The initial generation and transmission may be at relatively high voltages with a step down transformer and rectifier at the load center.

PURPOSE: To provide a high output of direct current from equipment which meets the weight and space requirements for engine mounting and is not subject to commutation and brush troubles associated with conventional generators.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Materiel Command has received and tested many low powered alternators and rectifiers. Test information showed the system to be practical, but further development was necessary to improve the efficiency. Considerable improvements in alternator design and rectifier efficiency have been evidenced during this program. The companies involved in this program include: General Electric Company, Schenectady, New York; Westinghouse Electric and Manufacturing Company, Lima, Ohio; Chrysler Corporation, Detroit, Michigan; Leland Electric Company, Dayton, Ohio; and

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the Federal Telephone and Radio Corporation, East Newark, New Jersey. The status of equipment on order is as follows:

200 Ampere, 30 Volt Rectifier and Alternator - Chrysler will deliver the 20 units on order by January 1944. Leland have delivered their units and laboratory tests have been completed. Further tests will be conducted to check operation under the conditions of sand, cold, humidity, and salt spray.

400 Ampere, 30 Volt Rectifier and Alternator - Chrysler delivered one unit which experienced an insulation failure on initial test. The unit has been returned to Chrysler for reworking. Two Westinghouse units have been delivered and laboratory tests are completed. This unit is now ready for flight test. Two Leland units have been delivered but no laboratory tests have been made.

800 Ampere, 30 Volt Rectifier and Alternator - Chrysler has completed one unit and will conduct a life test on the unit for the Materiel Command. The General Electric alternator is complete, but the rectifier is in process of redesign due to failure on initial test. Westinghouse has an alternator and rectifier complete. The Materiel Command will laboratory test and flight test the unit as soon as delivery is made.

This system is being developed to supply the ever increasing power demands on airplanes which will soon demand more power than present direct current equipment can produce.

ALTERNATING CURRENT VOLTAGE REGULATORS

656-811 Expenditure Order No.	See Remarks Mfg. or Activity Charged with Development
None Classified Project No.	(535) 43-13320-E (535) 43-27856-E (535) 43-14494-E Contract Number

DESCRIPTION: Subject regulator is a device to supply constant voltage with variable frequency for powering radar equipment from alternating current power lines. This device will correspond to the inverter in the direct current power system and has the possibility of being much lighter in weight. There are, essentially, two designs. The first is an automatic tap-changing transformer while the second consists of a saturable reactor scheme.

[redacted]

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PURPOSE: To provide a means of adapting alternating current power voltages to radar power supply in alternating current powered airplanes and, thus, eliminating the necessity of providing a rectifier and inverter to obtain satisfactory voltages.

AUTHORITY: Chief, Engineering Division.

REMARKS: Development orders have been placed with the Lorain Products Company, Lorain, Ohio, and the Edward Martin Sorensen, Inc., Stamford, Connecticut, for experimental units which are to be tested in cooperation with the Aircraft Radio Laboratory upon delivery. Results of tests on Lorain Products regulator proved that type of regulator unsatisfactory for use with rectified A.C. type of generator because the harmonic content of the power supply is transmitted to the load. Sorensen's regulator is designed and manufactured, but delivery has not been made.

Further development and tests will be made to determine the practicability of supplying radar equipment from the A.C. power system by means of this regulator when the necessary equipment becomes available.

ALTERNATING CURRENT SYSTEM

656-820 656-862
656-855 656-864
656-848 to 656-851 incl.
656-857 to 656-860 incl.
Expenditure Order No.

See Remarks
Mfg. or Activity Charged with Development

None
Classified Project No.

See Remarks
Contract Number

DESCRIPTION: This is a development program to produce a 400 cycle high voltage alternating current power system for large bombardment type airplanes. The program consists of the development of suitable alternators, voltage regulators, constant speed generator drives and controls, relays, circuit breakers, motors, rectifiers, converters, instruments, auxiliary power plant alternators and related equipment as well as a study of system design, protection and operation.

PURPOSE: To develop an electrical system capable of delivering larger amounts of power to the increased electrical loads of new types of bombardment aircraft without the corresponding increase in weight and operational difficulties.

[redacted]

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AUTHORITY: Chief, Engineering Division.

REMARKS: In January 1943, conferences were held and development contracts initiated concerning the complete aircraft power system and related equipment. The companies concerned are as follows: The General Electric Company, Schenectady, New York; Westinghouse Electric and Manufacturing Company, Lima, Ohio; Chrysler Corporation, Detroit, Michigan; Cutler-Hammer Inc., Milwaukee, Wisconsin; U. S. Electrical Motors, Inc., Milford, Connecticut; Federal Telephone & Radio Corporation, East Newark, New Jersey; Holtzer-Cabot Electric Company, Boston, Massachusetts; Lear Avia, Inc., Piqua, Ohio; Square D Company, Detroit, Michigan; Jack and Heintz Inc., Cleveland, Ohio; Leece-Neville Company, Cleveland, Ohio; Eclipse-Pioneer, Teterboro, New Jersey; Struthers-Dunn, Inc., Philadelphia, Pennsylvania; the Sundstrand Machine Tool Company, Rockford, Illinois; Sorensen & Co., Stanford, Connecticut; General Aviation Equipment Company, New York, New York; Frank Rieber, Inc., Los Angeles, California; and Burndy Engineering Company, New York, New York. Thus far the status of development is as follows:

Alternators And Voltage Regulator - Both General Electric Company and Westinghouse Electric Manufacturing Company have developed and tested the 30 KW, 3 phase 208 Volt, 400 cycle alternator and regulator. The Materiel Command will receive this equipment early in January 1944.

Constant Speed Drive - Sundstrand Machine Tool Company has built and tested their drive. General Electric Company is conducting further tests on this drive in order to develop a governor for controlling the drive.

Circuit Breakers - Westinghouse Electric Manufacturing Company, General Electric Company and Cutler-Hammer have submitted samples of this equipment. Final design is not complete.

Other equipment needed for the alternating current system is still in the first experimental stage and no samples have been submitted to the Materiel Command. This system is being developed for initial installation in Projects MX-140, MX-149 and MX-304.

Authorities of Purchase were initiated under the following numbers:

43-24241E	43-22817E	43-33317E	43-7897E	44-1604E
43-24240E	43-1879	43-33214	44-1020E	44-1560E
43-23770	43-29412E	43-30935	44-2722E	44-1237E
43-23771	43-30561E	43-30298	44-3222E	44-955E
43-23772	43-30426E	43-27856-E		

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ACCESSORY POWER PLANT

656-855 Expenditure Order No.	Graham-Paige Motor Co., Detroit, Michigan. Mfg. or Activity Charged with Development
None Classified Project No.	(20-017) 44-10360 Contract Number

DESCRIPTION: This power plant consists of an internal combustion engine directly connected to an AAF Model AC-1 alternator. The normal rating of the unit will be 20 KW at 208/120 volts, 400 cycles. The unit has a 5 minute emergency rating of 30 KW. The weight of the complete unit will be approximately 225 pounds.

PURPOSE: To provide an alternating current source of electrical power for heavy bombardment type aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Four units are being procured for experimental tests. The engineering design is completed and the fabrication is approximately 25 percent completed. Delivery of the first unit for experimental test is expected approximately 1 March 1944.

D-2 ACCESSORY POWER PLANT

656-867 Expenditure Order No.	See Remarks Mfg. or Activity Charged with Development
None Classified Project No.	(535) 41-7619 (535) 41-10643 (535) 43-1610 Contract Number

DESCRIPTION: This accessory power plant consists of a gasoline engine directly connected to an AAF Type P-2 generator. The electrical rating of this unit is 5 KW continuously and a 5 minute rating of 7.5 KW. The corresponding engine ratings are 10 and 15 horsepower respectively. The specification weight of the complete unit is 90 pounds.

PURPOSE: To provide a source of supplementary electrical power for bombardment type aircraft.

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AUTHORITY: Chief, Engineering Division.

REMARKS: The unit designed by Lawrence Engineering and Research Corp., Detroit, Michigan, has completed test and is approved for use. The weight of this unit is 111 pounds.

Delivery of the unit designed by Briggs Manufacturing Company, Detroit, Michigan is expected approximately 1 February 1944. It is anticipated that the weight on this unit will not exceed 95 pounds.

D-3 ACCESSORY POWER PLANT

656-906 656-916	McCullock Aviation Co., Milwaukee, Wis. Kiekhaefer Corp., Cedarburg, Wis.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(33-038) ac-3424E 371507
Classified Project No.	Contract Number

DESCRIPTION: This accessory power plant consists of a gasoline engine directly connected to an AAF Type Q-1 generator. The electrical rating of this unit is 10 KW. The corresponding engine ratings are 20 and 30 horsepower respectively. The complete weight of the unit will be approximately 150 lbs.

PURPOSE: To provide a source of electrical power for ground maintenance and takeoff and landing operation for heavy bombardment type aircraft utilizing direct current electrical power.

AUTHORITY: Chief, Engineering Division.

REMARKS: Two units are being procured from each source.

The McCullock Aviation Company has the engineering design approximately 75 percent completed.

Negotiations with the Kiekhaefer Corporation are being completed at this time.

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D-4 ACCESSORY POWER PLANT

656-765
656-907
Expenditure Order No.

Skinner, Mead and Wallace,
Detroit, Mich.
McCulloch Aviation Company
Milwaukee, Wisconsin
Mfg. or Activity Charged with Development

None
Classified Project No.

(20-017) 44-10569
(33-038) 44-3424-E
Contract Number

DESCRIPTION: This accessory power plant consists of a gasoline engine directly connected to an AAF Type O-4 generator. The electrical rating of this unit is 3KW continuously and 4.5 KW for a 5 minute emergency rating. The corresponding engine horsepower is 6 and 9 respectively. The complete weight of these units is expected to be approximately 65 pounds.

PURPOSE: To provide a source of electrical power for ground maintenance, and takeoff and landing operations for heavy pursuit and attack type aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Three units are being procured from the Skinner, Mead, and Wallace Company. The fabrication of the unit is approximately 90 percent completed. Delivery to the Material Command for acceptance and endurance tests is expected by February 1944.

Two units are being procured from the McCulloch Aviation Company. The engineering design is approximately 70 percent completed and fabrication is 50 percent completed. Delivery of the first unit is expected by 15 February 1944.

AIRCRAFT STEAM TURBINE

656-652
Expenditure Order No.

Lyman Mfg. Co., Cleveland, Ohio
Mfg. or Activity Charged with Development

None
Classified Project No.

W-535 AC-17536
Contract Number

DESCRIPTION: The aircraft steam turbine consists of an exhaust fired boiler, turbine, condenser, pipes, controls and an alternating current generator. This constitutes a closed circulating steam

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system for providing large amounts of electrical power from the aircraft exhaust. A 50 KW unit under development will weigh approximately 300 pounds, but by utilizing what is normally wasted energy the total weight chargeable to the electrical system is far less than with conventional methods of obtaining power. In addition, this development will permit the parallel operation of alternating current generators.

PURPOSE: To increase the efficiency of the methods of obtaining electrical energy in large aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: This development has proceeded to the point of laboratory operation of the experimental turbine system. The Laboratory operation of the turbine system appears to be satisfactory and flight testing is anticipated by 1 January 1944.

AIRPLANE INSTRUMENT LIGHTING

656-883	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Equipment necessary for this project will consist of cockpit mockups of a B-17B airplane and a P-39 airplane. These mockups will be refitted with new instruments and control knobs and the later types of instrument lighting will be installed.

PURPOSE: To improve present systems of cockpit lighting.

AUTHORITY: Chief, Engineering Division.

REMARKS: A cockpit mockup built from a fuselage section of a salvaged B-17B airplane is nearly completed. The cockpit section of a P-39 fuselage has been obtained and will be fitted as a mockup also.

In addition, an experimental instrument lighting installation is being made in an operational Type B-17E airplane for the purposes of this study.

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REDESIGNED COCKPIT LAMP ASSEMBLIES

656-845	Standard Aircraft Products Co. Dayton, Ohio
Expenditure Order No.	Mfg. or Activity Charged with Development
None	43-28763.F
Classified Project No.	Contract Number

DESCRIPTION: These cockpit lamp assemblies are approximately one-fourth smaller than the Types C-4 and C-7 lights. A three candle-power lamp is used behind a lens which may be adjusted to control the spread of the beam. A removable red filter is provided to floodlight instruments with either red or white light. The spherical reflector used in present types has been eliminated.

PURPOSE: To reduce size of present C-4 and C-7 cockpit lamp assemblies, to provide a better light beam and to eliminate stray light.

AUTHORITY: Chief, Engineering Division.

REMARKS: A sample of the redesigned lamp assembly has been submitted to the Equipment Laboratory and is being subjected to performance and life tests. A specification is being prepared.

GAS OPERATED BEACONS

656-927	American Gas Accumulator Co. Elizabeth, New Jersey
Expenditure Order No.	Mfg. or Activity Charged with Development
None	A.F.P. No. 371522
Classified Project No.	Contract Number

DESCRIPTION: This project covers the procurement and test of an experimental acetylene operated beacon for use in remotely located places where commercial electric power is not available. They may be used for obstruction markers or for horizon or orientation lights.

PURPOSE: To develop a suitable marker beacon for marking dangerous obstructions where power is not available and which are inaccessible during part of the year.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Procurement has been initiated for five experimental beacons for test. These will be procured from the American Gas Accumulator Company, Elizabeth, New Jersey. Delivery is expected in February 1944.

PORTABLE FLASHING BEACON

656-565
Expenditure Order No.

See Remarks
Mfg. or Activity Charged with Development

None
Classified Project No.

P.O. (535) 43-26369E
P.O. 4027-43-96E
P.O. (535) 42-20778E
Contract Number

DESCRIPTION: This project includes the procurement and test of experimental portable flashing beacons. These beacons use a high intensity, high voltage, condenser discharge type of lamp and a special power pack is required to provide the necessary high voltage for the lamp.

PURPOSE: To develop a flashing beacon which will be reliable, distinctive, easily transportable, and otherwise suitable for use at air fields in the Theater of Operations.

AUTHORITY: Chief, Engineering Division.

REMARKS: Experimental units have been procured from General Electric Company, West Lynn, Mass.; Ratheon Manufacturing Company, Boston, Mass.; and Electronic Laboratories, Inc., Indianapolis, Indiana. Performance and life tests are being conducted on these units.

Standardization of certain parts of this equipment has been accomplished by the three companies at the request of the Equipment Laboratory.

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FLASHING MECHANISM FOR TAIL LIGHTS

656-898	See Remarks
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: The flashing mechanism is a small inexpensive electro-mechanical flasher used to flash wing and tail lights through a cycle of 3/4 of a second "on" and 3/4 second "off".

PURPOSE: To provide a flashing unit for flashing exterior lights on bombers for use in training areas.

AUTHORITY: Chief, Engineering Division.

REMARKS: Sample flashing devices have been submitted for test by the following companies:

General Electric Company, Schenectady, New York
Bendix Aviation Ltd., North Hollywood, California
Reynolds Electric & Mfg. Company, Chicago, Illinois
Tung-Sol Lamp Works, Inc., Newark, New Jersey.

These samples have been tested and none was entirely satisfactory. Additional samples are expected from the same companies, and, in addition, from Bardwell & McAlister, Inc., Hollywood, California, and the Waters-Conley Company, Rochester, Minnesota.

FLASHING NEON LAMP ASSEMBLIES

656-891	AM-Glo Lamp Corp., Chicago, Ill.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	P.O. (33096) 44-3433-E
Classified Project No.	Contract Number

DESCRIPTION: This project covers the procurement and testing of portable flashing neon lamp assemblies for the following purposes:

a. Rescue Island Lights
b. Hazard Warning Lights for use on remotely located hazards.
c. Horizon Light as an aid to orientation immediately after takeoff.

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PURPOSE: To develop a light assembly which will be portable and have the necessary reliability for the uses for which it is intended.

AUTHORITY: Chief, Engineering Division.

REMARKS: Procurement has been initiated with the AT-Glo Lamp Corporation, Chicago, Illinois, for experimental light assemblies. Delivery of the assemblies is expected in January 1944.

NIGHT LANDING AIDS FOR AIRPLANE TROOPS

656-817	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(535) 43-10587
Classified Project No.	Contract Number.

DESCRIPTION: These aids consist of small, portable, expendable, landing area marker lights. Most of the units tested have been battery operated, one type was a solidified kerosene flare.

PURPOSE: To provide easily carried marker lights to aid landing of gliders and airplanes on advanced fields where no standard runway markers have yet been installed.

AUTHORITY: TI-1223, dated 14 August 1942.

REMARKS: As a result of preliminary tests of several types of experimental lamp assemblies by the Troop Carrier Command, a quantity of 200 experimental battery operated marker lights have been procured and delivered to that Command for test. These were tested during maneuvers held December 1943.

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MOUNTAIN TOP OBSTRUCTION MARKER

656-341 Expenditure Order No.	Hughey & Phillips Co. Los Angeles, California Mfg. or Activity Charged with Development
None Classified Project No.	(535) 43-22971-G Contract Number

DESCRIPTION: This equipment consists of a portable, self-contained, obstruction marker designed for automatic operation in mountainous areas where outside power supply is not available. The marker light is operated by a storage battery which is kept charged by an air-wheel generator. A photoelectric cell limits operation of the light to hours of darkness.

PURPOSE: To develop a portable, self-contained obstruction marker suitable for use in mountainour regions with very infrequent servicing.

AUTHORITY: Authorization was contained in the directive of 2-11-41 from the Hdq. of the AAF in Washington to the Commanding General, AAF Materiel Command requesting test data and recommendations on the suitability of commercial articles of a similar type.

REMARKS: After a preliminary survey of the devices of this kind which are commercially available, a specially designed lamp assembly was procured from the Hughey and Phillips Company, Los Angeles, California, and it has been tested. The sample was found to be unsatisfactory due to numerous failures of parts during test. A number of problems remain to be solved before a fully reliable marker can be made. However, based upon infromation gained in this test an exhibit outlining the requirements of such a marker will be prepared for use in contemplated additional experimental procurement.

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STANDARDIZATION OF GROUND LIGHTING EQUIPMENT

656-4-732
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This project covers standardization of ground lighting equipment used by the Army, Navy, and the C.A.A. This standardization is being conducted by a committee composed of representatives of these three Federal Agencies.

PURPOSE: To develop a standardized line of airport lighting equipment.

AUTHORITY: Authorization was contained in directive of 7 November 1942 from the office of the Chief of the Air Corps, Washington, D.C., to the Aeronautical Board requesting a meeting of Army, Navy and C.A.A. representatives for action on standardization of ground light equipment.

REMARKS: Since the initiation of this activity, considerable standardization has been completed or started. Approximately 60 percent of ground lighting equipment has been standardized or is in the process of standardization. As new equipment or new installation procedures are adopted, they are standardized. A comprehensive standardized installation specification is now being prepared.

PORTABLE MAINTENANCE FLOODLIGHTS

656-387
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This project covers the design and fabrication of a portable floodlight assembly for airplane maintenance illumination. The assembly will consist of a light weight, rigid stand on which will be mounted three 150 watt projector flood lamps. The relative positions of the three lamps will be adjustable, and the assembly will be portable.

[redacted]

[redacted]

PURPOSE: To develop a portable maintenance floodlight having the features necessary to properly serve the use for which it is designed.

AUTHORITY: Chief, Engineering Division.

REMARKS: Fabrication of an experimental assembly has been completed by the Equipment Laboratory and it will be tested at Eglin Field.

PORTABLE MAINTENANCE FLOODLIGHTS

656-374 Expenditure Order No.	Industrial Elect. Co. New Orleans, La. Mfg. or Activity Charged with Development
None Classified Project No.	P.O. (535) 43-32168E Contract Number

DESCRIPTION: This equipment consists of a maintenance flood light, compact and light enough to be portable-by-air and rugged enough to remain fixed while in use outdoors by ground crew members.

PURPOSE: To make additional refinements which are considered necessary for the service.

AUTHORITY: Chief, Engineering Division.

REMARKS: Experimental Lamp assemblies are being procured from Industrial Electric Company, New Orleans, La. One type will be supplied in a set consisting of one large stand, one small stand, one extension cord, and four lamp heads. Two other types have been received, and are being tested at Wright Field. Additional tests will be conducted at Eglin Field.

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BUNGHOLE LAMP

656-852
Expenditure Order No.

Daniel Woodhead Co.
Chicago, Illinois
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This equipment consists of a vapor tight lamp with a maximum diameter of 1 1/2 inches and a handle 26 inches long suitable for inspecting the interior of gas tanks.

PURPOSE: To provide suitable lamp assembly for inspecting gas tanks.

AUTHORITY: Chief, Engineering Division.

REMARKS: Samples of incandescent and fluorescent lamp assemblies were fabricated at Wright Field, Dayton, Ohio, and submitted directly to Gunter Field for test. As a result of this test, additional experimental lamp assemblies are being procured from the Daniel Woodhead Company, Chicago, Illinois, for further experimental test at Gunter Field and other stations. Delivery of these assemblies is expected in January 1944.

TAXI-STRIP DELINEATORS

656-861
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

(2620) 43-2548
Contract Number

DESCRIPTION: The delineators consist of a reflector material mounted on wood or masonite stakes which can be quickly installed along the edges of taxi-strips.

PURPOSE: To provide a convenient, inexpensive means of marking taxi-strips.

AUTHORITY: Chief, Engineering Division.

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REMARKS: These types of reflectors have the property of reflecting incident light directly back along the line of incidence. This property makes it possible, using a correctly designed lamp assembly, for an observer to see the markers while neither the lamp nor the markers would be visible to an unauthorized observer unless he happened to be in just the right location.

Tests of two types of markers have been completed at Eglin Field, and as the result of their recommendations, a specification is being prepared and the delineator will be standardized.

PLASTIC LENSES FOR SNOW CONTACT LIGHTS

656-379 Expenditure Order No.	American Gas Accum. Co. Elizabeth, New Jersey Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This project covers the development of Plastic Lenses, large enough to withstand the heat of a 40 watt lamp, for use with contact lights in areas of heavy snowfall. They are light in weight to minimize the load on the supporting columns and of plastic material in order to reduce breakage or damage in case of collison.

PURPOSE: To develop plastic lenses for the new type of contact lights to be used in snow areas.

AUTHORITY: Chief, Engineering Division.

REMARKS: Preliminary samples were delivered 9 December 1943. Additional samples are to be obtained for complete laboratory tests.

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SECTION 3

EMERGENCY RESCUE PROJECTS

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RESCUE

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WIND TUNNEL RESEARCH ON PARACHUTES

670-248 Expenditure Order No.	Daniel Guggenheim Airship Institute Mfg. or Activity Charged with Development
None Classified Project No.	(535) 43-2E Contract No.

DESCRIPTION: Wind tunnel investigation of parachute testing methods is being conducted by the Daniel Guggenheim Institute, Akron, Ohio.

PURPOSE: To determine most suitable methods of parachute model suspension and force measurement.

AUTHORITY: Chief, Engineering Division.

REMARKS: Tests of rigid model, flexible models and flexible models with stiff suspension lines are being conducted.

The Army Air Forces parachute wind tunnel now under construction will be used for this work when completed.

A renewed request has been initiated for the National Advisory Committee for Aeronautics to participate in the parachute research program, both wind tunnel and drop test.

LIGHTWEIGHT NYLON PARACHUTES

670-240 670-238 Expenditure Order No.	Equipment Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: Parachutes have been constructed of lightweight fabric for test by glider personnel, turret gunners, fighter pilots, bomber pilots, and transport pilots.

PURPOSE: To develop a lightweight Nylon parachute.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Tests on these parachutes indicate that the lightweight nylon results in the least bulky parachute developed to date. However opening tests of these parachutes when twists have been put in the lines have not proved satisfactory. Lower porosity fabric is being developed to overcome this difficulty.

COMMERCIAL AND FOREIGN PARACHUTES

670-222	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Commercial and foreign parachutes are examined and tested for possible improvements in design, construction or materials of Army Air Force Parachutes.

PURPOSE: To keep abreast of foreign and commercial parachute development.

AUTHORITY: Chief, Engineering Division.

REMARKS: Numerous commercial and foreign parachutes have been examined, tested and evaluated. Several features have been adopted, including the British quick release harness, Japanese locking snap (for aerial delivery parachutes), the Pioneer Parachute Company's back pack and pilot parachute. A safety pin, developed by the Germans as an improvement to the Irving quick release box, makes the British quick release harness safe for Army Air Force Use.

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LIFE RAFT DESIGN

671-69	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Standard multi-place life rafts are boat-shaped with both the bow and stern raised slightly and pointed. The inflation gear, consisting of the CO_2 cylinder and valve, and inlet manifold was formerly mounted on the bow. The location of the inflation gear was changed in June 1943 to the stern with the inlet manifold straddling the horizontal bulkhead. This change has the advantage of eliminating a channel or tube from one of the manifold inlets down through the upper chamber into the lower chamber, and of getting the inflation gear out of the way of the occupants.

PURPOSE: To develop a roomier and more compact life raft.

AUTHORITY: Chief, Engineering Division.

REMARKS: On the recommendation of service activities the elimination of one of the seats and the relocation of the other seat is being studied. The one seat will be placed on the floor to give two separate floor sections. The desirability of installing oar locks for rowing is also being studied.

LIFE RAFT ACCESSORIES

671-68	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Life raft accessories consist of the following items: 1 pyrotechnic pistol and 5 distress signals; 7 cans emergency drinking water; 3 cans sea marker; 7 units Type A life raft rations; 1 flashlight; 1 scout knife; 1 police whistle; 1 first aid kit; 1 fishing kit; 1 sail; 1 paulin for water catching, signal, shade and camouflage; 3 oars; 1 hand pump; 1 repair kit; 1 bailing bucket; 4 bullet hole plugs; 40 feet cotton cord; 1 sea anchor; 4 tubes sun protective ointment; 1 compass; 1 signaling mirror.

[redacted]

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PURPOSE: To provide more effective life raft accessories of lighter weight and less bulk.

AUTHORITY: Chief, Engineering Division.

REMARKS: Improved repair plugs are being developed in place of the present wood bullet hole plugs. An improved sea anchor which will be lighter in weight and more effective in operation is being developed. A water container for the storage of rain water has been adopted and is now under procurement. Four of these containers will be placed in each raft.

SUBSTITUTES FOR LIFE RAFT FABRIC

671-70	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Experimental rafts have been procured with the gas film of neoprene instead of rubber. It has been recommended by industry that an inner and outer layer of rubber would give protection to the neoprene. Rafts submitted to date have not been satisfactory inasmuch as the neoprene cracks upon inflation of the raft after exposure to a temperature of -65°F. for a period of 48 hours. Additional rafts are being procured with newly developed cold resistant neoprene compounds.

PURPOSE: To provide satisfactory rubber substitutes for use in life raft flotation tube fabric.

AUTHORITY: Chief, Engineering Division.

REMARKS: The synthetic program is being carried on with the cooperation of the Navy Department and Industry. Industry is conducting an investigation of synthetics to develop satisfactory synthetics which will meet service requirements.

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EMERGENCY KITS FOR AIRPLANE CREWS

671-82	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This kit is essentially a shoulder harness for carrying a flexible canteen and a caliber .45 automatic pistol. The harness is made of inch O D webbing.

PURPOSE: To furnish flying personnel with a better method of carrying a Service pistol and a canteen of water.

AUTHORITY: Letter from office of Assistant Chief of Air Staff, Materiel, Maintenance, and Distribution, Materiel Division, Washington D. C., dated 19 April 1943. Subject: Shoulder Harness, Military Requirements.

REMARKS: Several harnesses were submitted to AAF School of Applied Tactics, Orlando, Florida during the month of July 1943. On October 1, 1943, a report from AAFSAT Equipment Board was received stating that the holster and canteen bags were too bulky and were found to be uncomfortable in combat tactics.

On September 29, 1943 four types of shoulder harness were shipped to AAFSAT, Orlando, Florida eliminating much of the bulk which was so objectionable in the first samples submitted for test. To date no report has yet been received by this office.

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EMERGENCY KITS - AIRPLANE TYPE

671-62	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This project covers the procurement and assembly of various items of equipment and rations required for airplane types of emergency kits. The kits are for use in all theaters of operation for airplane crew members in event of a forced landing.

PURPOSE: To provide crew members of Army aircraft with emergency equipment and supplies to enable them to survive until rescued.

AUTHORITY: Chief, Engineering Division.

REMARKS: There was originally thirteen types of emergency kits standardized to cover various emergency condition. At the direction of the Director of Military Requirements all these kits were surveyed by the Equipment Board, Army Air Forces School of Applied Tactics, Orlando, Florida, for the purpose of consolidating and eliminating duplication as much as possible. The results of this survey were submitted to the Requirements Division, Operations, Commitments and Requirements, Washington, D. C., for study and approval.

In a Directive 5 July 1943 from C.C.&R. through M.M.&D., the following kits were approved:

(1) The Type E-14 Desert and Tropic Aerial Delivery which eliminates the Type E-1 Rations, E-2 Northern Implements, E-8 Desert Implements and E-10 Desert and Tropic Aerial Delivery.

(2) The Type E-15 Ocean Aerial Delivery which eliminates the Type E-5 and Type E-11 overwater kits.

The Type E-12 Arctic Aerial Delivery Kit was approved as submitted to the Equipment Board.

The Type E-9 Desert and Ocean Ration Kit was not approved in the Directive dated 5 July 1943 but was approved later in correspondence.

The status of the Type E-3 Aid Box was not affected by this survey.

A small pocket size packet containing trading items such as beads, tobacco, razor blades, jewelry etc., for trading with primitive people has been developed and will be available approximately 1 January 1944.

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INDIVIDUAL ARCTIC EMERGENCY KITS

671-82 Expenditure Order No.	Equipment Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: This equipment consists of a canvas duck bag, olive drab shade, for carrying a sleeping bag and emergency equipment for use in the arctic. The kit forms the seat and back pads of the standard seat type parachutes, and is fastened inside the parachute harness by means of the standard cushion attachments, which in this case are part of the kit. After an emergency jump or landing, the kit may be easily removed from the parachute harness and carried by means of a carrying strap.

PURPOSE: To furnish flying personnel with a convenient and easy method of carrying individual arctic emergency equipment.

AUTHORITY: Chief, Engineering Division.

REMARKS: This kit makes use of space formerly used for parachute seat and back cushions. It is easily carried, attached to the parachute harness, and makes a very convenient kit.

Five hundred of these kits are being procured for use and test by the Air Transport Command, Great Falls, Montana.

VEST, EMERGENCY SUSTENANCE, TYPE C-1

671-82 Expenditure Order No.	Equipment Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The experimental vest type emergency kit is a sleeveless ~~khaki~~ twill jacket that can be worn over any type flight clothes, and is so constructed that it will fit any size person up to size forty eight. The pockets are so arranged that no interference will be encountered with the parachute harness and that they will not restrict freedom of motion to the wearer in any way.

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PURPOSE: To provide flying personnel with necessary emergency equipment to sustain life in case of forced landings regardless of terrain.

AUTHORITY: Chief, Engineering Division.

REMARKS: The vest type kit has many advantages over the present seat or back type parachute emergency kits because of the reduced bulk and weight; thus enabling crew personnel more freedom of motion. Since the vest type kit is not attached in any way to the parachute harness, there is no danger of losing the kit when forced landings are made at sea.

In a directive dated 12 November 1943 from the Requirements Division, O.C.&R. through L.L.&D., it was recommended that the kit be redesigned to accommodate the recently adopted British (Quick Release) type parachute harness.

DISTILLATION EQUIPMENT

671-68
Expenditure Order No.

Equipment Laboratory
Mfg.or Activity Charged with Development

None
Classified Project No.

See Remarks
Contract No.

DESCRIPTION: The equipment is of several types, each using a different principle of operation. One type is based on chemical precipitation of sea water salts, followed by filtration, to give an almost salt free drinking water. A second type of equipment is a more or less conventional still, using a special fuel. The total amount of water obtainable from these two types is limited by the amount of chemical or fuel carried. A third type uses the heat of the sun to distill water. In this type a black fabric, kept wet with sea water, is warmed by the sun; pure water evaporates and leaves salt behind; the water vapor is condensed on a surface cooled by air and/or the sea. A fourth type is vacuum distillation; this permits either the heat of the sun or of the body to be used to evaporate the water; a vacuum pump is required as part of the apparatus. The latter two types are independent of fuel supply, and the fourth type is almost independent of atmosphere conditions.

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PURPOSE: To furnish personnel on life rafts with adequate and reliable sources of drinking water.

AUTHORITY: Chief, Engineering Division.

REMARKS: Chemical precipitation methods have been developed successfully by the Permutit Co., New York, N. Y. and the Naval Medical Research Institute, Bethesda, Md. Standardization of the Permutit process for one man life rafts is under way. The Fuel Still is under development by the Safety Fuel Inc. West Cheshire, Conn. Several of these have been purchased and are being tested. The successful development of Solar Stills is almost complete. Three organizations are chiefly involved. The Gallaher Chemical Corp., New York, N. Y. (two models, one in production for the AAF, P.O. # (535)43-2389-F and contract #W2620-ac-278; Higgins Industries, New Orleans, La., and Massachusetts Institute of Technology, Cambridge, Mass. The solar and body still originally developed at the University of Minnesota, Minneapolis, Minnesota is now being further developed by the M. M. Welch Mfg. Co., Chicago, Illinois. P. O. #(33-096) 44-3218-E.

RATION COMPONENTS FOR FLIGHT LUNCHES AND EMERGENCY KITS

671-81	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The Life Raft Ration, Type A, consisting of 13 packages of fruit flavored hard candies, gum and vitamin tablets, is being included in the multi-place life rafts. The Parachute Ration is being placed in Type B-4 and Type B-2 parachute kits. Rations under development are: Vest Type Emergency Ration, for use in emergency bail out conditions; menus for In Flight meals, for use in FT6-3 Food Warmer; Air Borne Rations designed to provide food for 275 men for 30 days in isolated stations; and components for producing milk, chocolate milk, cottage cheese and ice cream in the Mechanical Cow and experimental modifications of this machine.

PURPOSE: To develop suitable, easily prepared appetizing lunches for preparation and use in flight and compact concentrated food items for emergency use in Arctic, desert, ocean and jungle areas.

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AUTHORITY: Chief, Engineering Division.

REMARKS: This work is being carried out in close cooperation with the Subsistence Research Laboratory, Q. M. C., Chicago, Illinois, and the Q. M. G., Washington, D. C., in connection with packaging rations and preparation of food for In Flight meals. Two rations for emergency kits have been developed, the life raft ration and the parachute ration. The life raft ration is for use in the life rafts and contains food that requires minimum water intake. The parachute ration is used in the Type B-4 Parachute Emergency Kit and contains the maximum amount of nourishment for the space available. Experiments on Arctic rations of high calorie content, flight lunches and ground lunches are in process.

SAFETY BELTS

671-65 Expenditure Order No.	Equipment Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: Safety belts are cotton webbing straps that pass over the lap and/or shoulders of the pilot, crew members and passengers which will afford protection during the take-off, landing and crash landings.

PURPOSE: To continue the development of safety belts with the primary objective of reducing weight.

AUTHORITY: Chief, Engineering Division.

REMARKS: Experimental safety belts and shoulder harnesses have been submitted to Army Air Forces School of Applied Tactics at Orlando, Florida. They were approved by O. C. & R. and M. L. & D. Final samples are being prepared prior to standardization.

Work is being conducted on a lightweight troop belt to replace the AN7507-3 now used for troop carrying purposes. Drawings have been prepared on the experimental troop belt.

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STREAMLINED AERIAL DELIVERY CONTAINERS

671-79	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development
None	None
Classified Project No.	Contract No.

DESCRIPTION: These items are streamlined rigid aerial delivery containers capable of carrying loads up to 300 pounds for supply and resupply by air.

PURPOSE: To provide containers which will produce a minimum amount of drag when carried externally by airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Plasticized fabric containers were submitted by Western Plastics Inc., Glendale, California, and Airchox Division of Joyce Aviation, Co., Chicago, Illinois, Kraft-paper containers were submitted by Carpenter Container Corporation, Brooklyn, New York. These containers will be forwarded to Eglin Field, Florida and Camp MacKall, North Carolina for tests by the Army Ground Forces and the Army Air Forces.

RADIO DROP TEST RECORDER

670-247	Simmonds Aerocessories, Incorporated, New York, N.Y.
Expenditure Order No.	Mfg. or Activity Charged with development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This instrument transmits, by means of a radio receiver and transmitter, pressure, temperature and humidity. The transmitter and temperature pressure and humidity elements are dropped with the parachute and readings are obtained each fifteen seconds. Knowing the readings of pressure, temperature and humidity, the altitude can be calculated.

PURPOSE: To more accurately record parachute drop test data.

AUTHORITY: Chief, Engineering Division.

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REMARKS: High altitude tests of the available equipment are to be made. No further developments of this method of recording rate of descent are anticipated since more accurate methods are being developed.

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SECTION 4

SPECIAL WEAPONS PROJECTS

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WEAPONS

POWERED WEAPONS

NON-POWERED WEAPONS

TARGETS

GYRO PROJECTS

RADIO AIDS AND SYNTHETIC TRAINERS

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SECTION 4

SPECIAL WEAPONS PROJECTS
Continued

RADIO AIDS AND SYNTHETIC TRAINERS (Cont'd)

SPECIAL PROJECTS

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ELECTRIC SERVO UNIT

673-33	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity charged with development
None	None
Classified Project No.	Contract No.

DESCRIPTION: This equipment consists basically of electric servo motors and either electrically-driven or vacuum-driven gyros with an electric or pneumatic pick-off system.

PURPOSE: To provide electrically-operated, remotely-controlled equipment for use in controlling radio airplane targets (Project MX-264) and power driven bombs (MX-53) and to develop simplified equipment to replace or supplement present servo equipment.

AUTHORITY: Technical Instructions, Serial No. CTI-11, dated 5 January 1940, subject: Military Characteristics of Aerial Targets, and Technical Instructions, Serial No. CTI-1102, dated 16 February 1943, subject: Power Driven Controllable Bombs.

REMARKS: Approximately 10 units are to be fabricated and approximately 150 hours' flying will be necessary to test these units.

HYDRAULIC AND ELECTRICAL SERVO TEST EQUIPMENT

665-69	Aero Equipment Corporation Cleveland, Ohio
Expenditure Order No.	Mfg. or Activity charged with Development
MX-264	44-3608-E
Classified Project No.	Contract No.

DESCRIPTION: This equipment consists of portable field test apparatus for use in checking, adjusting or repairing the hydraulic or electrical servo equipment.

PURPOSE: To provide test equipment needed to determine causes of failure and to make such correct adjustments as required of servos used in the remote control systems of R.A.T. and BQ types of aircraft.

AUTHORITY: CTI-11 dated 5 January 1940, subject: "Military Characteristics of Aerial Targets."

REMARKS: Delivery of first unit is expected in January, 1944.

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SERVO, ASSEMBLY, HYDRAULIC, THREE-AXIS, STABILIZED CONTROL

673-34
Expenditure Order No.

Aro Equipment Corporation
Cleveland, Ohio
Mfg. or Activity charged with Development

MX-264
Classified Project No.

W 535 AC-20002
Contract No.

DESCRIPTION: The servo assembly is a gyro-stabilized control, hydraulic-operated servo assembly for actuating the airplane control surfaces. The servo assembly is controlled by means of remote control equipment as used in connection with the PQ radio airplane targets (Project MX-264) and BQ power driven bombs (Project MX-53).

PURPOSE: To provide control equipment to be operated remotely for use in radio airplane targets and power driven bombs

AUTHORITY: Technical Instructions, Serial No. CTI 11, dated 5 January 1940, subject: Military Characteristics for Aerial Targets, and Technical Instructions, Serial No CTI-1102, dated 16 February 1943, subject: Power Driven Controllable Bombs.

REMARKS: One type of 12 volt, D. C. servo unit has been released to standardization as the type A-3 for use in the PQ-8 and PQ-8A Radio airplane target. An experimental type 24 volt D. C. servo unit has been prepared for tests in the XBQ-2A airplane. The 12 volt D. C. experimental type A-4 servo unit is being prepared for testing in the PQ-14B aircraft Two (2) 24 volt D. C type A-4 are being fabricated for testing in the Power Driven Controllable Bomb. The size of cylinder, length and stroke are to be determined by these tests.

BQ TYPE REMOTE & AUTOMATIC CONTROL EQUIPMENT

673-31
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity charged with Development

MX-53
Classified Project No.

None
Contract No.

DESCRIPTION: The equipment consists of a hydraulic remote flight control unit, electrical automatic engine temperature controls, (carburetor, oil, and cylinder), automatic altitude control unit, and

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electrical automatic manifold pressure control device.

PURPOSE: To provide remote control and automatic flight and engine control devices for use in the BQ-1, 2, 3, 4, and 5 aircraft which this laboratory aided in developing.

AUTHORITY: Technical Instructions, Serial No CTI-11, dated 5 January 1940, subject: Military Characteristics of Aerial Targets, and Technical Instructions, Serial No. CTI-1102, dated 16 February 1943, subject: Power Driven Controllable Bombs.

REMARKS: The hydraulic remote flight control unit, electrical automatic engine temperature controls, automatic altitude control unit, and electrical automatic manifold pressure control device development was begun September, 1942, and installations were completed December, 1942 This equipment has been test flown in a type AT-11 airplane and numerous modifications were performed Although the development of this equipment is not completed, test of the equipment in the AT-11 airplane will be concluded and final tests will be conducted in the BQ type aircraft Delivery of several types of BQ airplanes is expected 1 January 1944.

CONTROLLABLE GLIDE BOMBS

673-12 Expenditure Order No.	"See Remarks" Mfg. or Activity charged with Development
MX 108 Classified Project No.	(W 33-038) AC 685 (535) 43-16638-E W535-AC-34482 (W330-96) 44AC-19 Contract Nos.

DESCRIPTION: This development will lead to equipment which will consist of a wing structure that may be attached to a 2000 pound bomb. The wing structure will contain the necessary servo control mechanism and a stabilizing gyro. This bomb, with special sighting equipment, may be dropped at relatively long distances from the target, and it will then glide toward its objective using radio control, television or target-seeking equipment. The radio control equipment will be installed so that the glide bomb may be remotely controlled by the bombardier.

PURPOSE: To provide a controllable glide bomb.

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AUTHORITY: Chief, Engineering Division.

REMARKS: (a) The type GB-1 bomb consists of a high wing type of aerodynamic structure with twin boom type fuselage, manufactured by the Aeronca Aircraft Corporation, Middletown, Ohio This bomb is also known as the Pre-Set Data type and is controlled in direction only, by a type B-6 servo control assembly manufactured by the Hammond Instrument Company, Chicago, Illinois. This bomb upon release from the carrying airplane will glide along a path set prior to its release. Its tactical purpose is to bomb area targets where enemy defenses do not permit normal horizontal bombing technique. The development of this bomb was begun in March 1941 and subsequent tests led to the procurement of 4,000 articles by the Production Division for tactical use.

(b) The type GB-4 Glide Bomb, a radio controlled high wing, single boom fuselage equipped with a television transmitter is controlled in flight by the carrying airplane, which employs a radio transmitter and television receiver. This, in effect, places the control pilot in the bomb itself. Twenty units of this type have been successfully tested at Eglin Field, Florida, and one hundred units are to be employed in the final type test to be conducted in the first months of 1944 at Eglin Field, Florida. The airframe is manufactured by the Klasson Company, Los Angeles, California. The servo control unit is manufactured by the Hammond Instrument Company, Chicago, Illinois, and the television equipment is manufactured by the R.C.A. Corporation, Camden, New Jersey. Negotiations are being made by the Production Division for the manufacture of two thousand of this type of glide bomb for tactical use according to instructions in CTI-1502.

(c) Types GB-5, GB-6 and GB-7, light, heat and radar detecting glide bombs respectively, all consist of the high wing, twin boom type airframe manufactured by the Aeronca Aircraft Corporation, Middletown, Ohio. The target-seeking devices are attached to a nose section of the bomb and are covered by a structure manufactured by the Andover-Kent Aviation Corporation, New Brunswick, New Jersey. This type of Glide Bomb is used for precision bombing of point objectives, glides in a controlled path after release from the carrying airplane and is guided in its flight to a particular target by the self-contained target seeking device. Tests are being conducted on the type GB-5 at Eglin Field, Florida. Tests of types GB-6 and GB-7 are scheduled to begin in the near future.

(d) Type GB-8 Glide Bomb is a radio controlled bomb equipped with visual aids consisting of flares or smoke. This bomb also uses the Aeronca type airframe manufactured by the Aeronca Aircraft Corporation, Middletown, Ohio, and in addition a control servo manufactured by the Hammond Instrument Company, Chicago, Illinois. Two axis controls consisting of rudders and elevator, remotely controlled by the radio from the carrying airplane, permits a large degree of correction of both range and azimuth. Experimental tests are being conducted at the Materiel Command Flight Test Base, Muroc, California. The Production Division, Materiel Command have been directed to procure 2,000 of this type of glide bomb for tactical use. CTI-1502.

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CONTROLLABLE, HIGH ANGLE BOMB

AC-36	See "Remarks"
Expenditure Order No.	Mfg. or Activity charged with Development
MX-225	None
Classified Project No.	Contract No.

DESCRIPTION: The high angle, controllable bomb, which is similar in size and shape to the M44, 1000 pound demolition bomb, is capable of making small changes in trajectory in order to convert present "near misses" into hits. The control surfaces are enlarged fins modified to act as rudders and elevators and actuated by solenoids; the whole device is gyrostabilized to prevent rolling. The bomb will be controlled either by radio or by target seeking devices in the following ways:

(1) Radio Controlled
(a) Controlled by Bombardier using television equipment in bomb.
(b) Controlled by Bombardier observing a flare mounted on the bomb.

(2) Target Seeking Devices.

PURPOSE: To develop a controllable high angle bomb and its method of operation.

AUTHORITY: Chief, Engineering Division

REMARKS: A series of tests with television equipment did not produce positive results. Improved television equipment is being procured from Farnsworth Television & Radio Corporation, Fort Wayne, Ind., and Remington-Rand Company, Middletown, Conn.

A series of radio control tests using a bomb carrying a powerful flare achieved very satisfactory correction in azimuth only, especially against linear targets such as roads. Active steps are being taken to carry out service tests proving this weapon prior to introduction into tactical use.

Work is continuing on applying elevator control to this type of bomb.

Tests of target seeking operation have been withheld pending improvements of elevator control.

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A-2 WATER BORNE TARGET

665-68	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
MX-401	W-2789 tc-1091
Classified Project No	Contract No.

DESCRIPTION: This type water borne target is to be used for both low and high bombing practice. The boat is 35 feet in length, having a 9-foot beam, built by the Hacker Boat Company. It is powered with a 550 h.p. Kermath "Sea Raider" engine capable of driving the boat up to approximately 46 m.p h. It is equipped with simplified radio control equipment. Remote control operation to be accomplished from an airplane.

PURPOSE: To cover development of a type A-2 water borne target for aerial bombing practice.

AUTHORITY: Authorization was contained in a teletype, No. AFDMA-2C-31, dated 10 May 1943, from Commanding General, Materiel Command, to Chief, Engineering Division.

REMARKS: Twenty (20))Hacker boats are now under procurement for conversion to type A-2 water borne targets. It is contemplated to use a Gray Laboratory, Dayton, Ohio modified turn indicator for control. Turns are to be accomplished with the gyro caged and centered. The approximate range of operation at high speed is 5 hours. It is planned to have the target boats ready for test on or about 1 February 1944. Action has been initiated to divert type C-61A airplane for air control of the subject target.

A-3 WATER BORNE TARGET

665-78	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
MX-456	(535) 43-33011-E
Classified Project No.	Contract No.

DESCRIPTION: The type A-3 water borne target is approximately 37 feet long with an 11' 3" beam. Controls will be similar to those of the type A-2 water borne target. This boat is powered with a 550 h.p. Kermath "Sea Raider" engine capable of driving the boat at 42 m p.h. with a 4000# load. This target is to be adapted for use as an offensive weapon, carrying either one or two 4000# bombs. Control of the

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target boat is to be accomplished from an airplane.

PURPOSE: To provide a target boat which can be adapted for use as an offensive weapon.

AUTHORITY: Chief, Engineering Division and a letter from Chief, Development Engineering Branch, Materiel Division, Washington, dated 21 August 1943, subject: Test of Radio Controlled Target Boat.

REMARKS: Two (2) Hacker Boats are now under procurement for conversion to type A-3 water borne targets. It is contemplated that the first unit will be ready for test on approximately 15 February 1944. When used as an offensive weapon, provisions are being made for electrical arming of fuzes for the bombs.

A-3 LAND BORNE TARGET

665-65 Expenditure Order No	Equipment Laboratory Mfg. or Activity charged with Development
MX-401 Classified Project No.	None Contract No.

DESCRIPTION: A 750-pound railroad section car powered with a 13 h.p., 1 cylinder, 2-cycle engine capable of driving the target up to 35 m.p.h. This type target can be used either for aerial bombing or flexible gunnery practice. When used for bombing, two (2) type A-1 trailers, converted for operation on a standard gage railroad track, are towed by the target. A suitable target will be mounted on the superstructure of the power-driven car and operated in a conventional manner without the trailers when used for flexible gunnery practice.

PURPOSE: To provide a light railroad type target for operation on a standard gage railroad track at Avon Park Bombing and Gunnery Range, Florida.

AUTHORITY: Technical Instructions, Serial No. CTI-37, dated 8 April 1940, subject: Land Bombing Target.

REMARKS: Target and related control equipment was shipped in January, 1944, to Avon Park, Florida, for experimental tests. Tests to be conducted on approximately 15 February 1944, at which date, the track is to be completed.

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A-5 LAND BORNE TARGET

665-72
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged with Development

MX-401
Classified Project No.

(33-938) 44-2873-E
Contract No.

DESCRIPTION: A 2000-pound railroad section car powered with a Ford 42 h.p., 4 cylinder Jeep engine capable of driving the car up to 65 m.p.h. Two (2) 6 volt electric servos are installed to actuate the brake, clutch, and throttle. The target is also equipped with an automatic starter to enable starting of the target from standstill by remote control. The target is controlled remotely by a 15 volt D. C. electrical impulse system through the steel rails. An electrical control system has been developed for multiple operation of type A-5 land borne targets for gunnery practice. This system will allow operation of three (3) targets simultaneously per range. An automatic spacing control is incorporated in the design so that targets do not overtake each other.

PURPOSE: To provide a land borne target for bombing and flexible gunnery practice. This target is to be faster and heavier than the type A-3 land borne target.

AUTHORITY: Technical Instructions, Serial No. CTI-37, dated 8 April 1940, subject: Land Bombing Target.

REMARKS: The target and related control equipment have been shipped to Avon Park Bombing and Gunnery Range, Florida, for experimental and service tests. The tests are to be conducted upon completion of the track installation on approximately 15 February 1944. When used for bombing, two (2) type A-1A target trailers, which have been converted for track operation, are to be towed by the power-driven car. For gunnery practice, a suitable target is mounted on the superstructure of the target car.

The AAF Training Command, Fort Worth, Texas, has been contacted regarding possible use of the electrical control system in their procurement of fifty (50) gunnery targets for all flexible gunnery schools.

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A-6 LAND BORNE TARGET

665-76 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
MX-401 Classified Project No.	(4027) 44-53-E (33-038) 44-2373-E Contract Nos.

DESCRIPTION: The type A-6 land borne target is a 2000-pound railroad section car converted into a maneuverable target for aerial bombing practice. It is to be operated on a dry lake area by installation of suitable steering mechanism, small trailer wheels, and rubber tires. This car is powered with an International 6 cylinder, 62 h.p. engine capable of driving the target at 35 m.p.h. In order to start the target from standstill it is to be equipped with a fluid drive. Operation of the target is to be accomplished from a 25-foot stationary tower. The target is to be equipped with non-critical armor structure. Total weight of target is approximately 3600-pounds. One target unit consists of a power-driven target car and three (3) type A-1A target trailers.

PURPOSE: To develop a type land borne target for bombing practice, which will be protected from bomb hits by non-critical armor and will also replace automotive vehicles which are at present used for this purpose.

AUTHORITY: Technical Instructions, Serial No. CTI-37, dated 8 April 1940, subject: Land Bombing Target.

REMARKS: This target will be equipped with 6 volt electrical servo motors for steering, brake, and throttle controls. In addition, it will be equipped with an automatic starter to enable starting from standstill by remote control. Twenty (20) targets are being procured in order to conduct experimental and service tests. It is contemplated that the first target will be ready for test on approximately 15 January 1944.

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A-3 AERIAL TARGET CATAPULT

665-77 Expenditure Order No.	Montpelier Manufacturing Co. Montpelier, Ohio Mfg. or Activity charged with Development
MX-378 Classified Project No.	None Contract No.

DESCRIPTION: The type A-3 aerial target catapult is a spring powered catapult for use in launching non-man-carrying targets, principally the type OQ-6 radio airplane target. It consists of a steel tube frame structure of a triangular cross-section with rails for guiding the launching car. The weight of the catapult assembly will be approximately 950-pounds.

PURPOSE: To develop a catapult for launching the type OQ-6 radio airplane target and to make a cheaper and more efficient catapult for launching other non-man-carrying targets.

AUTHORITY: Technical Instructions, Serial No. CTI-11, dated 5 January 1940, subject: Military Characteristics of Aerial Targets.

REMARKS: This expenditure order was opened in August, 1943. So far, development has been in a design status. Procurement has not yet been initiated.

OQ-6 RADIO AIRPLANE TARGET

665-74 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
MX-378 Classified Project No.	None Contract No.

DESCRIPTION: The OQ-6 radio airplane target is a non-man-carrying target for aerial gunnery and anti-aircraft artillery training. The target will have a wing span of approximately 12 feet, will be powered by an engine of approximately 20 h.p., and will be remotely controlled by radio. A high speed of 170 m.p.h. and a minimum possible gross weight is the aim in design. The target will be launched by catapult and landed by parachute.

PURPOSE: To provide a target for fixed and flexible aerial gunnery training that will simulate combat conditions more closely than the present sleeve and ground type targets.

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AUTHORITY: Technical Instructions, Serial No. CTI-11, dated 5 January 1940, subject: Military Characteristics of Aerial Targets.

REMARKS: Design criteria is not available for an airplane of the size, weight, performance, and intended use of the proposed type OQ-6 radio airplane target. The necessary criteria has been partially set up by the Aircraft Laboratory, based on the type OQ-2A radio airplane target which satisfactorily performs its mission, and a man-carrying airplane which is called upon to perform maneuvers similar to this target. Additional design data required is being obtained by aerodynamically improving the type OQ-3 radio airplane target until a speed is obtained with this 6 h p. target which will substantiate the 1[illegible]5 m.p.h. desired speed when a 20 h.p. engine is used.

D-3 SERVO UNIT

665-67
Expenditure Order No

Gray Lab., Inc., Dayton, Ohio.
Hansen Manufacturing Company,
Princeton, Indiana
Mfg. or Activity charged with Development

MX-378
Classified Project No.

(535) 43-14827-E (33-096)44-658-E
Contract Nos.

DESCRIPTION: The servo unit is a muscle for actuating the control surfaces of a non-man-carrying radio airplane target and is coupled directly with it. The unit consists of two electric permanent magnet motors, each geared to its own torque delivering arm. Relays are used to reverse the direction of the motors and to provide dynamic braking of the torque arms. The arc through which the torque arm travels is controlled by limit switches. Gyros are not used for stabilization of the target in connection with the operation of this type servo.

PURPOSE: To provide a unit for actuating the control surfaces of high speed targets now being developed which require greater torque output than is available in the present type D-1 servo unit.

AUTHORITY: Technical Instructions, Serial No. CTI-11, dated 5 January 1940, subject: Military Characteristics of Aerial Targets.

REMARKS: The type D-3 servo unit made up by personnel of this office has been flight tested for five hours and bench tested for fifty hours. Gray Laboratories, Inc., Dayton, Ohio, has made a waterproof version of this servo which is now being bench tested. The Hansen Manufacturing Company, Princeton, Indiana, has submitted a manufacturer's version of the model made up by this laboratory. This model has been bench tested and will soon be flight tested at Fort Bliss, Texas. Bench tests indicate that the type D-3 servo unit has the following advantages over the standard type D-1 servo unit:

a. Delivers three times as much torque.

b. Operates on lower current input.

c. Operates without fail on as low as four volts.

d. Gives less speed variation of torque arm delivery between loaded and unloaded conditions.

CONTROL GYROSCOPES, AIR-DRIVEN, AIR-PICKOFF

665-75 Expenditure Order No.	Gray Laboratories & Mfg. Co., Dayton, Ohio Mfg. or Activity charged with Development
MX-250 Classified Project No.	Contract Pending Contract No.

DESCRIPTION: Control gyroscopes incorporating Sperry aircraft type gyroscopic elements and pneumatic pickoffs as well as additional functionally designed parts necessary to give electrical sense signals for controlling aircraft monitored by radio or target-seeking devices.

PURPOSE: To provide compact control gyroscopes making use of well proven pneumatic principles, functionally designed for use in power driven controllable bombs and targets, and incorporating better dust protection, more compact mechanism and other improvements over previous equipment.

AUTHORITY: Chief, Engineering Division.

REMARKS: In April, 1943, a program was formulated at the Materiel Command to develop an improved version of the standard pneumatic pickoff control gyros being used in radio airplane target servos. The primary objects of the improvement are to minimize the vulnerability of the equipment to dust and mechanical damage and to include in compact form certain auxiliary motors, switches and relays formerly mounted external to the gyroscopes.

Gray Laboratories & Mfg. Company, the present source of pneumatic control gyros for radio airplane targets, was contacted regarding this program and has begun development of a set of air pickoff control gyros with integral trim motors.

Meanwhile, procurement has been made of an experimental quantity of gyros similar to the present standard ones and interchangeable with them, but incorporating an improved pickoff head construction which considerably decreases its vulnerability to both dust and mechanical damage. Bench tests have been made on this equipment and installation is currently being made in standard RAT servo units for accelerated tests by using activities.

CONTROL GYROSCOPE, AIR-DRIVEN, ELECTRIC PICKOFF

675 23 Expenditure Order No.	Research Laboratories Div. GMC, Detroit, Mich Mfg. or Activity charged with Development
MX-250 Classified Project No.	W 535 AC-28942 Contract No.

DESCRIPTION: Control gyroscopes incorporating Sperry aircraft type gyroscopic elements and additional functionally designed parts necessary to give electrical sense signals for controlling aircraft monitored by radio or target-seeking devices.

PURPOSE: To provide control gyroscopes (Directional and Vertical) for power-driven controllable bombs and targets which make maximum use of existing gyroscopic elements and give sense signals by means of electrical contacts. In this manner, it is hoped to provide greater simplicity and better performance than can be obtained from previous control gyroscopes which make use of air-actuated pickoffs.

AUTHORITY: Chief, Engineering Division.

REMARKS: In the spring of 1942, the Research Laboratories Division of General Motors Corporation was contacted by the Materiel Command with reference to the possibility of developing vertical and directional control gyroscopes utilizing the well known gyroscopic parts of Sperry instruments and adding thereto an electric pickoff and other working parts making use of principles which had been developed at the Materiel Command. All of the additional parts were to be designed with a view to quantity production.

Procurement was initiated in May and June, 1942. Experimental quantities of several modifications of the control gyros have been delivered to the Materiel Command and have been tested. One model, designed for use in the pre-set data glide bomb was found satisfactory and standardized in October, 1942 under the AAF designation "Gyroscope, Control, Directional, type B-1, (Air-Driven, Manual Caging)." This gyro has since been replaced by an all-electric gyro and reduced to obsolete classification.

Other types, adapted primarily for use in radio airplane targets, are currently being delivered periodically and tested at

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gyroscope by Hammond Instrument Company, Chicago, Illinois, which incorporated a similar erection feature to prevent tumbling but is otherwise different. In December, 1942, tests were completed which indicated that the Hammond Control Box, Type HB-P, incorporating this gyro,provided satisfactory flight control for pre-set data glide bombs (Project MX-108) and steps were begun to standardize this equipment by placing it on limited procurement status under the Army Air Forces designation "Servo, Flight Control, Type B-6 (Electric)." A 24 volt version of this same control box is being procured for tests under the classification of "Servo, Flight Control, Type B-9."

In September, 1942, the Research Laboratories Division of the General Motors Corporation, Detroit, Michigan, undertook the development of a precessing type gyro patterned after the laboratory model of the Materiel Command and procurement of an experimental quantity of five (5) has been made. Three of these have been delivered and given bench tests. One of them is currently being used to stabilize a PQ-8A target airplane in tests under simulated radio control. Delivery of the last two articles is anticipated by 1 January 1944.

As a result of conferences at the Materiel Command in November, 1942, the Schwien Engineering Company, Los Angeles, California, has undertaken a parallel development patterned after the Materiel Command laboratory model. Procurement has been made of an experimental quantity of 2 instruments, both of which have been delivered and given bench tests Certain features of the Schwien design appear to be superior to the General Motors Research design. It is anticipatd that the best features of both designs may ultimately be combined, in one instrument.

CONTROL GYROSCOPE, VERTICAL, ELECTRIC

	Research Lab. Div., Detroit, Michigan Fairchild Aviation Corp. Jamaica, N.Y.
673-17 Expenditure Order No.	Mfg. or Activity Charged with Development
MX 250 Classified Project No.	New Contract Pending Contract No.

DESCRIPTION: A gravity erected control gyroscope operated by direct current and giving electric sense signals necessary for pitch (or roll) control of aircraft monitored by radio or target-seeking devices.

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PURPOSE: To provide a vertical control gyroscope for power-driven controllable bombs and targets which will be driven by the aircraft battery instead of by a vacuum pump and which will make minimum use of critical parts and materials consistent with adequate performance.

AUTHORITY: Chief, Engineering Division.

REMARKS: Work in this project originated with a conference held at Wright Field in November 1941, with representatives of the Fairchild Aviation Corporation, at which time that Corporation agreed to make preliminary studies and to submit a proposal covering a gyro which would control two (2) axes (pitch and roll). After a second conference in February, 1942, to review detail requirements, a proposal was submitted in March, 1942, and procurement was made of two (2) experimental gyroscopes These have been delivered and given bench tests. Although the tests indicated that such gyroscopes could be used, the construction was considered too intricate and expensive to warrant its use in bombs and targets. The Fairchild gyro does contain a novel erection system which is considered to have merit. Procurement is currently underway of a small quantity of gyros utilizing this system but made to control only one (1) axis.

Following a conference in September, 1942, with representatives of the American Amplifier and Telephone Company, Los Angeles, California, concerning a vertical control gyro utilizing an inexpensive and rugged erection system proposed by that Corporation, procurement was made of two (2) such experimental gyroscopes. One of them has been delivered and bench tests made thereon Further tests are to be made to evaluate the erection scheme, but it is already evident that the design of the experimental samples is poor from a use standpoint. Research Laboratories Division, General Motors Corporation, has been contacted regarding the development of an all electric vertical gyro employing the same principle of bail erection and negotiations are currently underway to purchase a small quantity of such gyros.

Concurrently with these procurements, various schemes have been studied and models built at the Materiel Command. One laboratory model of a novel friction-erection vertical gyro conceived at the Materiel Command is now built and bench tests have indicated considerable promise for this type of gyro when used in conjunction with a tilted directional gyro.

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AUTOMATIC RATER

668-41 Expenditure Order No.	Metal Associates Inc., N.Y. Mfg. or Activity charged with Development
None Classified Project No.	Contract Pending Contract No.

DESCRIPTION: This unit is similar in design and operation to a pin-ball machine. It is fixed machine operating automatically for one student at a time. There is a 6" x 9" picture displayed of which the student has six (6) choices for the answer. A scoring mechanism operates during the time the student is selecting his answer and credits him in accordance with the time he requires for each answer. In case of an incorrect answer, the picture will reappear with the correct answer. The capacity of the machine is fifty (50) questions which can be easily changed.

PURPOSE: To provide a machine which can evaluate a student's knowledge of various pertinent subjects.

AUTHORITY: Authority was contained in a communication received from the Army Air Forces School of Applied Tactics, Training Aids Division dated 16 March 1945, subject: Automatic Rater.

REMARKS: The Materiel Command was directed by the above authority to procure a machine using an automatic slide projector arrangement instead of the card displaying method and evaluate the same for a new source of supply of these trainers.

AUTOMATIC MINIATURE RADIO RANGE

668-14 Expenditure Order No.	The Sparks-Withington Co. Jackson, Mich. Mfg. or Activity charged with Development
None Classified Project No.	W 535 AC-38337 (10134) Contract No.

DESCRIPTION: This project consists of a miniature radio transmitter, a standard receiver, and a miniature antenna system. This equipment may be used with instrument trainers, or it may be used by itself for classroom instruction purposes. It is possible with this equipment to simulate any radio range station in the United States.

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PURPOSE: To provide an Automatic Miniature Radio Range that will improve training in ground instrument trainers

AUTHORITY: Authorization was contained in a directive received from the Director of Individual Training, Washington, D. C. dated 1 January 1943, subject: To procure 799 Radio Range Trainers for Assignment to Schools in the Flying Training Command.

REMARKS: A contract was awarded for 812 radio range trainers on 2 April 1943. A sample of the production model has been completed and tested. The minor defects that were found are being corrected by the addition of an electronic keying unit that will replace the mechanical unit used in the first model. Work has been started on a marker beacon system to be incorporated in this trainer. Designs for a device to simulate instrument landings without constant manual control by the instructor have been completed. This action has been taken so that one instructor will be able to operate more than one trainer at a time.

AUTOMATIC LANDING SYSTEM

667-14 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: This equipment is composed of various electro-mechanical devices interconnected with standard automatic pilot and radio receiving equipment so as to control an airplane during an approach and landing

PURPOSE: To provide a radio aid to relieve the airplane pilot of the burden of performing a considerable portion of the duties involved in landing a modern military airplane, under the conditions of low or no visibility.

AUTHORITY: Chief, Engineering Division.

REMARKS: Successful automatic landings were made as early as 1937 using equipment and aircraft now obsolete. Present development has the aim of providing equipment fulfilling the requirements imposed by the high landing speeds and heavy weight of modern military airplanes.

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RADIO CONTROLLED, TELEVISION EQUIPPED

GLIDE BOMB TRAINER

668-26 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
MX-319 Classified Project No.	(535) 43-19194-E Contract No.

DESCRIPTION: This trainer consists of a silent 16 mm. motion picture projector mounted in such a manner that its attitude with respect to the screen can be remotely controlled from a viewing screen by the student and instructor. The projector can be maneuvered to represent turn, bank, climb, and dive.

PURPOSE: To develop a trainer for instructing students in the operation and control of glide bombs.

AUTHORITY: Chief, Engineering Division.

REMARKS: In October, 1942, a working sample was completed and was approved. In April, 1943, twenty-five (25) trainers were delivered to the Materiel Command, and several units have been distributed for evaluation and test.

MOCK-UP INSTRUMENTS

668-47 Expenditure Order No.	See "Remarks" Mfg. or Activity charged with Development
None Classified Project No.	Contract Pending Contract No.

DESCRIPTION: These mock-ups are oversize instruments made as far as practicable of wood and plastic and simulating the appearance and action of the standard aircraft instruments.

PURPOSE: To provide a simple means of classroom instruction and demonstration of the principles, appearance, and operation of aircraft instruments

AUTHORITY: Authorization was contained in a 1st Indorsement by the Hqs. Army Air Forces, Training Aids Division of Assistant Chief of Air

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Staff Training dated 23 April 1943 to a letter from Hqs. 334th Bombardment Group to the Commanding Officer, Synthetic Training Aids Division, Third Bomber Command, dated 14 April 1943 subject: Ground School Training Aids.

REMARKS: In February 1943 negotiations were started with the Gardner Displays Inc., Pittsburgh, Pa. for the procurement of several mock-up instruments for study evaluation. In May 1943, negotiations were started with the Cooperative Displays, Inc., Cincinnati, Ohio, Grand Rapids Industries, Grand Rapids, Mich., and G. Felsenthal & Sons, Chicago, Ill. for the procurement of additional mock-up instruments. Many of these devices have been received and distributed to AAF schools for evaluation. Reports received to date have been generally favorable.

COCKPIT INSTRUCTIONAL PANELS

668-28 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: This trainer is a pictorial illustration of the interior of an aircraft cockpit on panels. Two side panels are hinged to a front panel in such a manner that the three panels can be set up on the floor of the classroom to simulate the appearance of the interior of the cockpit used in actual aircraft. An ordinary chair will be placed in the position that would normally be occupied by the pilot's seat. The technical order number of each instrument or part displayed on the panel will be printed on that unit as a reference to the student to any part with which he is not familiar. Racks will be provided adjacent to the trainer which will contain the Technical Orders pertinent to the parts of the portrayed cockpit.

PURPOSE: To familiarize students with the appearance and function of all instruments and controls of any particular aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: An experimental cockpit instruction panel was made up using photographs of the interior of the aircraft cockpit, which was not entirely satisfactory because of distortion and lack of clarity of detail. Nine panels, with cockpit details of the PT-19A aircraft silk-screened on a black background, have been shipped for evaluation.

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TACTICAL TRAINING MAP

668-44 Expenditure Order No.	Gardner Displays Inc., Pittsburgh, Pa. Mfg. or Activity Charged with Development
None Classified Project No.	(535) 43-32824-E Contract No.

DESCRIPTION: The tactical training map is built in five (5) sections which when bolted together has overall dimensions of 19'-6" x 19'-6". Coloration and texturing are used to indicate grassland, sanded areas, runways, roads, swamp areas, and lakes, Miniature trees, shrubs, airplanes, trucks, trailers, jeeps, command cars, ambulances, tents, machine guns, and field guns are supplied as accessories to be used in laying out tactical problems.

PURPOSE: To provide means of classroom instruction in planning flights to avoid hazardous terrain and to avoid undue exposure to hostile attack.

AUTHORITY: Authorization was contained in paragraph d of a letter from the Assistant Chief of Air Staff, Training Aids Division, New York, New York to the Materiel Command, Engineering Division dated 5 May 1943, subject: Requests for the Development of Synthetic Training Devices.

REMARKS: In April 1943, negotiations were begun with Gardner Displays Inc., Pittsburgh, Pa. to procure an experimental model of the tactical training map. An Authority for Purchase was approved on 17 May 1943. Favorable reports have been received on the original model.

TERRAIN TABLE MAP

668-35 Expenditure Order No.	Gardner Displays Inc., Pittsburgh, Pa. Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-32823-E Contract No.

DESCRIPTION: This table map is a scale model in three dimensions of the terrain existing at Needles, Arizona. Coloration and texturing will

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be employed to reproduce in miniature the actual appearance of the terrain. Model homes and buildings will be placed on the map to depict existing structures Forests, fields, grazing areas, and roadways will be simulated by means of coloration, texturing and flocking.

PURPOSE: To provide a means of classroom instruction in the planning of tactical missions taking into account the existing terrain.

AUTHORITY: Paragraph b of a letter from the Assistant Chief of Air Staff, Training Aids Division, to the Materiel Command, Engineering Division dated 5 May 1943, subject: Requests for the Development of Synthetic Training Devices.

REMARKS: In April 1943, negotiations were begun with Gardner Displays Co., Pittsburgh, Pa. to procure one of these models. An Authority for Purchase was approved on 17 May 1943. Favorable comments have been received on the original model.

TORPEDO RELEASE TRAINER

668-40 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
MX-377. Classified Project No.	W(535) AC 40284 Contract No.

DESCRIPTION: This trainer consists of a simulated airplane cockpit equipped with a rear projection screen used as cockpit windows. A silent 16 m.m. motion picture projector is so mounted that its attitude with respect to the screen can be remotely controlled by the student and instructor. The movement of the projector can be maneuvered to represent turning, banking, or elevation as experienced in actual flight. The controls provided in the cockpit will be operated in the same manner as is required for actual torpedo approach and releasing. A mechanism is provided which will indicate hits or misses to the operators.

PURPOSE: To develop a trainer for instructing the proper preparation and flight approach for torpedo releasing.

AUTHORITY: Authorization was contained in an immediate action directive from the Director of Training Aids Division, New York, New York, dated 18 June 1943.

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REMARKS: At the present time there is a need for a training device which will teach the proper approach and releasing of torpedos. It is the opinion of the Training Aids Division that the radio-controlled, television-equipped glide bomb trainer can be reworked to cover this type trainer. A contract has been placed with the Moore Equipment Co., Dayton, Ohio for two experimental trainers. Delivery is expected approximately 15 January 1944.

PRE-FLIGHT REFLEX TRAINER

668-1-20 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-29754 Contract No.

DESCRIPTION: This trainer is a device equipped with a maneuverable cockpit mounted on a tricycle undercarriage. A small gasoline engine provides the motive power for operating this unit which moves over the ground and simulates to a limited degree, the climb, dive, bank, and turn effect as experienced in actual flight. Conventional aircraft controls are used to operate this trainer.

PURPOSE: To provide a pre flight trainer, ground type, for training primary flying students in the control and elementary flight maneuvers preliminary to actual flight in the air.

AUTHORITY: Authorization is contained in a directive received from the Hqs. AAF, Washington, D.C. dated 22 May 1942, subject: Pre-Flight Reflex trainer.

REMARKS: One of these units has been fabricated and tested at this Station. This unit is being forwarded to a primary flying school for test and evaluation.

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MULTI-MOTOR TAXIING TRAINER

668-39 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: This device is a three-wheeled ground vehicle, propelled by two Continental 65 h.p. airplane engines fitted with conventional wood propellers. Two standard automobile wheels are used for rear wheels and a P-39 nose wheel on the front. The vehicle is suspended on automobile leaf springs. The frame and fuselage are made entirely of wood except for metal fittings. The general type of construction is such that the use of aeronautical grade wood or aeronautical woodworkers is not required. Wherever possible, the overall dimensions are made equal to one-half of those of a type B-25 airplane. Dual seats and controls are provided in the cockpit with the intention that the vehicle will be used by an instructor and a student. The vehicle will be operated by means of the engine controls, rudder controls, and individual automobile hydraulic brakes on the two rear wheels. The nose wheel will caster similarly to the nose wheel of a B-25.

PURPOSE: To provide a means of simulating conditions encountered by a pilot while taxiing multi-motored aircraft on the ground.

AUTHORITY: In February, 1942, the development of this trainer was verbally requested by the AAF School of Applied Tactics, Orlando, Fla.

REMARKS: The design of the trainer was started on 1 April 1943 and construction of the first experimental article was started on 15 April 1943. Test of one trainer has been completed at Randolph Field, Texas, and is in use there at the present time.

MAP READING TRAINER

668-38 Expenditure Order No.	H. C. Evans Co., Chicago, Ill. Mfg. or Activity charged with Development
None Classified Project No.	(2119) 43-1428 Contract No.

DESCRIPTION: This trainer consists of a machine displaying half of a standard section map. Aerial photographs of prominent landmarks

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are shown of small areas covered by the section map. The operator is required to identify the location of these small aerial photos which represent his position during a theoretical flight. His accuracy and the time required to identify his position are registered on a scoring mechanism included in this trainer.

PURPOSE: To provide a simple means of map reading training or instruction simulating actual conditions encountered by the student.

AUTHORITY: Authorization was contained in a communication received from the Army Air Forces School of Applied Tactics, Training Aids Division dated February 1943, subject: Automatic Rater.

REMARKS: The basic idea for this trainer was disclosed to the H. C. Evans, Company, Chicago, Ill., and they were awarded a contract for three (3) experimental units on 14 April 1943. Three units have been delivered and sent out for evaluation tests by Training Command.

IMPROVEMENT OF INSTRUMENT FLYING TRAINERS

668-57 Expenditure Order No.	Equipment Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: The following trainer improvements are to be developed in connection with this project:

1. Modification of control pressures to more clearly simulate aircraft controls.
2. Change of tachometer indication with change of propeller pitch.
3. Addition of a manifold pressure gauge to the trainer.
4. Change of airspeed indication when landing gear control is operated.
5. Change of airspeed indication when flap control is operated.
6. Addition of a vacuum gauge to the instrument panel.
7. Addition of trim tab controls for aileron, rudder, and elevator.
8. Simulation of engine torque with varying airspeed.

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PURPOSE: To provide more complete and accurate simulation of aircraft control and instrument reactions during flight in present instrument flying trainers.

AUTHORITY: The development of these trainer improvements was directed in 6th Ind. from Office Assistant Chief of Air Staff, Training, RM&D., dated 11 October 1943.

REMARKS: An expenditure order was approved in November 1943, covering the development and test of the above items. A trial installation has been made of a twin-engine simulator manufactured by West Aeronautical Devices, Inc., Montreal, Canada. This device provides most of the required items, plus a few more not specifically requested. When these trainer improvements have been satisfactorily developed, they are to be installed in an instrument flying trainer and shipped to Bryan Field, Texas, for evaluation.

INSTRUMENT LANDING TRAINER (TYPE B-4)

668-39 Expenditure Order No.	Moore Equipment Company, Dayton, Ohio Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-25086-E Contract Number

DESCRIPTION: The type B-4 instrument landing trainer is a portable, self-contained, synthetic training device, which may be used with any type of aircraft to practice instrument landing approaches. It consists of an instructor's control panel with built-in signal generator to produce 400 cycle and 800 cycle signals simulating the inner and outer stations of an Army instrument landing range, an instrument panel containing simulated glide path and runway localizer indicators, also simulated radio compass. Two pairs of head phones are provided, one pair for the student pilot and the instructor respectively. The head phones are plugged into phone cords emanating from the control panel. Manipulation of the controls by the instructor regulates the indications on the student pilot's instrument panel. The student pilot makes instrument landing approaches by reference to the indications of the simulated radio compass and glide path and runway localizer instruments.

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PURPOSE: To provide a means for instructing student pilot in making instrument landing approaches at locations where instrument landing facilities are not available.

AUTHORITY: Authorization was contained in a communication from Hqs. AAF Flying Training Command, Fort Worth, Texas, dated 21 November 1942, subject: Procurement of Type B-4 Instrument Landing Trainers.

REMARKS: An experimental model of this trainer was built in the Radio Aids Unit of the Equipment Laboratory, Wright Field, Dayton, Ohio, in November 1942. A contract has been negotiated with the Moore Equipment Co., Dayton, Ohio, to procure thirty (30) trainers.

INSTRUMENT FLIGHT TRAINER

668-32 Expenditure Order No.	Equipment Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	AC 27760 Contract Number

DESCRIPTION: The trainer consists of three (3) sections; fuselage, base, and instructor's desk. The complete unit contains the mechanism, instruments, and controls necessary for the simulation of an aircraft on instrument flight and the necessary instruments and radio equipment for reproducing the instrument indications as well as the aural and visual radio signals utilized in radio aids to navigation. It is intended for use as ground equipment in teaching both elementary and advanced instrument flying, including radio navigation, radio range orientation, British and American landing procedures, etc. The automatic recorder on the instructor's desk furnishes an accurate record of the problems flown in the trainer by which the student's knowledge, skill, and adaptability can be readily determined.

PURPOSE: To test the AN-T-18 trainer for performance and conformance with governing specification, and proper design.

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AUTHORITY: In accordance with a request from the Army-Navy Specification Board, authority for this project was obtained from the Chief, Engineering Division on 8 January 1943.

REMARKS: This ground trainer for instrument and radio flying was standardized for joint use by the Army, Navy, British, and Canadians on 30 March 1942 and specification AN-T-18 covering the trainer was approved on 26 September 1942. Tests conducted on this trainer during January and February 1943 revealed a number of defects of varying degree in importance. Some of the major items were as follows:

a. Control reactions of stick and rudder were found to be unrealistic.
b. Artificial horizon bank indication only 1/4 of proper value to simulate the degree of bank during standard rate turn.
c. The single pointer runway localizer indicator in the cockpit is not adequate for instrument landing instruction. For best results, two cross-pointer indicators of the I-101C type are required, one in the cockpit, and one on the remote instrument panel.

All of the above defects have either been corrected or are being investigated at the present time.

FIXED PRE-FLIGHT TRAINER

668-24 Expenditure Order No.	Equipment Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	W-11-107 AC-287 Contract Number

DESCRIPTION: The trainer is a wooden inclosure in which there is a cockpit equipped with conventional airplane controls i.e. sticks, rudder pedals and throttle. These controls operate a sphere which is driven by three electric motors. On the sphere are painted sky, horizon, and section lines. A small section of the sphere is projected on a screen which is located in the position of the windshield of an airplane. Movement of the controls causes the projected image of the sphere to move as the view from an airplane would move, and since the sphere merely rests on the motor drive shafts, it is free to rotate any amount in any direction and maneuvers such as loops, rolls, and 360° turns may be simulated.

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PURPOSE: To develop a fixed pre-flight trainer to familiarize the pilot with the appearance of the earth during various contact flight maneuvers such as turns, banks, rolls, loops, etc.

AUTHORITY: Chief, Engineering Division.

REMARKS: In December 1942, three (3) trainers were procured from the McAleer Displays Co., Chicago, Ill. One of these trainers was sent to Orlando, Florida 28 January 1943 for field test and evaluation. The trainer was returned on 25 May 1943. It was the opinion of that station that the controls on this trainer did not correctly simulate those of an airplane. This defect has since been corrected by the addition of a new control spring assembly. Air pistons have been added to simulate a slipstream effect on the rudder, aileron, and elevator. One Beindorf trainer is being sent to McAleer Displays, Chicago, Ill., for reworking to provide more positive and dependable control action. Delivery date of reworked trainer is approximately 15 April, 1944.

NIGHT APPROACH TRAINER

668-42 Expenditure Order No.	Gardner Displays Co., Pittsburgh, Pa. Mfg. or Activity Charged with Development
None Classified Project No.	(535) 43-32905-E Contract Number

DESCRIPTION: This trainer is a model airdrome 6' x 6' electrically operated and controlled, showing the latest arrangements of flare path and other lighting facilities including hoods, different colored lights, and collimated lights. Individual control of all the light installations for the purpose of controlling their respective intensities is maintained by means of a control panel located on the side of the map.

PURPOSE: To provide a means of instructing students regarding the appearance, functions, and use of airfield night lighting systems.

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AUTHORITY: Authorization was contained in a letter from the Assistant Chief of Air Staff, Training Aids Division to the Materiel Command, Engineering Division, dated 5 May 1943, subject: Requests for the Development of Synthetic Training Devices.

REMARKS: In April 1943 negotiations were started with Gardner Displays Co., Pittsburgh, Pa. for the procurement of this trainer. An Authority for Purchase was approved on 22 May 1943. Favorable comments have been received on a model together with recommendations.

FIXED GUNNERY TRAINER (OUTDOOR)

668-31 Expenditure Order No.	The Sparks-Withington Co. Jackson, Mich. Mfg. or Activity Charged with Development
None Classified Project No.	W535 AC 38731 Contract Number

DESCRIPTION: The trainer consists of a fuselage capable of simulating the climb, dive, and bank movements of an airplane. It is capable of 130 degrees rotation in the horizontal plane. On the fuselage are mounted a compressed air gun and three gunsights; one for the student in the fuselage and one above the seats attached to either side of the fuselage. The side seats are for the instructor and another student. One way interphone (from instructor to student) is included. An electric motor driven target traveling on a track completes the equipment. The track is divided into right and left hand sections with two fuselages capable of operating simultaneously for each section.

PURPOSE: To provide a rapid and efficient means for ground training in fixed aerial gunnery prior to combat.

AUTHORITY: Authorization was contained in a communication from the Hqs. Army Air Forces, Flying Training Command, dated 28 January 1943, subject: Fixed Gunnery Trainer.

REMARKS: Experimental equipment of this type was first constructed at Eglin Field, Florida. Later, improvements were made on a model constructed by the Special Weapons Branch, Wright Field, and tested at Eglin Field with satisfactory reports. Negotiations were started in January 1943 with the Sparks Withington Company, Jackson, Michigan. A contract for 552 fuselages and associated equipment was approved 10 May 1943. Delivery on the contract was started in July 1943 and will be completed in January 1944.

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DITCHING TRAINER

668-45	Gardner Displays Inc., Pittsburgh, Pa.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This trainer is a full scale model of a B-17F aircraft, constructed entirely of wood. The interior of the fuselage is also reproduced to represent the hazards present in evacuating this type of aircraft. Sound effects are provided to simulate the engine noise of the actual aircraft and to allow communication between an instructor on the shore and students in the trainer. The mock-up is placed in a body of water near the shore, thus allowing abandoning procedure to take place under simulated emergency conditions.

PURPOSE: To provide a means for training flying personnel to abandon aircraft under conditions of an emergency landing at sea.

AUTHORITY: Letter from the Assistant Chief of Air Staff, Training Aids Division to the Materiel Command, Engineering Division, dated 8 May 1943, subject: Request for the Development of Synthetic Training Devices.

REMARKS: In April 1943, negotiations were begun with Gardner Displays Inc., Pittsburgh, Pa., to procure one (1) experimental model. The negotiations resulted in the initiation of an Authority for Purchase on 17 May 1943. Delivery has been made to the activity involved.

DEAD RECKONING NAVIGATION TRAINER, TYPE G-1

668-23	American Automatic Typewriter Co., Chicago, Ill.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	(535) 43-22319
Classified Project No.	Contract Number

DESCRIPTION: Equipment consists of a navigator's car equipped with the instruments essential for dead reckoning navigation and mounted on a three wheel frame which travels over a map mounted on a traveling table which also moves to introduce the element of drift.

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PURPOSE: To develop a dead reckoning trainer for ground training in air navigation.

AUTHORITY: Authorization was contained in a directive received from the Training Aids Division, New York, dated 1 January 1943.

REMARKS: The first production model of this trainer has been completed and inspected at the American Automatic Typewriter Company, Chicago, Ill. Tests proved this trainer very satisfactory. An authority for purchase has been initiated for an additional 150 trainers for distribution to various Navigation Schools.

CAMOUFLAGE TRAINER

668-43 Expenditure Order No.	Gardner Displays Co., Pittsburgh, Pa. Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: The camouflage trainer is a relief map consisting of model homes, buildings, trees, and roads, and has different areas designated by different colors. Supplementing this will be model airplanes, trucks, and anti-aircraft guns casting representative shadows and capable of being placed in any desired position. The vertical and horizontal scale will be equal. The map will be built in four (4) sections with one (1) section removable and two (2) interchangeable; one of the latter finished in high gloss, and the other in dull.

PURPOSE: To provide a means of instructing flying personnel in the use of camouflage technique involving the principles of dispersion, concealment coloration, disruption, decoys, form and texture.

AUTHORITY: Authorization was contained in a letter from the Assistant Chief of Air Staff, Training Aids Division to the Materiel Command, Experimental Engineering Division, 5 May 1943, subject : Requests for the Development of Synthetic Training Devices.

REMARKS: In April 1943, negotiations were started with the Gardner Displays Co., Pittsburgh, Pa. for the procurement of this trainer. The authority for Purchase was initiated on 17 May 1943, and one model was released for evaluation. A favorable report has been received on this item.

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P-40 INSTRUMENT TRAINER

668-51
Expenditure Order No.

Moore Equipment Co.,
Dayton, Ohio
Mfg. or Activity Charged with Development

None
Classified Project No.

(33-038) 44-2710-E
Contract Number

DESCRIPTION: This trainer is a standard An-T-18 instrument flying trainer reworked to include actual and simulated instruments and controls of the P-40 airplane. The desk operator is provided with a control panel to enable him to simulate abnormal instrument readings, failure of landing gear or flaps to operate properly, and various other operating conditions which require prompt corrective action on the part of the pilot in the trainer cockpit.

PURPOSE: To provide ground equipment to familiarize trainee pilots with the main instruments and controls of the P-40 airplane and to give them practice in spotting and correcting abnormal instrument readings.

AUTHORITY: Director of Individual Training, Army Air Forces.

REMARKS: An Expenditure Order was approved 26 July 1943 covering development and test of this trainer. A contract was completed with Moore Equipment Company, Dayton, Ohio, in September 1943 for development and installation of this equipment. Delivery has been requested for approximately 1 March, 1944.

VIEW LIMITER

668-33
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Equipment consists of transparent green plastic aircraft windshield and window liners, and a pair of light fabric goggles equipped with plastic red lenses to be worn by the pilot practicing instrument flying. The spectral cut-off is so arranged that no

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light filters through the red and green plastic. The student, however, has full vision of the interior of the cockpit. The safety pilot does not wear red goggles and therefore has unrestricted view from the plane.

PURPOSE: To replace the blind flying hood used during instrument flying and landing, and to make this type training less hazardous.

AUTHORITY: Chief, Engineering Division.

REMARKS: Tests were made with a large variety of filter materials, which resulted in the use of green and red filtering plastics. The green sheets for the instrument flying inclosures have been standardized and conform to AAF Specification No. 12034. The goggles have been standardized for dark adaptation of the eyes and are known as type E-1, AAF Specification No. 3142. These same goggles are also suitable for use with the view limiter system except in some cases additional ventilation may have to be provided by perforating the side lenses and leather binding with small holes. Action has been initiated to modify above specification to cover this requirement when goggles are to be used solely for instrument flying training.

SILHOUETTE PROJECTORS

668-46 Expenditure Order No.	Gardner Displays Company Pittsburgh, Pa. Mfg. or Activity Charged with Development
None Classified Project No.	(535) 43-32514-E Contract Number

DESCRIPTION: This projector is mounted in a ring allowing rotation through 360° about its longitudinal axis; the ring is mounted on a swivel allowing 150° adjustment North and South, and the mounting rod of the projector moving 150° East and West permitting the projector to be adjusted for any location and in any direction. Thus six silhouettes, views of various types of aircraft, are projected on a screen in varied positions. By means of a green and a red filter, the silhouette may be projected in three different colors, red, green, or white.

PURPOSE: To provide a simple, convenient and quick way of instructing flying personnel in the recognition of aircraft.

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AUTHORITY: Authorization was contained in a letter from the Assistant Chief of Air Staff, Training Aids Division, to the Materiel Command, Engineering Division dated 5 May 1943 subject: Requests for the Development of Synthetic Training Devices.

REMARKS: In April 1943 negotiations were started with Gardner Displays Co., Pittsburgh, Pa. for the procurement of the silhouette projector. An Authority for Purchase was approved on 25 May 1943. All units have been shipped for evaluation.

TELEVISION AND RADIO CONTROL EQUIPMENT

673-14 Expenditure Order No.	Equipment Laboratory Mfg. or Activity Charged with Development
MX-108 Classified Project No.	None Contract Number

DESCRIPTION: The controllable bomb, either a glider or power driven, is provided with a television transmitter facing in the direction of flight which transmits to the controlling aircraft an image of the view directly in front of the bomb. A television receiver is mounted on the controlling plane and also a radio transmitter for controlling the bomb by radio impulses. The controllable bomb contains, in addition to the television transmitter, a radio receiver operating through relays and servo mechanism to control the bomb.

PURPOSE: The development of a controllable bomb provided with television equipment and radio operated controls.

AUTHORITY: Chief, Engineering Division.

REMARKS: Experimental equipment was delivered and installed in December, 1941. Preliminary tests were conducted on January 1, 1942. On March 2, 1942, television units were tested at Eglin Field.

The preliminary tests indicated that clear images of the area before the transmitter could be obtained in the receiver so that control can be exercised over the bomb in accordance with the receiver image.

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During April, 1942, estimates were obtained and procurement was initiated for 555 transmitters of new type (Block III) and a corresponding number of receivers and monitors.

During December, 1942, the first model of the new type of R.C.A. transmitter was submitted for tests. These tests indicated need of certain improvements. A series of tests have been carried out at Wings Field, Pa., which produced vastly improved operation and a range of 10 to 15 miles. Installation of equipment in a GB-4 Glider Bomb has been field tested with very satisfactory results. Slight corrections are needed for the elevational control of the bomb. 100 service test units are being set up.

Investigation is being made of alternative types of television equipment: Farnsworth Television Co., Fort Wayne, Ind., and Remington Rand, Electronics Division, Middletown, Conn. A model of Farnsworth device has been tested for the high angle bomb and operated with relatively satisfactory results. 3 Models for Aeronca bomb will be available for tests early in 1944.

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SECTION 5

MISCELLANEOUS PROJECTS

AERIAL TOW TARGET AND PICK-UP PROJECTS

HEATING, COOLING AND ICE PREVENTION PROJECTS

MISC. PRO- JECTS

AIRCRAFT SERVICING AND CARGO EQUIPMENT

SPECIAL VEHICLES AND AIRBORNE EQUIPMENT PROJECTS

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SECTION 5

MISCELLANEOUS PROJECTS
(continued)

SPECIAL VEHICLES AND AIRBORNE EQUIPMENT PROJECTS (continued)

SPECIAL PROJECTS

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WATER TYPE BOMBING TARGET

664-583 Expenditure Order No.	National Carbon Co. Bennington, Vermont Mfg. or Activity Charged with Development
None Classified Project No.	W-2620-AC-220 W-2620-AC-221 Contract Number

DESCRIPTION: This equipment consists of a water type bombing target which can be dropped by parachute from the bomb bay of an airplane.

PURPOSE: To provide a convenient and economical practice bombing target.

AUTHORITY: Chief, Engineering Division.

REMARKS: Test work has been completed at Wright Field. Thirty targets have been shipped to Eglin Field for further test.

HIGH SPEED TOW TARGETS

664-583 Expenditure Order No.	See "Remarks" Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This equipment consists of a sleeve type tow target which can be towed at extremely high speeds without failure and with the least possible drag. This project also includes the design, modification and fabrication of auxiliary equipment used for target towing to make high speed towing possible.

PURPOSE: To develop targets and auxiliary equipment for high speed target towing.

AUTHORITY: Chief, Engineering Division.

REMARKS: At the present time standard tow targets and auxiliary equipment are available for towing at speeds of approximately 225 miles per hour. The following manufacturers are developing the tow targets:

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Lite Manufacturing Company, New York, New York
W. A. Apple Manufacturing Company, Dayton, Ohio
City Awning and Supply Company, Cleveland, Ohio
Chas. W. Breneman Company, Cincinnati, Ohio

TOW TARGET EXCHANGE MECHANISM

664-537 Expenditure Order No.	Franklin Machine Products New York, N.Y. American Steel & Wire Co. New Haven, Conn. American Chain & Cable Co. Detroit, Michigan Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: The Tow Target Exchange Mechanism is a mechanical device used to exchange targets that are being towed by an airplane in flight.

PURPOSE: To provide a more satisfactory mechanism than the present standard exchange assembly.

AUTHORITY: Chief, Engineering Division.

REMARKS: It is believed that considerable progress has been made in that a successful target exchange was made at 240 miles per hour with one article and over 100 successful exchanges were made with another article.

A new method of attaching the cable to the exchange mechanism is being developed which is expected to facilitate this procedure to the extent that the exchange mechanism may be attached in a fraction of the time previously required.

Definite progress has been made in the development of a satisfactory hand cable cutting tool which has been urgently needed. Progress has been made in the development of a cable cutter which travels down the cable and cuts the cable when it comes in contact with the release assembly or other obstructions.

The design, fabrication and test of several new promising exchange mechanisms are in different stages of progress.

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TOW TARGET WINDLASS

664-586
Expenditure Order No.

Air Associates, Inc.
Teteboro, New Jersey
Mfg. or Activity Charged
With Development

None
Classified Project No.

(535) 43-33269-E
Contract Number

DESCRIPTION: This Tow Target Windlass will hold 10,000 ft. of 1/8" 7 x 19 Tow Cable and will rewind the cable at a speed of 600 feet per minute.

PURPOSE: To develop a tow target windlass for high altitude anti-aircraft target practice.

AUTHORITY: Assistant Chief of Air Staff, Materiel, Maintenance, & Distribution.

REMARKS: Air Associates Inc., Teteboro, New Jersey, is manufacturing the experimental windlass.

HYDRAULIC REWIND SYSTEM FOR TOW WINDLASS

664-585
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged
with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This equipment consists of a hydraulic motor, an adapter and installation for the Type C-5 Windlass which will provide a fast rewinding speed.

PURPOSE: To provide a faster, more reliable rewind system for the Type C-5 Tow Target Windlass.

AUTHORITY: Chief, Engineering Division.

REMARKS: An installation of the rewind system in a type A-20 airplane has just been completed and is undergoing tests.

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SMALL LIGHTWEIGHT TOW TARGET WINDLASS

665-584 Expenditure Order No.	Air Associates, Inc. Teterboro, N. J. Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: This tow target windlass will hold 1500 feet of 1/8", 7 x 19 tow target cable and will rewind 400 feet of cable per minute.

PURPOSE: To develop a tow target windlass for aerial gunnery training.

AUTHORITY: Commanding General, Air Service Command.

REMARKS: Manufacture of prototype is to be made by Air Associates, Inc. Teterboro, New Jersey.

AIRCRAFT CABIN HEATERS

664-479 Expenditure Order No.	General Properties Co., Inc., Toledo, O. Stewart-Warner Corp., Chicago, Illinois Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: These heaters are of the internal combustion type designed to burn 100 octane aviation gasoline in a combustion chamber, and to disperse the heat generated in the combustion chamber by means of a heat exchanger to ventilating air forced across the heat exchanger.

PURPOSE: To provide an aircraft heating system capable of maintaining airplane cabins at a temperature sufficiently warm for efficient crew operation, and to provide adequate heat for de-icing and de-fogging windshields, warming engines, batteries, cameras and other accessories.

AUTHORITY: Chief, Engineering Division.

REMARKS: The current production type internal combustion heater is one which derives a combustible mixture from the aircraft engine. This particular heater has not proven exactly suitable and, therefore, a

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concentration of effort has now been placed upon the development of an internal combustion heater which will obtain raw fuel from the aircraft fuel supply, and which will accomplish its own carburation. Both combustion air and ventilating air for such a heater will be obtained during flight from a ram conveniently located on the outside of the airplane, thus the forward motion of the airplane will develop sufficient air pressure to cause the heater to function properly. Automatic pressure adjustments will compensate for changes in altitude, and will tend to provide as nearly as possible a constant heat output. The ram operated type combustion heater is also being developed to operate with a fan so that heater operation may be obtained when the airplane is not in flight. This development is particularly for defrosting of windshields during warm-up and taxiing. All airplanes routed through Wright Field which are scheduled for test at the Cold Weather Test Detachment during the winter of 1943-1944 have been instrumented in order to obtain information on the suitability of the cabin heating systems. Personnel of the Equipment Laboratory and manufacturer's personnel are stationed at the Cold Weather Test Detachment at this time for the purpose of obtaining operational and test data on cabin heating systems.

PORTABLE GROUND HEATER

664-480	See "Remarks"
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: These are heaters of various sizes and capacities, all gasoline burning, which are utilized for ground heating applications, such as pre-heating aircraft and small auxiliary engines, warming shelters, portable houses and aircraft cabins. Thus far there are four standard ground heaters:

- Type D-1, rated capacity 100,000 BTU/hr., weight approximately 185 lbs.
- Type F-1, rated capacity 250,000 BTU/hr., weight approximately 580 lbs.
- Type F-2, rated capacity 20,000 BTU/hr., weight approximately 25 lbs.
- Type F-3, rated capacity 35,000 BTU/hr., weight approximately 125 lbs.

PURPOSE: To develop portable ground heaters which will be suitable for specific applications, particularly for warming maintenance shelters and for stand by use for aircraft engine heating where the airplanes are on the "alert", and to improve the operation of standard types. Also to develop improved heaters to replace the present standard types.

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AUTHORITY: Chief, Engineering Division.

REMARKS: The present Types D-1 and F-1 heaters have been modified in production and in the field to give improved operation at low temperatures. Several types of experimental heaters and modified standard heaters have been shipped to the Cold Weather Test Detachment for test during the winter of 1943-1944. Action has been initiated to procure a ground heater having a capacity of at least 500,000 BTU/hr. for use in ground heating large airplanes, such as the B-36.

The following companies are engaged in the development:

Evans Products Company, Detroit, Michigan.
Chrysler Corporation, Airtemp Division, Dayton, Ohio
Hunter & Company, Cleveland, Ohio
Stewart-Warner Corporation, Chicago, Illinois.
Herman Nelson Corporation, Moline, Illinois.
Peerless Manufacturing Corporation, Louisville, Kentucky
Harvey Whipple, Inc., Springfield, Massachusetts.
Borg-Warner Corporation, Detroit, Michigan.

AIRCRAFT COOLING EQUIPMENT

664-529	See "Remarks"
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Units for this purpose are basically of three types, namely: (a) Ventilators, (b) Evaporative Coolers and (c) Refrigerated Coolers. (Air Conditioners). All of these units are designed on the basis of being light weight and self-contained. These units will be equipped with a flexible duct system so that air from the unit may be blown inside of an airplane fuselage for cooling purposes.

PURPOSE: To develop light weight, self contained cooling equipment suitable for cooling airplane fuselages to allow maintenance personnel to work in these enclosures.

AUTHORITY: Chief, Engineering Division.

REMARKS: Airplanes parked in the hot sun or in the desert become so hot inside that it is impossible for personnel to work in them. In order to overcome this difficulty, this project was initiated to provide cooling equipment suitable for cooling aircraft cabins so

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that personnel can carry on their work. Evaporative coolers and air conditioners were tested in the desert during the summer of 1943. Based on these tests, work is continuing to develop lighter weight and more satisfactory units of this type. Self contained ventilators have been obtained and forwarded to Eglin Field for tests. The following companies are engaged in the development:

Carrier Corporation, Syracuse, New York.
Waukesha Company, Waukesha, Wisconsin.
Herman Nelson Corporation, Moline, Illinois
Comfort Products Corporation, Harvey, Illinois.

SERUM REFRIGERATORS

664-554	General Electric Co., Ft. Wayne, Ind. Chrysler Corp., Airtemp Div., Dayton, O.
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: These refrigerators are for the purpose of transporting by air, blood plasma, and vaccines such as yellow fever, small pox and typhoid fever. They are to be capable of maintaining the necessary temperatures required for the proper storage of these items, regardless of outside free air temperature in the range of -65°F. to 120°F.

PURPOSE: To develop light weight, air-borne refrigerators capable of maintaining the required temperatures for the safe transportation of blood plasma and vaccines.

AUTHORITY: Chief, Engineering Division.

REMARKS: With the advance of medical science in combating disease encountered throughout the world, and in combating such things as "shell-shock", it is necessary that a supply of blood plasma and vaccines be available in combat theaters at all times. At the present time there is no satisfactory method available for safely transporting these medical supplies by air. The problem of serum refrigeration has been discussed with The Surgeon General's Office and Air Surgeon's Office to establish the basic requirements for refrigerators for this purpose. Action has been initiated to obtain experimental refrigerators in accordance with the requirements of the Surgeon General's Office and Air Surgeon's Office.

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THERMAL DOUBLE PANES

664-559
Expenditure Order No.

Pittsburg Plate Glass Co.,
Pittsburgh, Pennsylvania.
Raymond De-Icer Co., Inc.,
Los Angeles, California.
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: A thermal double pane is a secondary pane which is installed parallel to a primary pane, such as a windshield, with an air space approximately 1/2 inch between the two panes. Hot air is blown between these two panes, and keeps the glass surfaces warm, thus preventing the formation of ice on the exterior surface and frost or fog on the interior surface.

PURPOSE: To develop thermal double panes suitable for installation on pilots', co-pilots' bombardiers' and turret gunners' windshields and sighting windows to prevent the formation of exterior ice and interior frost and fog on these areas.

AUTHORITY: Chief, Engineering Division.

REMARKS: Because of the fire hazard involved, the use of alcohol for windshield anti-icing is not considered safe for use in airplanes going into combat. Therefore, the anti-icing of windshields must be accomplished by some other means, and the thermal double pane holds the most promise for this purpose. There is also the problem of preventing the formation of frost on the exterior surface of bullet-proof windshields when the airplane moves from a high altitude where the temperature and the absolute humidity is low to a low altitude where the temperature and the absolute humidity may be high. Thermal double panes have been designed for and are being installed in the following airplanes: C-47, C-54, B-34, B-25, B-26 and C-46. All airplanes equipped with thermal double panes assigned to the Cold Weather Test Detachment have been instrumented to determine the amount of heat being supplied to the panes and the effectiveness of the panes.

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DE-ICER MAINTENANCE EQUIPMENT

664-568
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This equipment consists of a kit containing all the necessary tools and materials for the installation, removal and minor repair of rubber de-icer boots.

PURPOSE: To procure and test all the tools and materials necessary to facilitate the maintenance of rubber de-icer boots, and to assemble them into a complete and compact kit.

AUTHORITY: Chief, Engineering Division.

REMARKS: At the present time there is no standard de-icer maintenance kit. The use of this kit will enable maintenance personnel to install and remove aircraft de-icer shoes more rapidly than at present, and it should enable personnel to accomplish minor vulcanized repairs on de-icers without having to remove the shoes from the airplane.

All of the necessary items for the kit and the container have been obtained, and assembled in the kit. This kit has been taken by personnel of the Equipment Laboratory to Eglin Field and Orlando, Florida for tests.

AIRCRAFT ANTI-ICING STUDY

664-577
Expenditure Order No.

Massachusetts Institute of Technology, Cambridge, Massachusetts.
Mfg. or Activity Charged with Development

None
Classified project No.

None
Contract Number

DESCRIPTION: This is fundamentally a basic study of the problem of aircraft icing, and means of preventing or overcoming such icing.

PURPOSE: To provide for the study of aircraft icing prevention.

AUTHORITY: Chief, Engineering Division.

[redacted]

REMARKS: The problem of aircraft icing is always present, and while de-icer boots are available at the present time, lighter weight and more effective means of preventing ice formation are necessary. A study of ice formation on aircraft is necessary to obtain information on which to base the design of equipment for removing or preventing this ice formation.

A type A-29 airplane was assigned to M.I.T. for use in anti-icing studies. During a preliminary flight prior to starting tests, this airplane crashed, and those on board were killed. This crash has delayed the study, but M.I.T. has indicated a willingness to continue the project upon the completion of the investigation of the crash.

THERMAL ANTI-ICING OF WING AND EMPENNAGE

664-556	NACA Equipment Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Projects No.	Contract Number

DESCRIPTION: Ice formation on the wings and empennage of an airplane can be prevented by applying heat to these surfaces. This heat may be obtained from the airplane engine exhaust gases or from separate heaters installed for the purpose. Air is passed over the heat exchanger where it picks up the necessary heat, it is then ducted to the areas requiring ice prevention, where it is distributed in such a manner that all necessary areas are sufficiently heated to prevent the formation of ice.

PURPOSE: To conduct tests to determine the amount of heat which is necessary to insure adequate ice prevention, and to determine the most suitable means and method of distributing the heated air in a wing and empennage.

AUTHORITY: T.I. 1236 dated 25 August 1942.

REMARKS: The use of rubber de-icer boots affects the flight characteristics of an airplane because of their effect on the shape of the airfoil. De-icer boots also require the use of large quantities of rubber. Development of thermal wing and empennage anti-icing will eliminate both of these disadvantages. The XC-60B airplane which has heated wing anti-icing has been assigned to the Equipment Laboratory for tests. This airplane is now being completely instrumented for flight tests in order that data on which to base future designs may be obtained. A type JU-88 airplane with heated wings has been assigned to the Equipment Laboratory for test.

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ANTI-ICING SURFACE FINISHES

664-524	See "Remarks"
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: The items covered by this project consist of various types of pastes and lacquers which can be applied to airplane surfaces, and which, due to their chemical composition, are intended to prevent the formation of ice, frost and fog.

PURPOSE: To conduct a study to develop a suitable anti-icing surface finish for aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Pastes and lacquers developed for this purpose, if satisfactory, could be used in place of de-icer boots and thermal double panes, thus resulting in a saving of weight in the airplane. Such pastes and lacquers developed to date are not completely satisfactory, in that their effect is limited, and is not lasting. Samples of Trimethyl phosphate and Hoarfrost F-9 have been shipped to the Cold Weather Test Detachment for tests during the winter of 1943-1944. The following companies are engaged in the development:

Victor Chemical Works, Chicago, Illinois.
Merix Photo Company, Chicago, Illinois.
Lorr Laboratories, Inc., Paterson, New Jersey.
Wilco Company, Los Angeles, California.

HYDRAULIC WINDSHIELD WIPER

664-537	Automotive Development Company Cleveland, Ohio
Expenditure Order No.	Mfg. or Activity Charged
None	None
Classified Project No.	Contract Number

DESCRIPTION: This item is a hydraulic operated light weight windshield wiper. Its main advantages over windshield wipers now in use are its light weight and its compact size.

PURPOSE: To test the hydraulic windshield wiper to determine whether or not it is satisfactory for the intended purpose.

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AUTHORITY: Chief, Engineering Division.

REMARKS: Weight and space requirements are critical items to be considered on any piece of equipment to be installed in an airplane. Therefore, if this wiper is satisfactory, a hydraulic windshield wiper having less weight and requiring smaller space requirements will be available. A unit has been obtained, and is being set up for tests to determine its operating characteristics and life.

UNIVERSAL AIRPLANE WINDSHIELD WIPER

664-570 Expenditure Order No.	See "Remarks" Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This windshield wiper is one which will be built basically to fit on any airplane. The variables will be the sweep of the blade and blade arm length. These variables may be changed in the field, thus making it possible to standardize on one type of windshield wiper.

PURPOSE: To develop a universal windshield wiper for installation on military aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: The development of a universal windshield wiper will eliminate the necessity of procuring a special unit for each type of airplane, and will make possible the procurement of one type windshield wiper, which can be adapted to all types of airplanes. The problem of a universal windshield wiper is basically one of design. However, upon completion of design, tests are necessary to determine operating characteristics and life. Action has been initiated to procure windshield wipers for test which have been designed to be universal.

The following companies are engaged in the development:

Anderson Company, Gary, Indiana.
Marquette Metal Products Company, Cleveland, Ohio.
Bossart Machine Company, Cincinnati, Ohio.
Automotive Development Company, Cleveland, Ohio.

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SPECIAL TOOLS

664-572
Expenditure Order No.

Kent-Moore Organization,
Detroit, Michigan
A.E.Bausenbach,Detroit,Mich.
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Special tools are those tools not incorporated in the kits and sets issued to squadrons but are required in the proper maintenance, assembly, and disassembly of aircraft assigned to that squadron.

PURPOSE: To analyze the tool requirements of new aircraft to determine the special tools required for the aircraft and to design or determine sources for the special tools required. Also to furnish illustrations and instructions for the use of the special tools and a complete parts list of the tools.

AUTHORITY: Chief, Engineering Division.

REMARKS: Contracts for the tool analysis and development of special tools are in the process of being made for the B-29 and the P-63A airplanes.

BAGS, PNEUMATIC LIFTING

664-563
Expenditure Order No.

Firestone Tire & Rubber Co.,Akron,O.
Goodyear Tire & Rubber Co.,Akron,O.
Pharis Tire & Rubber Co.,Newark,O.
Mfg. or Activity charged with development

None
Classified Project No.

(33-096) 44-4423
(535) 43-28987E
Contract Number

DESCRIPTION: Pneumatic Lifting Bags are canvas bags impregnated with synthetic rubber and equipped with either a small portable low pressure - high output compressor, or a CO_2 bottle. These bags are used for raising crashed airplanes from the belly landing position.

PURPOSE: To study and develop Pneumatic Lifting Bags for the raising of crashed airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Bags weighing 210 lbs. and measuring 6 ft. in height have been fabricated and are being tested. These bags are of 12.5 ton capacity. As lacing bonds are provided along the four upper edges of the bag, two bags may be laced together, giving a lifting height up to 10 ft.

A lighter and smaller bag of 5 ton capacity has been fabricated and is now being tested. This test will determine its suitability for use as an emergency bag to be inflated by CO_2 and to be used in raising a crashed airplane.

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POWER PUMP-JACK OPERATING

664-478	Dennison Engineering Co., Columbus, Ohio.
Expenditure Order No.	Mfg. or Activity Charged With Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: An electric motor driven pump with the necessary oil reservoir, valves, gages, hose, and fittings; supported on wheels. Three hydraulic pressure hose lines are provided for supplying oil to the aircraft wing and nose jacks at three different hydraulic pressures for the right wing, left wing, and nose jacks respectively, at the same time.

PURPOSE: To provide an electric motor-driven pump suitable for operating several jacks simultaneously.

AUTHORITY: Chief, Engineering Division.

REMARKS: The previously developed jack pumping equipment was engine driven and rather clumsy to handle. It has been decided to redesign the equipment with an electric motor drive and to make the unit more compact. Since 10 jacks are needed to jack the XB-36 and XC-99 types of aircraft, this unit will be a great time saver. One man can easily operate all jacks at one time and raise or lower the aircraft with the proposed equipment.

AIRCRAFT TRIPOD JACKS, HEAVY

664-472	Walker Manufacturing Co., Racine, Wisconsin.
Expenditure Order No.	Mfg. or Activity Charged With Development.
None	(33-096) 44-1954-E
Classified Project No.	Contract Number.

DESCRIPTION: The jack is of the folding tripod type, hydraulically operated, having a locking device on the lifting ram. The jack has adjustable legs and is portable by air, since it can be disassembled and packed into four shipping containers, each not

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weighing more than 250 pounds for easy handling. The unit is 20 tons capacity with a 40-inch lift covering a jacking range between 87 and 195 inches. High rigidity and lightweight will be obtained without the use of alloy steels. The production jack should not weigh more than 700 pounds.

PURPOSE: To provide adequate and flexible jacks for the heavier types of aircraft, such as the XB-35, XB-36 and C-99 airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Drawings have been completed on the proposed design and 16 experimental jacks are now being procured. Tests on the experimental jacks will be conducted approximately 1 February 1944. The jacks will be supplied with hand-operated pumps and with the necessary hose and fittings necessary for manifolding four jacks together so that they may act as one jack lifting equal amounts of load at four points.

DOLLIES, AIRPLANE WHEEL

664-491 Expenditure Order No.	Weaver Manufacturing Co., Springfield, Illinois. Steel and Tube Products Co., Milwaukee, Wisconsin. Mfg. or Activity Charged With Development.
None Classified Project No.	(33-038) 44-3646-E (33-096) 44-1267-E Contract Number.

DESCRIPTION: A wheel dolly is in the process of being developed for the 110" wheel assembly. The dolly will weigh approximately 500 pounds and will have facilities for removing the outboard brake, the wheel assembly, and for transporting the assemblies. The dolly adopted for wheels varying in size from the 36" to the 56" weighs approximately 125 pounds and is a two-wheel unit fabricated of angle form.

PURPOSE: To study and develop airplane tire and wheel assembly handling equipment.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Steel and Tube Products Company and the Weaver Manufacturing Company have contracts for fabricating dollies for the 110" wheel and tire assemblies. The Steel Tube and Products Company dolly

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should be delivered to Wright Field by 1 January 1944. The Weaver dolly is scheduled for delivery by 1 February 1944. Both dollies will be tested at Wright Field.

BEAD BREAKERS

664-558	Firestone Tire & Rubber Co., Akron, Ohio.
Expenditure Order No.	Mfg. or Activity Charged With Development.
None	None
Classified Project No.	Contract Number

DESCRIPTION: A tire repair kit including a bead breaking tool, tire irons, valve repair tool, valve cores, caps, et cetera, is being developed for the 110" tire. A similar kit has been standardized for use on wheels up to the 65" size. The kit will weigh approximately 50 pounds and will be supplied in a wooden chest.

PURPOSE: To study and develop tire tools and bead breakers for changing airplane tires.

AUTHORITY: Chief, Engineering Division.

REMARKS: Action was taken in the summer of 1942 to develop a bead breaker for airplane tires. A platform type unit was standardized the first of 1943. Since that time, Firestone engineers working with Wright Field personnel have developed the kit referred to above. This kit will be adapted for use with the 110" tire.

MAINTENANCE SHELTERS

664-508	Equipment Laboratory
Expenditure Order No.	Mfg. or Activity Charged With Development.
None	None
Classified Project No.	Contract Number.

DESCRIPTION: The shelters are prefabricated, portable-by-air and are constructed of wood, plywood, and insulating board.

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PURPOSE: To develop prefabricated portable-by-air maintenance shelters for repair and maintenance use.

AUTHORITY: Chief, Engineering Division.

REMARKS: The shelters are used for the following repair and maintenance work:

- Parachute Repair
- Technical Supply
- Instrument Repair
- A-3 Shop
- Glider Repair
- Tool Room
- Bombsight Repair
- Turret Repair
- Mobile Repair Set

CRASH FIRE TRUCK, CARBON DIOXIDE

Cardox Corporation, Chicago, Illinois.
Walter Kidds Company, New York, New York.
Mfg. or Activity Charged With Development.

651-129
Expenditure Order No.

None
Classified Project No.

(535) 42-2873
W-535-ac-22436
Contract Number.

DESCRIPTION: This airdrome fire truck consists of a 7-1/2 ton, 6 wheel, 6 wheel drive truck chassis and cab on which is mounted fire extinguishing apparatus. The fire extinguishing apparatus consists of a carbon dioxide pressure tank capable of holding 600 pounds of liquid CO_2, a pressure water tank of 500 gallons capacity, and discharge equipment. The carbon dioxide pressure tank is provided with a refrigerating unit capable of maintaining atemperature of 0^{o}F. in order to permit pressures within the tank of 300 p.s.i. The discharge equipment consists of a boom nozzle, a front nozzle, a ground sweep nozzle and two playpipe nozzles and hose.

PURPOSE: To provide a suitable fire truck for permanent airdromes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Two crash trucks for test on zone protection of airdromes have been received and are assigned to the Flight Line, Wright Field for test.

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CRASH FIRE TRUCKS AND TRAILERS

American LaFrance-Foamite Corp.,
Elmira, New York.
Yankee Motor Bodies, Inc.,
Los Angeles, California.
Mfg. or Activity Charged
With Development.

658-155
Expenditure Order No.

W-535-ac-32591
(535) 43-3564-E
Contract Number

None
Classified Project No.

DESCRIPTION: The American LaFrance crash truck consists of a truck-tractor and a semi-trailer having a 2000 gallon water capacity. Six fog nozzles are mounted on the front of the tractor and are controlled from the cab. A gasoline engine-driven centrifugal pump is mounted behind the cab of the tractor to furnish water under pressure for the fog nozzles. The truck-tractor and semi-trailer are connected by means of a fifth wheel. All water connections between truck-tractor and semi-trailer are flexible to permit easy operation. Rescue tools are provided for rescuing trapped personnel in crashed aircraft. The trailer has 600 feet of 1-1/2 inch fire hose complete with fog nozzle, to be used as hand lines.

The Yankee crash truck consists of a 4-wheel, 2-wheel drive, cab over engine truck with a gasoline engine-driven centrifugal pump and a 1200 gallon water tank installed on the truck. A monitor type fog nozzle is mounted on the front of the truck and controlled from the cab. Two one-inch play lines with fog nozzle applicators and reels are mounted on the top of the tank. The water tank is heated with a hot air heater to prevent freezing of the water. Rescue equipment is furnished and mounted on the truck.

PURPOSE: To provide a crash truck and trailer suitable for operation at advanced bases. Water is used as a fire extinguisher medium as it is available in all theaters of operation.

AUTHORITY: Chief, Engineering Division.

REMARKS: A truck and trailer have been received and will be tested shortly.

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FUEL & OIL DRUM TRAILER

658-164
Expenditure Order No.

Superior Auto Inc.,
Dayton, Ohio.
Mfg. or Activity Charged
With Development

None
Classified Project No.

(535) 43-25705-E
Contract Number

DESCRIPTION: The trailer consists of a two-wheel trailer frame on which is mounted a cradle to carry two drums. The trailer is equipped with two 6.00 x 9 tires to provide adequate bearing on rough and rutted terrain. The cradle has two straps for holding the drums securely in place. A pintle hook is mounted on the rear to provide a hitch for towing the trailers in trains of two or more.

The trailer is loaded in the same manner as a hand truck. The straps are then placed around the drums and drawn up tight. The trailer is then pulled down on its wheels and hooked to the towing vehicle.

PURPOSE: To provide a trailer to transport fuel and oil drums for refueling airplanes at advanced airdromes.

AUTHORITY: Chief, Engineering Division.

REMARKS: The trailers have been tested and recommended for standardization by the AAF Proving Ground Command. Results of tests by the AAF School of Applied Tactics have not yet been received. Specifications and drawings will be released on these trailers.

FUEL SERVICING TRAILER, 2000 GALLON

658-135
Expenditure Order No.

Standard Steel Works,
Kansas City, Missouri.
Mfg. or Activity Charged
With Development.

None
Classified Project No.

W-535-ac-24554
Contract Number

DESCRIPTION: This equipment consists of a conventional type fuel servicing semi-trailer of 2000 gallons capacity to which has been added two high capacity fuel transfer pumps. The unit is designed to refuel aircraft from its own 2000 gallon tank or from any other large reservoir.

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PURPOSE: To provide fuel servicing semi-trailers of high pumping capacity.

AUTHORITY: Chief, Engineering Division.

REMARKS: Two fuel servicing semi-trailers and one trailer converter dolly have been received and tests are being conducted at Army Air Forces School of Applied Tactics, Orlando, Florida.

TRACTORS - AIRBORNE

653-166 Expenditure Order No.	Crosley Corporation, Cincinnati, Ohio. Mfg. or Activity Charged With Development
None Classified Project No.	(535) 43-209-E Contract Number

DESCRIPTION: The sample vehicle is a 4-wheel, 4 wheel drive tractor, powered by a two cylinder, 13 h.p. air-cooled motor. This vehicle is capable of a maximum speed of 40 m.p.h. and weighs approximately 1000 pounds. The vehicle has a transfer case with a low and high range.

PURPOSE: To make available to the Army Air Forces a light-weight portable-by-air tug for use in towing fighter airplanes and a general purpose truck for use at advance bases where equipment must be taken in by air.

AUTHORITY: Chief, Engineering Division.

REMARKS: The vehicles are being manufactured by the Crosley Corporation, Cincinnati, Ohio. Two of the vehicles have been delivered to Wright Field and are now undergoing tests; one is being tested by the Flight Section, Wright Field, and one has been shipped to AAF School of Applied Tactics to determine the allocation of this vehicle if standardization of the vehicle is recommended.

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AIRBORNE TRACTOR TUG, 3/4 TON 6 X 6

658-168	Willys-Overland Motors, Inc., Toledo, Ohio.
Expenditure Order No.	Mfg. or Activity Charged With Development.
None	Ordnance Requisition
Classified Project No.	Contract Number

DESCRIPTION: These tractor tugs have been developed by the Willys-Overland Company and are six wheel drive vehicles. Approximately 65% of the tractor tugs parts are interchangeable with the standard 1/4 ton 4 x 4 tug. This vehicle weighs 3150 pounds, and can be transported in the C-46 and C-54 airplanes.

PURPOSE: To develop an airborne tractor tug to replace the Clark tug and to be used for towing aircraft at advanced flying fields.

AUTHORITY: Chief, Engineering Division.

REMARKS: At present 15 units are under test and one of the 15 units is being modified so the body can be rapidly removed for loading into the C-47 airplane. To date sufficient information is not available to warrant standardization of the tractor tug.

GLIDER TRANSPORT TRAILER

658-127	U. S. Airplane Carriers, Inc., Dover, Delaware
Expenditure Order No.	Mfg. or Activity Charged With Development
None	P.O. No. (535) 43-16370
Classified Project No.	Contract Number

DESCRIPTION: These are two trailers used in transporting gliders. One is designed for transporting the fuselage of the CG-4A glider and is 32 feet long and 8 feet wide. The trailer is constructed of light-weight structural angles and plates. The other is a trailer for transporting the wings of the CG-4A glider. The length is 32 feet and the width is 8 feet.

PURPOSE: To provide trailers for retrieving and transporting gliders back to the airdrome.

AUTHORITY: Chief, Engineering Division.

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REMARKS: One trailer has been tested at Orlando, Florida, and one at Laurinburger-Maxton Army Air Base. An informal report has been received from Orlando stating that the glider transport trailers will be satisfactory after certain improvements have been made.

FUEL SERVICING TRACTOR AND TRAILER ASSEMBLY 6,000 GALLON CAPACITY

658-150 Expenditure Order No.	Euclid Road Machinery Co., Cleveland, Ohio Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-14208-E Contract No.

DESCRIPTION: The tractor is powered with a four cycle, six cylinder, Cummins diesel engine connected through a heavy duty clutch to a selective sliding gear type transmission with eight speeds forward and two reverse. The fuel trailer is fabricated of steel with all joints welded, and has a total capacity of 6000 gallons. Listed below are the overall dimensions, weight empty and loaded, and weight distribution:

Length - 49 feet, 6 in.	Weight Distribution Empty
Width - 9 feet, 6 in.	Front axle tractor - 14,860 pounds
Height - 10 feet, 6 in.	Rear axle tractor - 15,870 pounds
	Rear axle trailer - 17,180 pounds
Total Weight Empty - 47,910 pounds	47,910 pounds
Total Weight Loaded - 85,010 pounds	

PURPOSE: The fuel servicing tractor and trailer assembly, 6,000 gallon capacity, was developed for use on new flying fields, especially where soft ground is encountered, auxiliary airfields for bombardment airplanes, and for sandy and snow-covered terrain.

AUTHORITY: Chief, Engineering Division.

REMARKS: This equipment was shipped to Orlando, Florida, 24 September 1943, to be tested.

[redacted]

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SNOW PLOW, TRUCK ATTACHMENT

658-165	Snow Removal Equipment Company San Francisco, California
Expenditure Order No.	Mfg. or Activity charged with Development
None	W 535 AC-35528
Classified Project No.	Contract No.

DESCRIPTION: The snow plow is a combination block and rotary snow plow that accumulates and disperses the snow in one operation. The plow consists of a moldboard with a rotary blade mounted at the discharge end of the moldboard. A duct system is mounted above the rotary blade for discharging the snow. The rotary blade is driven by a Ford 1941 Mercury V-8 truck engine through transmission and clutch. The blade is attached to the front end of the truck or tractor.

PURPOSE: To provide a snow plow for removing snow from airport runways.

AUTHORITY: Chief, Engineering Division.

REMARKS: Two snow plows were received 1 October 1943. One is being tested at the present time on the flight line at Wright Field.

PORTABLE CRANE FOR C-2 WRECKER

658-158	Gar Wood Industries, Inc. Detroit, Michigan
Expenditure Order No.	Mfg. or Activity charged with Development
None	(535) 43-6722-E
Classified Project No.	Contract No.

DESCRIPTION: This equipment consists of a jib crane with blocks, hooks, and cables to provide proper lifting power with an extension boom.

PURPOSE: To provide a wrecking attachment to be used with the standard C-2 wrecking truck to facilitate the handling of crashed heavy bombers.

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AUTHORITY: Chief, Engineering Division.

REMARKS: This equipment was received on or about 10 December 1943 and tests will be started in the near future.

CRANE, FULL REVOLVING

658-131 Expenditure Order No.	Michigan Power Shovel Company Benton Harbor, Michigan Mfg. or Activity charged with Development
None Classified Project No.	P. O. No. (33096) 44-4943-E Contract No.

DESCRIPTION: This equipment consists of a full revolving crane equipped with a 25 foot crane boom, including an extra 5 foot center section for crane boom, a swing brake, and two sheave ten ton hook blocks.

PURPOSE: To provide cranes suitable for loading and unloading cargo to and from airplanes and for lifting airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: In October, 1943, a contract was issued to the Michigan Power Shovel Company for one full revolving crane suitable for mounting on a F-1 truck-chassis, Beiderman model. The truck crane was received 14 December 1943 and tests are now being conducted at Wright Field.

MAINTENANCE AND SERVICING EQUIPMENT FOR HEAVY BOMBARDMENT AIRPLANES

658-174 Expenditure Order No.	Davey Compressor Company Kent, Ohio Mfg. or Activity charged with Development
None Classified Project No.	Wright Field Requisition No. (33-096) 44-3806-E Contract No.

DESCRIPTION: This equipment consists of different vehicles for the servicing and maintenance of heavy bombardment aircraft of 150,000

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pounds or over. The equipment can be used at advanced bases.

PURPOSE: To make available to the AAF a unit for the servicing of heavy bombardment aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Davey Compressor Company is installing equipment on truck No. 1 which is the power truck of these servicing units. The equipment is mounted on a standard 2-1/2 ton 6 x 6 truck. Davey Compressor Co. is installing a split propeller power take-off to run the generator for the electrical power requirements.

AIR COMPRESSOR, LIGHT-WEIGHT

664-533 Expenditure Order No.	See Remarks Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-10766-E (535) 43-6002-E (535) 43-17980-E (535) 43-9989-E Contract No.

DESCRIPTION: The compressor unit consists of an air compressor directly connected or belted to a gasoline engine with a regulation system and accessories including intake air filter, pressure gage, air receiver, and connections. The compressor is to produce at least 3.6 c.f.m. free air at 80 p.s.i., but the maximum pressure can go to 150 p.s.i. The air receiver will have a minimum capacity of 250 cu. in., and the total weight is not to exceed 85 pounds.

PURPOSE: To provide improved, light-weight gasoline engine driven air compressors for squadron use.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Frigidaire compressor was on test during the summer of 1943 and was returned to the company because of crankshaft

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failure. To date it has not been returned.

The following companies are engaged in the development:

General Motors Corporation, Frigidaire Division, Dayton, Ohio
Wayne Pump Company, Fort Wayne, Indiana
DeVilbiss Company, Toledo, Ohio
Quincy Compressor Company, Quincy, Illinois

COMPRESSOR, SINGLE STAGE, 55 C.F.M.

664-578	Ingersoll Rand Corporation New York, New York
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The compressor is a single stage 55 c.f.m. gasoline engine driven, complete with two pneumatic tired wheels, combination drawbar and lifting bail, air receiver, discharge line unloader and all necessary accessories.

PURPOSE: To provide a lighter and more compact self-contained source of compressed air for use in a mobile Depot Shop.

AUTHORITY: Chief, Engineering Division.

REMARKS: The sample compressor has not been received as yet.

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AIR OPERATED BOOSTER PUMP

604-553 Expenditure Order No.	See Remarks Mfg. or Activity charged with Development
None Classified Project No.	(535) 43-10766-E (535) 43-11010-E (535) 43-21203-E Contract No.

DESCRIPTION: This booster pump consists of an air-operated power cylinder and a direct-connected two-stage, single-acting compressor to take primary compressed air and boost it to a maximum of twenty times the initial intake pressure. The unit is of the straight-line reciprocating type. Maximum design intake pressure is 200 p.s.i.; discharge pressures up to 4000 p.s.i. will be obtainable to charge oleos, accumulators, and shimmy dampers.

PURPOSE: To provide a satisfactory, air-operated air booster pump.

AUTHORITY: Chief, Engineering Division.

REMARKS: The boosters under this E. O. have not proven satisfactory under conditions specified. All sample boosters have been returned to their respective companies. The General Engineering Company will submit a new design in the near future.

The following companies are engaged in the development:

Frigidaire Division, G.M.C., Dayton, Ohio
General Engineering & Manufacturing Co., St. Louis, Missouri
Bird-White Corporation, Chicago, Illinois.

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SWAMP BUGGY, SALVAGING AND RETRIEVING

658-121
Expenditure Order No.

Superior Auto, Inc.
Dayton, Ohio
Mfg. or Activity Charged with Development

None
Classified Project No.

(535) 43-23315-E
Contract Number

DESCRIPTION: The swamp buggy consists of a flat body with seats along the outside, under which is provided storage space for tools and equipment. A three leg hoist and winch are also provided for mounting on the rear of the truck. The special body is mounted on a standard 1-1/2 ton, 4 x 4 Ordnance truck. The regular 7.50 x 20 tires are replaced by swamp buggy tires of 14 x 20 size. Space for carrying two litters is also provided.

PURPOSE: To provide a rescue truck for use around flying fields where swamps present a hazard to accessibility to personnel and aircraft that have been forced down.

AUTHORITY: Chief, Engineering Division.

REMARKS: The vehicle was rebuilt by Superior Auto, Inc. and will be used as a rescue truck in areas where swamps are prevalent around flying fields.

The vehicle has been sent to Orlando, Florida, for test to begin approximately 1 January 1944.

PORTABLE FUEL PIPE LINE

664-481
Expenditure Order No.

The Heil Company,
Milwaukee, Wisconsin
Mfg. or Activity Charged with Development

None
Classified Project No.

W535 AC-34218
Contract Number

DESCRIPTION: The pipe line is made of short portable sections of light steel pipe joined by couplings. The fuel is driven through the pipe line by small booster pumps.

PURPOSE: To provide a portable pipe line to supply aircraft engine fuel to airdromes from railheads and existing pipe lines.

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AUTHORITY: Chief, Engineering Division.

REMARKS: An experimental portable pipe has been forwarded to AAF School of Applied Tactics, Leesburg Airdrome, Leesburg, Florida, for comparitive tests with pipe line developed by Corps of Engineers. If tests are successful, the portable pipe line will be standardized.

PORTABLE SAW MILL

664-544 Expenditure Order No.	American Saw Mill Machinery Company, Hackettstown, New Jersey Mfg. or Activity Charged with Development
None Classified Project No.	(535) 43-7856-E Contract Number

DESCRIPTION: The saw mill consists of a frame upon which is mounted the carriage feed and a saw mandrel equipped with roller bearings, a carriage to hold the log while it is being sawed with hand operated set and quick receder, and a complete set of holding dogs. A track upon which the carriage traverses is furnished. The saw is 48 inches in diameter with inserted teeth to facilitate repairs if the saw is damaged. The power for the saw mill is derived from the power take-off of a tractor or truck. The complete mill can be broken down into small packages to facilitate transporting by air.

PURPOSE: To provide a suitable saw mill to be transported by air to aid in the establishment of new airdrome and advanced bases.

AUTHORITY: Chief, Engineering Division.

REMARKS: The two saw mills were shipped from the contractor's plant in September 1942 and were received at Ladd Field in March 1943. Test will be conducted on these saw mills and a report submitted to the Materiel Command as to their suitability for use at advance bases.

An order for two more saw mills has been placed with this Company so that tests can be conducted on this type equipment in various theaters of operation.

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GROUND TEST EQUIPMENT

664-575
Expenditure Order No.

Roots-Connersville Blower Corporation
Connersville, Indiana
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This equipment will consist of a gasoline engine driven blower, coolers, muffler, and necessary controls, all mounted as a compact unit on a suitable trailer.

PURPOSE: To provide mobile test equipment to put proof test pressures in pressure cabin airplanes at Wright Field. This same equipment will be adaptable for use at any depot for load testing pressure cabin airplanes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Procurement authority has been initiated for one test trailer. Delivery is expected approximately 1 January 1944.

AERIAL PICK-UP AND DELIVERY SYSTEMS

664-493
Expenditure Order No.

All American Aviation, Inc.
Wilmington, Delaware
Foote Bros. Gear and Machine Corporation
Chicago, Illinois
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Energy and shock absorption mechanisms consisting of a reel, line, brakes, reeling-in-motor, and accessories constitute the components of this equipment.

PURPOSE: To develop a mechanism which will enable airplanes in flight to pick-up objects from the ground.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Aerial Pick-Up Devices are available for picking-up gliders weighing up to a maximum of 9000 pounds gross at a resultant speed of 140 miles per hour. Pick-up equipment is also available for picking-up personnel in rescue work.

CASES

664-546
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: The cases are constructed of wood, plywood, phenolic materials and steel. Some cases contain special transparent plastic drawers for the storage of small parts.

PURPOSE: To develop special cases for use in repairing aircraft and aircraft parts.

AUTHORITY: Chief, Engineering Division.

REMARKS: Included are tool cases for special tools, squadron engineer technical supply case, armament spare parts case, communications, grease kit, mechanic's tool case, special equipment shipping case, shipping and filing case, technical order file case and stationery storage container.

BOXES AND CRATES

664-475
Expenditure Order No.

Equipment Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Reusable wood boxes and cleated plywood boxes are constructed of water resistant materials. The boxes are fabricated with screws and bolts.

PURPOSE: To develop reusable boxes and crates for AAF organization equipment.

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AUTHORITY: Chief, Engineering Division.

REMARKS: Reusable boxes and crates are necessary for the transporting of organization equipment in the field. Tactical units have neither the time nor the experience necessary for proper packaging of equipment. When equipment is standardized, the proper package is also included in the specification.

COLLAPSIBLE FUEL CELLS

664-530
Expenditure Order No.

U.S.Rubber Company,Akron,Ohio
B.F.Goodrich Company,Akron,Ohio
Vanguard Engineering Co.,Los Angeles
Goodyear Tire and Rubber Co., Akron, Ohio
Mfg. or Activity Charged with Development

W2119 ac-312
(535) 43-18198-E
1942-43-754
(535) 43-28982-E
Contract Number

None
Classified Project No.

DESCRIPTION: The cells are made of various synthetic rubbers, or plastic coated fabric, cut and assembled to the desired shape and size.

PURPOSE: To provide portable collapsible fuel storage facilities for units in the field.

AUTHORITY: Chief, Engineering Division.

REMARKS: There are three general classifications of cells, namely, storage tanks, transporting tanks and hand portable fuel bags.

The 1,000 gallon storage tanks have been standardized and tested at Eglin Field and the AAF School of Applied Tactics, Orlando, Florida, with favorable results. Three, five and ten thousand gallon tanks have been installed and tested. Pending favorable results on tests being conducted, the three and five thousand gallon units will be standardized. Transportable units have been standardized for use with the 2-1/2 ton 6 x 6 truck, the Ordnance 1 ton trailer and the two wheel utility trailer of 660, 550 and 220 gallons capacity, respectively. Tests are continuing on this One-half gallon hand portable fuel bags have been standardized. Developments are continuing on new types of filler caps and on similar containers lined with impregnated paper.

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GALLEY KITS AND EQUIPMENT

664-574
Expenditure Order No.

Tappan Stove Co.,
Mansfield, Ohio
Mfg. or Activity Charged
with Development

None
Classified Project No.

(535) 43-17161
Contract Number

DESCRIPTION: This equipment consists of an insulated metal container having six individual service casseroles and liquid containers. Operating on 24 and 110 volts, it carries complete utensils for a crew of six.

PURPOSE: To provide means of preparing or serving hot food aboard military aircraft engaged in long range flights.

AUTHORITY: Chief, Engineering Division.

REMARKS: It is known that hot food is responsible for maintaining morale, relieving fatigue and nervousness. The tendency in hot food service on military aircraft is toward the serving of hot foods prepared on the ground and kept at serving temperatures in insulated-electrically heated containers. This eliminates the necessity of preparing food in flight and does not require a high current draw from the airplane system. This idea appears to be very practical for combat aircraft. The problem of serving hot foods in flight is still being considered from both standpoints mentioned above.

FORM-FITTING WING COVERS

664-535
Expenditure Order No.

See "Remarks"
Mfg. or Activity Charged
with Development

None
Classified Project No.

(14-055) 44-10060 (See Remarks)
Contract Number

DESCRIPTION: This item consists of fabric covers which are cut to fit the contour of the airplane wing. The covers are designed so that they fit the airplane wing snugly and may be left on while the engines are running.

PURPOSE: To develop form-fitting, quick removal covers for the protection of airplane parked in the open. Covers are to be of both coated and uncoated material and designed for the horizontal wing and tail surfaces.

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AUTHORITY: Chief, Engineering Division.

REMARKS: Various designs of covers and methods of attaching them to the airplane have been developed and tested. Covers of this type are essential for cold weather operation. The following manufacturers are charged with developing the wing covers:

Buchsbaum & Company, Chicago, Illinois
Crawford Manufacturing Company, Richmond, Virginia
Inland Manufacturing Company, Kansas City, Kansas
Professional Specialities, St. Louis, Missouri
Phil Mar Products, Cleveland, Ohio
Porters Aircraft, Kansas City, Kansas
Sweebrock Aviation, Fort Wayne, Indiana
R. M. Thomas Company, Muncie, Indiana
Howard Zink Corporation, Freemont, Ohio

Contracts issued are as follows:

(14-055)44-10060	(14-055)44-10070
(14-055)44-10073	(14-055)44-10072
(14-055)44-10068	(14-055)44-10066
(14-055)44-10069	(14-055)44-10065

AIRCRAFT INSULATION

664-543
Expenditure Order No.

Owens-Corning Fiberglass Corporation, Newark, Ohio
Illinois Institute of Technology, Chicago, Ill.
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: In August 1942 it became apparent that only one type of insulation, namely Kapok, was suitable for aircraft, and there would soon be a critical shortage in the supply.

A study of the properties of other insulants was undertaken, as well as a study of the most satisfactory methods of application to the airplane.

PURPOSE: To conduct studies of the properties of available thermal insulations, and to develop new and improved ones.

AUTHORITY: Chief, Engineering Division.

[redacted]

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REMARKS: At present a new insulant is near production at Owens-Corning Fiberglass Corporation. This insulant is made of extremely fine glass fiber, and has properties of insulation and weight that make it six times as effective on a pound for pound basis as currently available insulants.

Negotiations are currently under way with Illinois Institute of Technology to continue the investigations, and provide accurate data for aircraft manufacturers. This investigation is being coordinated with soundproofing studies.

METHYL BROMIDE FIRE EXTINGUISHING SYSTEMS FOR AIRCRAFT POWER PLANTS

651-130 Expenditure Order No.	Walter Kidde Company, New York, New York Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Development of a light weight, low pressure fire extinguishing system for aircraft power plants. An investigation of extinguishing systems utilizing Methyl Bromide as the fire extinguisher will be made. Methyl Bromide is known to be one of the best fire extinguishing agents. Because of its high toxicity and the fact that extremely rapid discharge is necessary, considerable research will be necessary.

PURPOSE: To obtain a light weight system, more efficient than present standard CO_2 systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: An installation has been made in a P-38 airplane and forwarded to the Army Air Forces Board for evaluation.

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Photo
Lab. Projects

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SECTION 1

AERIAL PHOTOGRAPHIC PROJECTS

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PHOTOGRAPHIC INSTALLATIONS IN AIRPLANES

675-125
Expenditure Order No.

Photographic Laboratory
Mfg. or Activity Charged
with Development

None
Classified Project No.

43-27016-E
Contract No.

DESCRIPTION: Standard combat type airplanes have been modified for photographic purposes. The modifications consist of multiple camera installations, which are operated by means of a multiple camera control. This allows various combinations of focal lengths to be used, up to 11 cameras in one airplane. Long range, high altitude photographic missions are possible with these airplanes. The types P-38J, B-17, B-24, and Mosquito have been modified for photographic purposes, and consultations with engineers of the Hughes Aircraft Co. are progressing, regarding the conversion of the Hughes D-5 into a photographic airplane which has been designated the F-11.

PURPOSE: To provide suitable photographic installation in airplanes so that photographic missions requested by theater commanders may be performed.

AUTHORITY: Mosquito - R& R dated 23 March 1943, from OC&R, subject: "Camera Installations in Mosquito Airplanes". CTI-1456 dated 23 Sept. 1943. B-24, CTI-1217 dated 5 March 1943. B-17 - MM&D directive dated 4 June 1943, "Photographic Installations in B-17". P-38J - teletype dated 13 October 1943 (2D-175).

REMARKS: Many photographic reconnaissance squadrons have been unable to performed required photographic missions with existing photographic aircraft. It is believed that the photographic installations made under this project will allow the squadron to make long range, high speed, high altitude missions both day and night, depending upon the demands of the tactical organizations. The Hughes D-5 (F-11) aircraft, though still in the experimental stage, shows great possibilities as an aerial photographic ship, since its designer anticipates that it will combine extreme range, extremely high altitude, great speed, and great weight carrying qualities. Engineers of the Photographic Laboratory are at present in California working out installation problems with the Hughes Company.

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IMPROVEMENT OF STANDARD CAMERAS

675-153
Expenditure Order No.

Photographic Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: Minor faults now exist in certain standard aerial cameras used by the Air Forces, and it is essential that the present equipment be improved.

PURPOSE: To improve present standard aerial cameras with particular emphasis on the K-17, K-18, and K-24 cameras.

AUTHORITY: Chief, Engineering Division.

REMARKS: The following improvements are being made on the above-mentioned cameras:

1. K-17 camera.

a. The ratchet drive gear assembly will be designed so that breaks will not be difficult to service.

b. The serial number stencil will be made smaller.

c. The trip lever will be fixed so that it will not shear off or bend.

2. K-18 camera

a. The operating solenoid will be designed for continous operation rather than intermittent duty.

b. The retard snubber plate will be made so that it will not shear.

3. K-24 camera

a. The K-24 camera will be modified so that its operation will be dependable.

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STEREOSCOPIC CONTINUOUS STRIP AERIAL CAMERA

6 5-1-84 Expenditure Order No.	Chicago Aerial Survey Co., Chicago, Ill. Mfg. or Activity Charged with Development
None Classified Project No.	42-16499 Contract No.

DESCRIPTION: Strip cameras differ from the usual aerial cameras in that they are shutterless and the film is kept in constant motion during exposure. No shutter is required, since the film moves continuously at a constant rate past and adjustable slit, which is the reverse of the focal plane shutter in the C-3 Ground Camera. The equivalent shutter speed is determined by the width of the slit and the speed of the film travel. The type S-5 strip camera, which uses 9-1/2" aerial roll film in standard lengths, has been adapted to take stereo photographs.

PURPOSE: To take a continuous picture 5-1/2 inches (S-6 and S-6A) or 9-1/2 inches (S-5 type) wide, in any length to and including 200 feet long for reconnaissance. The stereo strip camera obviously is intended to perform the same work, with the addition of the apparent third dimension. The chief value of strip cameras lies in their efficiency at low altitudes and extremely high speeds. Also, because a shutter is not involved, strip cameras take better pictures in unfavorable light than other cameras so far developed.

AUTHORITY: Chief, Engineering Division.

REMARKS: The strip camera, though not a camera with a stereoscopic device, has been tested tactically in at least one theater, and has caused favorable comment by the commanders of that theater. Many agencies in the United States also have manifested considerable interest in the use of the various strip cameras for low altitude reconnaissance. Several test flights of the strip camera with the stereo device have been made with gratifying results. Although control of the slit for use in stereo photography must be re-worked, it is believed that this equipment shows excellent possibilities for low altitude reconnaissance flights. In addition to experimentation with the stereoscopic continuous strip camera, a 60" cone has been developed for the S-2A aircraft camera, and flight tests are being conducted at the present time.

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PLASTIC CAMERA PARTS

675-145
Expenditure Order No.

Photographic Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: It is desired to make the camera lighter and more efficiently insulated against heat loss without sacrificing rigidity and strength. There is also a need for a cone whose thermal coefficient of expansion will be such that the lens-film distance remains practically constant from -65°F to +160°F. The use of plastic materials offers a possible solution to the above problem.

PURPOSE: A study of the possibility of making camera parts from plastic or plasticized materials for AAF photographic use.

AUTHORITY: Chief, Engineering Division.

REMARKS: Plastic shutters have been fabricated and tested. Shutters of this type show an increase of efficiency of 50% or more. This type shutter will be able to withstand more shock, thus increasing the life of the shutter. Other parts to be made with plastic are the cone and lens housing.

ELECTRIL FLASH LAMP ASSEMBLY

676-40
Expenditure Order No.

Mass. Institute of Technology
Cambrigde, Mass.
Mfg. or Activity Charged with Development

MX-48 and MX-251
Classified Project No.

42-19816
43-5615-E
Contract No.

DESCRIPTION: The electric flash lamp assembly is carried in the bomb bay of a photographic airplane for the purpose of taking night photographs. The principle involved is as follows: a high voltage charge of electricity is built up by suitable inverters in the airplane. At the proper time the high voltage is dissipated through a gas filled lamp resulting in light of correct intensity and very short duration.

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PURPOSE: It is necessary to produce illumination for night aerial photographs and this method permits large numbers of photographs to be made using light source and cameras in the airplane.

AUTHORITY: Chief, Engineering Division.

REMARKS: The electric flash lamp assembly permits successful night photographs to be taken up to 15,000' with the D-3 lamp assembly, up to 3000' with the D-2 lamp assembly, and up to 500' with the D-1 lamp assembly. The three type units are being manufactured by the Massachusetts Institute of Technology and will be subjected to accelerated service tests.

A-2 MULTI-CAMERA CONTROLS

675-1-109 Expenditure Order No.	Auto. Electric Sales Co. Chicago, Ill. Mfg. or Activity Charged with Development
None Classified Project No.	43-20797-E 43-1918-E Contract No.

DESCRIPTION: This is a new type of multi-camera control utilizing all electrical mechanisms in its operation, as opposed to the mechanical system of the Type A-1 control, to reduce weight and size, and to insure more dependable operation. The Type A-2 Control also provides for the operation of more cameras than does the Type A-1, and permits cycling the camera focal-length groups in more different relationships, one to another. The control is composed of two separate control stations, one main operating station, and as many junction stations as are necessitated by the number of camera groups and cameras in each group.

PURPOSE: To provide automatic or manual remote means of cycling the various camera groups in the newer types of photographic airplanes. The newer installations require a wider range of operating choice, with regard to cycling time, and have a greater number of camera groups to be operated than previous types.

AUTHORITY: MM& D letter dated 19 June 1943, subject: "Standardization, A-2 Multi-camera Control".

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REMARKS: Two models of the A-2 control in simplified form, but involving the same operating principles, have been built, and tested by laboratory inspection and flight tests. The results were satisfactory and standardization was effected.

A limited number of controls is being finished in the form that is to be followed in production. It is expected that final tests of the production prototypes can be made within the next ten days.

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GROUND PHOTO-GRAPHIC

SECTION 2

GROUND PHOTOGRAPHIC PROJECTS

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C-1 CONTINUOUS PRINTER

681-99
Expenditure Order No.

Chicago Aerial Surveys Co.,
Chicago, Illinois.
Mfg. or Activity charged with Development

None
Classified Project No.

43-14226-E
Contract No.

DESCRIPTION: The Type C-1 printer is a continuous slit printer in which the film and printing paper move past an illuminated slit at the rate of 40 feet per minute. Provision is made for variation of exposure by varying the width of the slit. Rough dodging can be done by varying the width of the slit at the sides or center. The production model of the printer will weigh approximately 200 pounds with its plywood carrying case and is approximately 2 feet square by 2 feet high.

PURPOSE: To print 1000 or more negatives per hour on bromide paper in rolls.

AUTHORITY: Chief, Engineering Division.

REMARKS: The Sonne printer was originally developed to print continuous film negatives exposed in the Sonne strip camera. Preliminary tests found this type of printer to be satisfactory for production printing of all types of aerial negatives. Results of the tests were sent to Headquarters, Materiel Command, who authorized Air Service Command to procure 100 of these printers for issue to photo activities. Several of a service test quantity of 12 printers are now undergoing tests at various locations. Other service test printers are being shipped to overseas destinations as directed by O.C. & R. and M.M. & D., Washington, D. C.

This printer provides a rapid means of obtaining prints from a roll of aerial negatives in a minimum of time and with a minimum amount of personnel and equipment. Its use would be applicable where a large number of aerial roll film negatives must be printed and individual treatment for each negative is not required.

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FILM PROCESSING EQUIPMENT

681-120	Photographic Laboratory.
Expenditure Order No.	Mfg. or Activity charged with Development
None	Pending
Classified Project No.	Contract No.

DESCRIPTION: This project consists of the development of a small portable developing machine for the field processing of both 16 and 35 mm. motion picture film. Arrangements are now in progress for the procurement of several types of commercial machines that tests and experiments of a laboratory nature may be conducted with the same. Emphasis in this project is being placed upon the productive quality and speed with which such a machine may be operated to give satisfactory results under varied conditions in the field. Comparative processing tests have been and are being conducted utilizing several methods and types of processing procedure. Following present laboratory tests practical experimentation and tests simulating field conditions are contemplated upon models now in service and others which manufacturers will soon submit for approval..

PURPOSE: To develop a small portable processing machine for processing in the field both 16 and 35 mm. motion picture film. The machine will be very specifically designed to meet the requirements of being airborne.

AUTHORITY: Chief, Engineering Division.

REMARKS: Although there are many commercial organizations marketing developing machines, they are units of extreme size and great weight. To date a survey of the available machines that are in the market has not been too satisfactory. Some specifically designed machines are now being constructed and coordination has been initiated with other services respecting their experience with motion picture processing equipment. Progress of the project may be considered satisfactory, and many present results give a justifiable view of success.

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PHOTOGRAPHIC FINISHING KITS

681-126	Photographic Laboratory.
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Kits now under development to supplement other kits developed for Airborne Photographic Laboratories are: - Type N-3 Negative Viewing and Marking Kit, which consists of viewing table, stamps, pads, ink, and a numbering machine, packed in a case which may be used as a field deck. A folding chair will be included if it is found possible to do so. Type N-4 Sink and Large Print Developing Kit. To be used with the P-1 Copying and Enlarging Kit and with the A-8 Contact Printer for developing large (20 x 24) sheets of photographic paper. Type N-5 Print Washing and Drying Kit. To include a print washer, print drying rack, blotters, and squeegee, packed in a case which may be divided into two tables, one for blotting wet prints and one to sort and dry the prints.

PURPOSE: To provide facilities for complete Photographic operations packed for Field Laboratory use.

AUTHORITY: Letter dated 6 August 1943 (No. 14688) from M.M. & D. - A.C.A.S.

REMARKS: The new kits supplement present Airborne Laboratory Kits (The U-1 Darkroom Kit, O-1 and O-2 Water Supply Kits, and N-1 and N-2 Processing Kits) recently standardized and under procurement, and provide facilities for the new operations as listed.

Mockup models of each kit have been made up. Lists of apparatus and means of packing have been studied.

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SECTION 3

PHOTOGRAPHIC PHYSICS PROJECTS

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DEVELOPMENT OF AERIAL PHOTOGRAPHIC LENSES

680-1-20
Expenditure Order No.

Eastman Kodak, Rochester, N.Y.
Bausch & Lomb Optical Co., Rochester, N.Y.
Harvard U., Cambridge, Mass.
Photographic Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

None
W 30-053 AC 568
W-535-ac-22506
Contract Number

DESCRIPTION: This project has as its primary aims the study, development, and testing of lenses for use in Army Air Forces aerial photography. It involves optical bench tests, resolving and illumination measurements, measurements of optical constants such as equivalent focal length, et cetera, and the coordination of laboratory findings with scientific personnel of other organizations.

PURPOSE: To improve lenses for use in Army Air Forces aerial photography.

AUTHORITY: Chief, Engineering Division.

REMARKS: A number of U. S. Army specifications currently being used for procurement of both aerial camera lenses and lenses used on other equipment, have been developed under this project. A new lens program under this project has for its ultimate aim the development of better lenses for high altitude photography, night aerial photography, and mapping photography. Among the lenses currently being developed, the following are considered the most important:

6"	F/2.8	for	5" x 5" negatives
12"	F/4	for	9" x 9" negatives
48"	F/6.3	for	9" x 18" negatives

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SHUTTERS & SHUTTER EFFECTS

680-60 Expenditure Order No.	Fairchild Aviation Corp., Jamaica, L.I., N.Y. Photographic Laboratory Mfg. or Activity charged with Development
None Classified Project No.	43-2092-E Contract Number

DESCRIPTION: Under this project, studies of shutter performance are being made, both for focal plane and between-the-lens shutters. Methods of analysis have been developed whereby shutter performance, even for extremely high speed shutters, can be measured with high precision. This project involves research in a field which has largely been neglected by shutter manufacturers.

PURPOSE: To improve camera shutters for Army Air Forces use, and to develop suitable methods and equipment for shutter analysis.

AUTHORITY: Chief, Engineering Division.

REMARKS: Test methods and standards developed under this project are now being considered for adoption by the American Standards Association. This project has for its aim the continuous improvement of shutters, from the standpoint of both efficiency and durability under extreme conditions of use by the Army Air Forces.

DESIGN OF VIEW FINDERS AND OTHER OPTICAL SYSTEMS

680-61 Expenditure Order No.	Photographic Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This project includes the design of a new and improved view finder to replace the Type A-4 for use on the Type F-5 airplane. Several experimental models will be designed, fabricated, and tested.

PURPOSE: To provide a suitable view finder for the F-5 Airplane.

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AUTHORITY: Chief, Engineering Division.

REMARKS: Operational pilots returning from the North African Theater have pronounced the A-4 view finder entirely useless on the F-5 airplane, and have made recommendations for features necessary in a suitable view finder to replace the A-4. This project has for its primary aim the production of such an instrument.

OPTICAL FILTERS FOR PHOTOGRAPHIC LENSES

680-52 Expenditure Order No.	Bausch & Lomb Co., Rochester, N.Y. Polaroid Corp., Cambridge, Mass. Photographic Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Under this project two important developments have taken place. These are (1) the development of plastic-between-glass filters, and (2) vignetting-correction filters which permit the even exposure of negatives made with wide-angle lenses such as the "Metrogon".

PURPOSE: To provide for Army Air Forces use suitable filters which will result in improved photography and which will perform satisfactorily under the most adverse conditions.

AUTHORITY: Chief, Engineering Division.

REMARKS: Plastic-between-glass filters, which are much superior to gelatin-between-glass, especially in the tropics, are being developed in an adequate range of colors to meet Army Air Forces requirements. Vignetting-correction filters, consisting of a non-corrosive metal evaporated in the form of a variable area or variable density pattern, either on solid glass filters or plastic-between-glass, have been developed to a high state of perfection, and are continuously being improved, under this project. Very favorable reports on these filters have been obtained from the war theaters.

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The vignetting-correction filters were developed by the Bausch & Lomb Co. at the request of the Photographic Laboratory.

PHOTOGRAPHIC FILM SENSITOMETRY

680-1-23 Expenditure Order No.	Photographic Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Under this project, sensitometric investigations of photographic films and of chemicals used in photography are accomplished, and investigations are made of the effects of various physical factors on film. These factors include high and low temperatures and humidities.

PURPOSE: To continually improve the quality of photographic film for Army Air Forces use, and to exploit new film and photographic chemical products from the military photography standpoint.

AUTHORITY: Chief, Engineering Division.

REMARKS: Under this project, nine different specifications have been made U. S. Army specifications, and are currently being used for procurement for the Army Air Forces, U. S. Navy, Signal Corps, Corps of Engineers, and other organizations of the Armed Forces. These specifications are continually being modified as improved materials develop, in order to provide the Armed Forces with the most modern, up-to-date developments in sensitized film and photographic chemicals.

PHOTOGRAPHIC PAPER SENSITOMETRY

680-1-22 Expenditure Order No.	Photographic Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: Under this project, sensitometric investigations are made

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on sensitized photographic papers, and on the chemical solutions used with these papers. Investigations are also made to determine the influence on these materials of various physical factors, such as humidity and temperature.

PURPOSE: To continually improve the quality of photographic papers for Army Air Forces use, and to exploit new papers and photographic chemical products for use with these papers.

AUTHORITY: Chief, Engineering Division.

REMARKS: Specifications developed under this project are currently being used for the procurement of papers for the entire United States Army, and are being continually revised and improved in order to provide the Armed Forces with the most modern, up-to-date developments in sensitized papers.

AERIAL KODACOLOR DUPLICATING MATERIAL

677-1-23	Photographic Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Investigation of dye-reversal color transparency and printing processes.

PURPOSE: To find a color process suitable for standardization for Army Air Forces use in the field.

AUTHORITY: Chief, Engineering Division.

REMARKS: Tests are being conducted on dye-bleach reversal and dye-coupling color printing papers, as well as on dye-coupling, reversal color transparency film. In the dye-coupling types of materials, the dye-formers are incorporated in the emulsion, and coupling is accomplished in a color developer, after which all silver is removed by chemical bleaching, leaving a positive color image.

In dye-bleach materials, each layer making up the multi-layered film contains suitable dye. The film, after exposure, is developed in an "M.Q." type of developer, and is then immersed in a dye-bleach which destroys the dye in the vicinity of the silver image. All silver is then bleached out, leaving a positive color image.

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WINTERIZATION & TROPICALIZATION OF LENSES

680-59	Photographic Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: This project, as recently amended, involves investigations of the optical and physical performance of camera lenses under Arctic and tropical conditions. The investigation of new lens cements capable of withstanding temperatures from -65° F. to +160° F is also included in this project.

PURPOSE: To continually improve the performance of lenses used under wide extremes of climatic conditions.

AUTHORITY: Chief, Engineering Division.

REMARKS: Technical Order No. 10-10-41 dated 5 November 1943, title: "Care of Camera Lenses" was published as a result of investigations conducted under this project. Investigations are now being conducted to determine the most efficacious methods of preventing fungus growth on lenses and other optical equipment. New cements, which are much superior to Canada balsam, have been substituted for the latter for use in Army Air Forces lenses. New cements are continually being tested to further improve cemented lenses.

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Materials Lab. Projects

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SECTION I

PHYSICS PROJECTS

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PLASTIC, SHEET, VINYL COPOLYMER BASE

606-1-22	Materials Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Data were obtained and evaluated on the physical properties of a Plastic, Sheet, Vinyl Copolymer Base and incorporated into a proposed specification.

PURPOSE: To prepare a specification for copolymer vinyl plastic.

AUTHORITY: Chief, Engineering Division.

REMARKS: Copolymer vinyl plastic in sheet form remains flat and free from warpage under normal changes in climatic conditions. It has a very low water absorption and is chemically resistant to alcohols and a great number of other chemical solutions. However it has two inherent weaknesses, a low softening temperature 50°C.(122°F.) and serious darkening of clear transparent plastics after extended outdoor exposure in the far South. The dimensional stability of copolymer vinyl plastic sheets make it valuable for use in navigation computers and charts.

PHYSICAL PROPERTIES OF COLUMBIA RESIN PLASTIC CR-39-1

606-35	Materials Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Tests were conducted for specific physical properties of a transparent, allyl base plastic known as CR-39-1 developed by the Columbia Chemical Division of Pittsburgh Plate Glass Company. The resistance to outdoor and accelerated weathering, and to abrasion; mechanical, optical, and thermal properties of the material were determined.

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PURPOSE: To determine the physical properties of allyl base plastic for proposed specification requirements.

AUTHORITY: Chief, Engineering Division.

REMARKS: The allyl base plastic has properties comparable to those of acrylate base plastic, U. S. Army Specification 94-12014. The parallel light transmission of allyl base plastic is 92 percent and only decreases 2 percent after a half-year of weathering. The mechanical strength properties are generally less favorable for allyl base plastic. The CR-39-1 however is the most abrasion resistant plastic developed to date. The chemical resistance of allyl base plastic material is an outstanding characteristic; so much so that finding a suitable solvent cement is a major problem. The allyl base plastic is considerably more difficult to form, machine and fabricate than acrylate base plastic.

PARALLEL LIGHT TRANSMISSION

606-39	Materials Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Comparison of methods of measurement of parallel light transmission of transparent materials.

PURPOSE: To determine whether any existing method for the determination of parallel light transmission in transparent materials is more satisfactory than that specified in Army Air Forces Specification No. 12025.

AUTHORITY: Chief, Engineering Division.

REMARKS: The data obtained by the methods given in Army Air Forces Specification No. 12025 were specifically compared with those obtained by Federal Specification L-P-406 and with integrated I.C.I. transmittances from spectral data. The effect of collimation of light source, collimation of the photocell and the effect of the color temperature of the light source were specifically

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considered. Within the limits imposed by the various specifications, the only significant factor was the change in the color temperature of the light source. The usual conditions encountered by aircraft are more similar to the source specified in the Army Air Forces Specification than to that used in the Federal Specification method. The exact specification of dimensions to an even greater extent than given in the Federal Specification would definitely improve the Army Air Forces Specification method.

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SECTION 2

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CHEMISTRY PROJECTS

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HIGH SOLVENCY AND HOT DOPES

601-211 Expenditure Order No.	Materials Laboratory Mfg. or Activity Charged with development.
None Classified Project No.	None Contract Number

DESCRIPTION: These dopes are used to build up a doped surface more rapidly with fewer coats than can be done with regular dope, thus effecting a saving in time and solvents in the manufacture of gliders and training planes.

PURPOSE: To evaluate high solvency and hot dopes and compare them with regular doping systems with respect to durability.

AUTHORITY: Chief, Engineering Division.

REMARKS: Panels coated with several high solvency and hot dope systems have been sent to Florida for exposure to compare these dopes with regular doping systems with respect to durability. Some production experience has also been obtained with this type of finishing scheme, and production planes and gliders are being observed to ascertain durability in service.

INVESTIGATION OF DOPE FORMULATIONS

601-197 Expenditure Order No.	Materials Laboratory Mfg. or Activity Charged with development
None Classified Project No.	None Contract Number

DESCRIPTION: Investigation of durability properties of aircraft dopes of various types and compositions.

PURPOSE: To improve durability of dope finishes used on training and combat aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Previous work on this project has established that improvement in durability of doped surfaces may be obtained by use of chemical plasticizers and aluminum pigment. The six month exposure period in Florida previously used was not enough, however, to weather the doping

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schemes tested sufficiently to evaluate all of the schemes. A new set of panels has been prepared, in duplicate, and sent to Florida for exposure until failure of the dope is observed.

It is expected that the tests of these panels will shed considerable light on type of and quantity of plasticizers and pigments which will give the best performance in service.

LOW TEMPERATURE GREASES

601-203	Materials Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Low temperature greases are used in aircraft lubrication primarily for control bearings, but also in other applications where low torque and efficient operation at -67° F. are important, and where high temperatures or high speeds are not encountered.

PURPOSE: To develop suitable test methods for the determination of the physical properties of low temperature greases.

AUTHORITY: Chief, Engineering Division.

REMARKS: Pending completion of the new design low temperature concentric cylinder viscosimeter for measuring the low temperature viscosity of greases, emphasis of work has been on the development of test methods to predict the storage stability in the can and in bearings of various low temperature greases. Data have been collected to correlate the bleeding and evaporation test of Specification AN-G-3a with pan evaporation, bleeding from a wire basket in a closed container and separation of oil by centrifuging.

A pressure type capillary viscosimeter has been obtained for correlation of viscosity data.

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SPARK INHIBITING FINISHES

601-1	Materials Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Spark inhibiting finishes are paint materials which when painted over metal aircraft structures prevent the striking of sparks by the passage of a projectile.

PURPOSE: To investigate and develop new paint materials and finishing schemes which will afford improved protection against fires started by sparks from projectiles passing through metal members in the vicinity of the fuel tank, etc.

AUTHORITY: Chief, Engineering Division.

REMARKS: Satisfactory finishing schemes have been developed for the protection of aluminum alloys from sparking in thicknesses up to and including .064 inch. Present work is directed toward the testing and development of coatings for thicker members. Firing tests on coated cylinders of heavier aluminum alloys have been conducted in the same manner as those dealing with inhibiting coatings on lighter gage metals. However, to date no satisfactory coating schemes for the heavier gage aluminum alloys have been found.

Future work will include further evaluation of coatings for the heavier gage aluminum alloys.

INVESTIGATION OF CHROMIUM PLATE VS. FATIGUE RESISTANCE

601-1-132	Materials Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development.
None	None
Classified Project No.	Contract Number

DESCRIPTION: Evaluation of the effect of chromium plating on the fatigue resistance of S.A.E. No. 4630 steel.

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PURPOSE: To develop methods of chromium plating which will reduce the deleterious effects of chromium plating upon the fatigue resistance of steel.

AUTHORITY: Chief, Engineering Division.

REMARKS: The reduction in fatigue strength of chromium plated steel has been investigated further. In particular the effects of surface treatment of the steel prior to plating, current density, temperature, and other plating conditions have been evaluated.

Optimum temperatures and current density have been found. Baking has been found to be detrimental to platings which show relatively low reduction in fatigue limit before baking. Certain surface treatments have been found to decrease the loss in fatigue resistance on plating.

Chromium plating in general, however, is sufficiently detrimental to fatigue resistance, that applications which might be subject to fatigue failure should not be chromium plated in production unless laboratory tests of the part plated with the maximum thickness of chromium to be used indicate that performance will be satisfactory.

COATINGS FOR EXHAUST DISPOSAL SYSTEMS

535-27	University of Illinois Urbana, Illinois.
Expenditure Order No.	Mfg. or Activity charged with development.
None	W535 AC-40114
Classified Project No.	Contract No.

DESCRIPTION: These coatings are intended to serve the dual purpose of protecting non-stainless steel exhaust systems from corrosion and lowering the infrared and visible emissivity of exhaust stacks, etc.

PURPOSE: To develop ceramic enamels which possess satisfactory adhesion, protection, and emissivity for coating exhaust systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: Two preliminary reports have been written by the University of Illinois, dealing with methods of evaluating ceramic coatings for adhesion, emissivity and resistance to thermal shock. Several

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commercial and experimental enamels have been tested and evaluated in terms of these properties. It has been found that S.A.E. 1120, mild carbon steel is a more satisfactory base material than enameling iron for these coatings.

The best of the laboratory enamels will be selected for further improvement with regard to workability for large scale application and further lowering emissivity.

CORROSION OF MAGNESIUM FUEL TANKS

601-213 Expenditure Order No.	Materials Laboratory Mfg. or Activity Charged with development
None Classified Project No.	None Contract Number

DESCRIPTION: Magnesium fuel tanks have been developed to take advantage of the low density of magnesium in order to save weight.

PURPOSE: To investigate the corrosive action of aviation fuels on magnesium tank materials.

AUTHORITY: Chief, Engineering Division.

REMARKS: The necessary magnesium sheets have been obtained from the Dow Chemical Company and the Materican Magnesium Corporation. These companies were also contacted for information based on their previous work and experience which might indicate whether the use of magnesium as a fuel tank material was practicable. Their replies were not encouraging.

It is planned, nevertheless, to evaluate several types of magnesium sheet, treated in different ways, in the presence of fuel-water mixtures, with and without inhibitors. If a satisfactory alloy-treatment-inhibitor combination can be found, it will be recommended for use for magnesium fuel tanks.

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XYLIDINE FUELS

601-212
Expenditure Order No.

Materials Laboratory
Mfg. or Activity Charged with development.

None
Classified Project No.

None
Contract Number

DESCRIPTION: Xylidine containing fuels have been developed to utilize otherwise submarginal base stocks in the production of high performance aviation fuels, in order to increase the total aviation fuel supply.

PURPOSE: To investigate the corrosion and stability properties of fuels containing xylidine.

AUTHORITY: Chief, Engineering Division.

REMARKS: The vital importance of aviation fuels for the satisfactory performance of military aircraft demands careful scrutiny of any new type of aviation fuel in order to insure its stability and satisfactory performance in service. Preliminary tests, based largely on accelerated laboratory aging, indicate that xylidine fuels are adequately stable with respect to the precipitation of lead salts. Oxidation stability and corrosion due to this type of fuel are being investigated, but it is indicated that these properties are also probably satisfactory.

Future work will include corrosion of xylidine containing fuels with metals used in fuel induction systems, and correlation of accelerated laboratory tests with storage under simulated tropical conditions.

ANTI-ICING COMPOUNDS

601-201
Expenditure Order No.

Materials Laboratory
Mfg. or Activity Charged with development.

None
Classified Project No.

None
Contract Number

DESCRIPTION: These compounds are materials which may be applied to aircraft propellers to prevent icing.

PURPOSE: To develop paste, lacquers, or other non-inflammable propeller anti-icing compounds which will operate satisfactorily to prevent ice formation.

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AUTHORITY: Chief, Engineering Division

REMARKS: Several non-inflammable liquid anti-icing compounds have been examined, a few of which have shown satisfactory freezing point depressant properties in laboratory tests.

Extensive investigations are being performed by other units of the Engineering Division and work will be performed so as to cooperate more closely with all organizations.

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SECTION 3

METALLURGICAL PROJECTS

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INVESTIGATION OF ALTERNATE STEELS

605-1-152	Materials Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: When the shortage of alloying elements for use in steel-making developed, the American Iron and Steel Institute proposed several series of alloy steel compositions as alternates for those normally used. These new compositions required a lesser quantity of any one alloying element, but required the use of a larger number of elements. More recently a method of using "addition agents" (minute quantities of certain powerful elements) to increase the hardenability in the same way as a much larger quantity of the usual alloying elements was developed.

PURPOSE: This part of the investigation was undertaken to compare the physical properties and response to heat treatment of steels treated with these addition agents with the results obtained on untreated steels of similar compositions.

AUTHORITY: Chief, Engineering Division.

REMARKS: A number of different compositions of addition agents are made. While the exact compositions are not available, all are reported to be ferro-alloys containing boron. Aluminum, ticonium, calcium and/or zinc may also be present. The amount of the addition agent used is so small that its presence has not been detected even spectroscopically in the finished steel.

The results of the first part of this investigation were used as as basis for the preparation of Army-Navy-Aeronautical Specifications for those alternate steels of value for aircraft use. All of these specifications have been released.

It is not anticipated that specifications will be issued for the steels containing these addition agents.

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PROPERTIES OF ALUMINUM ALLOYS
MELTED BY HIGH FREQUENCY ELECTRICITY

605-172	Materials Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The physical properties of aluminum alloys melted in fuel fired furnaces are adversely affected by gases absorbed from the products of combustion. Various fluxing treatments are nowused to free the molten metal from these harmful gases. Metal melted in electrically heated furnaces should be free of these gases and consequently would be expected to have satisfactory physical properties without the necessity of fluxing.

PURPOSE: This investigation is conducted to determine the physical properties of aluminum alloys melted in an electrically heated furnace and to compare the results with those obtained on alloys melted in gas fired furnaces.

AUTHORITY: Chief, Engineering Division.

REMARKS: The three alloys used in this investigation are melted in conducting (graphite) crucibles heated by induced high frequency electric currents and are then cast into test bars. Although the equipment used for this investigation has a capacity of only 30-40 pounds of non-ferrous alloys, commercial equipment with a 500 pound capacity is available if the results warrant its use.

Chlorine gas is one of the most commonly used means of freeing aluminum alloys from harmful absorbed gases. Preliminary results indicate that melting in this induction furnace will produce castings with properties equal to or greater than those obtained on castings produced from chlorine treated metal. High quality castings could therefore be produced by this method in the event of another serious shortage of chlorine, such as occurred about two years ago.

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TEST OF MAGNESIUM CASTING ALLOYS

605-162	Materials Laboratory
Expenditure Order No.	Mfg, or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: An experimental magnesium foundry has been established which will be capable of making finished castings up to a maximum finished weight of fifty pounds. Hitherto, no magnesium castings have been made at the Materiel Command.

PURPOSE: To set up an experimental magnesium foundry and to study magnesium casting alloys for use in aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Work has begun on the study of standard American sand casting alloy compositions versus standard Continental sand casting alloy compositions.

MAGNESIUM ALLOY CASTINGS

605-159	Materials Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Several commercial magnesium alloy sand castings are being radiographed and tensile and fatigue specimens are being machined from areas selected by the radiographic examination. A correlation between radiographic appearance and physical properties is being attempted.

PURPOSE: To correlate the physical and radiographic properties of magnesium alloy sand castings.

AUTHORITY: Chief, Engineering Division.

REMARKS: Specimens have been machined from two of the castings and radiographs taken of them. It was found that the tensile strength of specimens from one casting which appeared radiographically sound varied from 30,000 to 38,000 psi. Fatigue strength has not been tested as yet.

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SUMMARY OF ETHYL CORPORATION
STRESS-CORROSION TESTING

605-164
Expenditure Order No.

Ethyl Corporation
Detroit, Michigan
Mfg. or Activity Charged with Development

None
Classified Project No.

(W535) AC-28222
Contract No.

DESCRIPTION: The stress-rupture testing is done in a cylindrical furnace capable of testing fourteen tensile bars simultaneously. The apparatus includes the necessary auxiliary equipment for operation of the furnace which includes a cooling water tank, water pump, fuel system, and temperature recorder.

PURPOSE: To determine the stress-rupture properties of alloys now in use or proposed for use in turbosuperchargers under conditions which simulate actual operation.

AUTHORITY: Chief, Engineering Division.

REMARKS: Testing is done by assembling the bars in the furnace, loading to the proper stress and heating to temperature by a revolving gas flame. The gas burner so revolves as to impinge consecutively on each of the fourteen bars and to cycle the temperature of the bars either from about 1050°F. to 1500°F., or from 850°F. to 1200°F., depending upon the alloy to be tested. The time for failure under a given load is determined for each bar and is considered an index of the quality of the alloy. One half of each bar is sent to the Materiel Command and the other half to the Battelle Memorial Institute for further investigation.

To date, the following alloys have been tested: G. E. 61, 6059, Vitallium, Hastelloy A, Hastelloy B, Chromel A, Hoskins 717, Gamma Columbium, Inconel, Ticonium, and KA2S-Ti. Of these, G. E. 61 alloy showed the best properties, followed by 6059 and Vitallium respectively.

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IDENTOMETER

605-1	Materials Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The Identometer is an instrument which has recently been developed for the rapid identification of steel, based on the theory of thero-electricity. This instrument is manufactured by the American Tubular Elevator Company and distributed by the Machinery Division of the Dravo Corporation, Neville Island, Pittsburgh, Pennsylvania.

PURPOSE: To conduct a series of tests to determine the usefulness and application that might be made of the Identometer in AAF Supply Depots when separating steel stock.

AUTHORITY: Chief, Engineering Division.

REMARKS: The investigation has indicated that this instrument is reliable when suitable reference specimens of known chemical composition and of known condition of heat treatment are used for comparison with unknown steel. During the investigation, tests were conducted which embodied different grades of steel, several lots of the same grade of steel, various heat treatments of the same piece of steel and different surface conditions present on the steel. The investigation is nearly completed.

ENEMY EQUIPMENT

605-166	Battelle Memorial Institute Columbus 1, Ohio
Expenditure Order No.	Mfg. or Activity Charged with Development
None	535-43-30618
Classified Project No.	Contract No.

DESCRIPTION: Metallurgical analyses are made on parts of captured enemy aircraft equipment which are submitted from the various theaters of operation.

[redacted]

PURPOSE: To investigate captured enemy equipment to reveal the types employed by the enemy, and to note substitute and synthetic materials, fabrication methods and processes, and materials critical to the enemy.

AUTHORITY: Chief, Engineering Division.

REMARKS: The major parts from a German Mercedes-Benz, DB601-E, engine were analysed. This engine was reported to have a cast crankshaft of chromium-nickel-molybdenum steel, and to have cast magnesium alloy camshaft bearings. There was a notable absence of copper base alloys in this engine. Nearly all of the bearings were of the steel, assembly type, ball and roller bearings, including the main bearings. The steel used for the bearings was similar to SAE 52100.

The parts from a BMW 801-D, 14 cylinder, radial engine from a German FW 190 airplane are now in process of being examined.

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SHORT TIME TESTS ON
TURBOSUPERCHARGER ALLOYS

605-168 Expenditure Order No.	Materials Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The short time tests are made in a 50,000 pound Olsen testing machine equipped with a furnace and temperature controller to permit high temperature testing.

PURPOSE: To determine the short time tensile properties of alloys being used or contemplated for use in turbosupercharger buckets or wheels at temperatures obtained in actual use.

AUTHORITY: Chief, Engineering Division.

[redacted]

REMARKS: Testing is done with .250 inch diameter bars, 1 inch in gage length. The bars are assembled in the furnace on the testing machine, heated to temperature for one hour and pulled in tension. Yield strength, ultimate strength, elongation and hardness are determined. Prior to testing, some bars are aged for 48 hours at the testing temperature and air cooled, tending to simulate 48 hours use in a turbosupercharger at that temperature.

The following are among those alloys tested to date:

a. For turbine discs: Timken (16-25-6), 1803, and 234-A-5. Timken alloy showed best results.

b. For turbine buckets: Vitallium, G. E. 61, 6059, and S-495, given in order of best results.

[redacted]

SECTION 4

TEXTILE AND RUBBER PROJECTS

TEXTILE & RUBBER

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IMPACT INVESTIGATION ON TEXTILE MATERIALS

602-1-140
Expenditure Order No.

Textile Division Laboratories,
Mass. Institute of Technology,
Cambridge, Mass.
Mfg. or Activity charged with Development

none
Classified Project No.

W33-038 ac-319(11052)
Contract Number

DESCRIPTION: An investigation initiated to obtain basic information as to the impact properties of nylon and silk so that efficient parachute materials can be designed or present materials redesigned so that a more efficient parachute will result.

PURPOSE: To obtain basic inherent physical characteristics of nylon and their comparison with silk.

AUTHORITY: Chief, Engineering Division

REMARKS: A testing apparatus has been developed and built at the present time. A few preliminary tests have been conducted in order to determine the best type of static testing so that static loading and impact loading results can be coordinated. There have been no results obtained to give definite information as to the performance of nylon to date.

RAMIE CORDAGE & WEBBING

602-1-124
Expenditure Order No.

Materials Laboratory
Mfg. or Activity charged with Development

none
Classified Project No.

none
Contract Number

DESCRIPTION: Ramie is a bast fiber cultivated in plant form in the southern part of the United States and the West Indies.

PURPOSE: To determine the suitability of ramie as a substitute for the use of linen and long staple cotton.

AUTHORITY: Chief, Engineering Division

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[redacted]

REMARKS: Ramie Cordage.- Results of extensive tests have shown that ramie fiber possesses uneven physical characteristics which compared with cotton and linen are of an inferior nature. Ramie when exposed to accelerated aging shows greater losses of tensile strength between the high and low ranges than do cotton or linen of similar size and weight.

Ramie Webbing.- The same thing is true of webbing made of ramie yarn as compared with that made of either cotton or linen of an equivalent size. Due to the low strength-weight ratio of ramie the use of this fiber to replace the present production of cotton webbing is not considered advisable and would not be satfactory for Army Air Forces use.

SHEEP SHEARLINGS

602-1-102	Materials Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
none	none
Classified Project No.	Contract Number

DESCRIPTION: The sheep shearlings are being used for winter flying clothing for pilots and ground crews.

PURPOSE: To develop suitable specification standards and formulae for finishes of the backing to allow the greatest flexibility and durability at low and high temperatures.

AUTHORITY: Chief, Engineering Division

REMARKS: From the various types of plastic resin finishes tested to conform with all of the requirements of extreme high and low temperature as well as aging, one has been found which is most satisfactory. This finish may be more fully identified as "The United Finish Company's" finish. To produce this finish, two separate applications of different compounds are necessary. The first application is to apply a base coat of Style E-665 which is a methacrylate compound; over this is applied a top coat of Style V-507 which is a vinylacetate compound. This gives a soft and flexible finish at very low temperatures and does not become tacky at the high temperatures required by the specification. It also has good aging qualities when subjected to 80 hours exposure to a sunshine carbon arc. It is a very desirable finish and may be produced with or without high lustre.

[redacted]

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NYLON CORD TIRES

602-1-123	Materials Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
none	none
Classified Project No.	Contract Number

DESCRIPTION: Aircraft tires made with nylon cord fabric.

PURPOSE: To develop a tire that will reduce the weight of the casing, increase the performance, and add to the safety of tire operations.

AUTHORITY: Chief, Engineering Division

REMARKS: Since 1941 tests have been conducted on experimental nylon fabric aircraft casings. The nylon cord has apparently many distinct advantages over other types of aircraft tire cord. The principle advantage is the increased strength-weight ratio. It is not possible to take full advantage of the additional strength of the nylon cord at the present time due to the fact that the adhesion between the rubber and the nylon has not been developed to a point where it can be considered any more than equal to the adhesion between rayon and rubber. It is therefore impossible to rate the nylon tire as being able to carry more load than the rayon tire. However, the fact that nylon tires have a vastly superior bruise resistance effect due to the increased strength of the nylon cord warrants the use of nylon tires in equivalent plies to the standard rayon tires where the tires suffer a severe overload. Development work continues on improving the adhesion of nylon and rubber and tests are now being conducted on tires incorporating a new adhesive. If these tires perform well it is possible that the nylon tire may be rated as carrying a higher load provided that the manufacturing defects connected with production of tires incorporating this new adhesive can be worked out. The principal difficulty with the new adhesive is that it is inflammable and slightly toxic. Therefore, to avoid complications with state and federal health regulations, the manufacturers are reluctant to sanction the use of this adhesive. In the early stages of development of nylon tires it was apparent that the growth of the nylon tire might be a limiting factor in the use of nylon tires for aircraft. It has also been noted that the nylon tire will stretch more than the rayon or cotton tire upon initial inflation. This introduces a severe clearance problem. The development work to date has been successful in reducing the service growth of the nylon tire where the tires have not been severely overloaded. The initial stretch has to be compensated for by

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smaller mold equipment. Since the nylon tire is stretched upon initial inflation the tread being under tension was found to have a higher rate of wear. It is therefore more economically feasible to procure nylon tires for installations that do not require the added safety factor provided by the nylon tire; that is, if the rayon tire performs satisfactorily from a carcass strength standpoint it will outwear the nylon casing. Development work is continuing on reduction of the initial inflation stretch. If this disadvantage can be eliminated it is probable that the nylon tire will be used for the majority of aircraft tire production due to its inherent safety and load carrying advantages.

CHANNEL TREAD TIRES

602-132	Materials Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
none	none
Classified Project No.	Contract Number

DESCRIPTION: The channel tread tire is a square treaded tire designed to give increased tire performance on aircraft.

PURPOSE: The purpose of the channel tread tire is to give increased performance in regard to flotation, wear, and anti-shimmy.

AUTHORITY: Chief, Engineering Division

REMARKS: Previous tests on channel tread casings indicated that the channel tread tire is able to carry slightly increased loads due to the increase in contact area. The channel tread tire is inherently stiffer and heavier than the standard tire. To date certain advantages and disadvantages have been noted. It has been found that the channel tread tire wears from 50 to 100% longer than the standard tire. This advantage would seem to be practical on training type airplanes where wheel clearance permits. The additional wear is of doubtful advantage in tactical airplanes due to the short life expectancy of the airplane and the air performance penalties imposed by the heavier tire installation. The channel tread tire has been applied to many tail wheel installations. It is found to have particular advantage where the existing tires are overloaded. The remaining tests on channel tread tires are nearly completed. One of these tests is to determine the exact factor of increased wear on training type airplanes. The other tests in progress pertain to a decrease in difficulty on the P-47 tail wheel installation.

SPECIAL SOFT LANDING FIELD TIRES

602-131
Expenditure Order No.

Materials Laboratory
Mfg. or Activity charged with Development

none
Classified Project No.

none
Contract Number

DESCRIPTION: Tires that will give maximum flotation on soft landing fields, beaches or similar soft surfaces.

PURPOSE: To provide information regarding the best possible aircraft tire for improved flotation.

AUTHORITY: Chief, Engineering Division.

REMARKS: During the summer of 1943 many types of aircraft tires were tested in the desert near Blythe, California. These tests were run in an effort to determine what factors affected flotation and which types of tires performed the best on soft surfaces. It was concluded that in order to obtain improved flotation larger tires are needed. It was also found that more pliable tires performed better than stiffer tires from a rolling resistance or power required standpoint. In general larger tires cannot be installed on tactical aircraft due to the fact that the retraction cavities and landing gear forks do not provide sufficient clearance.

SYNTHETIC RUBBER AIRCRAFT TIRES

602-1-121
Expenditure Order No.

Materials Laboratory
Mfg. or Activity charged with Development

none
Classified Project No.

none
Contract Number

DESCRIPTION: Aircraft tires manufactured with synthetic rubber tread and carcass compounds.

PURPOSE: The purpose of this project is to continue the conversion of natural crude rubber and to give the manufacturers necessary experience in handling materials involved.

AUTHORITY: Chief, Engineering Division

[redacted]

REMARKS: Development work on synthetic aircraft tires has been in progress for several years. To date it has been possible to convert production aircraft tires of all types and sizes, except ice grip and fighter style, to an S-5 synthetic construction. These conversions are based on test results obtained. Further testing is underway to endeavor to accomplish further conversions to synthetic constructions involving additional savings of crude rubber. Testing is also underway in an effort to provide an adequate nylon and synthetic casing. Tests on fighter style synthetic casings are being continued to determine practicability of fighter styles constructed with synthetic rubber. These tests are nearly complete. Laboratory test work is being done in an effort to perfect an adequate synthetic ice grip tire. To date all synthetic aircraft tires have performed as well as the natural rubber tires in every respect except minor cutting and chipping. tests now underway incorporate 100% synthetic tires in smaller sizes. Tests underway also are laid out to provide information as to the performance of S-5, S-6, and S-4 constructions in extremely cold climates. All synthetic tire testing is being conducted by joint cooperation of the Armed Forces and the Aircraft Tire Industry.

ICE GRIP TIRES

602-136 Expenditure Order No.	Materials Laboratory Mfg. or Activity charged with Development
none Classified Project No.	none Contract Number

DESCRIPTION: An ice grip tire is a specialized casing designed to improve traction on slippery winter surfaces.

PURPOSE: The purpose of this tire is to increase the safety of winter operations on icy runways.

AUTHORITY: Chief, Engineering Division.

REMARKS: The testing of ice grip tires has been in progress for a number of years. Each year further developments have been made to improve previous years' tires. In each case an effort was made to eliminate the difficulties previously experienced. Consideration must be given to surfaces covered with soft snow, hard-packed snow and wet and dry ice, as well as clear runways due to the fact that any and all surfaces are encountered by airplanes operating under

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winter conditions. It has been observed that the higher the bearing pressure on the steel ice grip inserts the better the tractive ability on clear ice. The high bearing pressure has an adverse effect on clear runways in that the rate of wear is prohibitive and the tractive ability is reduced. It is therefore necessary to arrive at an optimum construction which will provide adequate traction on both clear and icy surfaces as well as a feasible and economical rate of wear. It has been found that standard tires perform satisfactorily in loosely packed snow. However, it is necessary to have a non-skid feature in hard-packed snow. To date it has not been possible to manufacture the ice grip tire with synthetic rubber compounds due to the poor tear resistance of the synthetic stocks. Substantial progress has been made, however, in the indoor development of synthetic ice grip tires. This particular phase of ice grip tire development is being conducted under the synthetic aircraft tire development project. The development work has proceeded far enough to consider the short steel spring insert type ice grip tire as standard. This tire can be manufactured in any non-skid airplane tire molds thereby eliminating the necessity for extra and additional mold equipment. The performance on ice, snow and clear runways is considered adequate and the rate of wear and cost per item are more satisfactory than any other ice grip tire yet presented. A specification to cover the procurement of ice grip tires is being prepared.

FIGHTER STYLE TIRES

602-1-125 Expenditure Order No.	Materials Laboratory Mfg. or Activity charged with Development
none Classified Project No.	none Contract Number

DESCRIPTION: The "Fighter" style tire is a special casing built expressly for combat aircraft in the theater of operations. The cord body or carcass is full strength but only a veneer coat is built onto the sidewalls and undertread.

PURPOSE: The purpose of this construction is to save rubber and weight.

AUTHORITY: Chief, Engineering Division.

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REMARKS: The "Fighter" style tire was developed in an effort to save weight and rubber by taking advantage of the relatively short life expectancy of combat airplanes involved in operations against the enemy. Tests conducted on these tires installed on fighter aircraft indicate that the "fighter" style tire does not have sufficient advantage over the regular tire to balance with the additional problems encountered in production and stocking of different casings in the same numeral size. Specifications are being revised to eliminate the fighter style casing and reduce the weights of the standard casing to a compromised value in order not to penalize the air performance of fighter aircraft. One of the principal reasons for the failure of the fighter style aircraft tire to meet specifications is that the average fighter aircraft overloads the tires to such an extent that the rate of tread wear is increased excessively.

ALL-PURPOSE AIRCRAFT HOSE

602-1-130
Expenditure Order No.

Materials Laboratory
Mfg. or Activity charged with Development

none
Classified Project No.

none
Contract Number

DESCRIPTION: Fuel oil and coolant hose.

PURPOSE: Develop an all-purpose hose or hoses for use in aircraft fuel oil or coolant lines.

AUTHORITY: Chief, Engineering Division.

REMARKS: Numerous samples of neoprene hose and buna N hose have been tested for resistance to hot oil, coolant and 40 percent aromatic fuel.

Hose clamps tend to loosen when buna N hose is used on oil and coolant lines due to permanent deformation of cover stock and shrinkage of the tube stock; in the case of buna N hose for fuel lines, the tube swells slightly and helps to counteract the tendency of the cover to take permanent deformation.

The tube of neoprene hose swells excessively in 40 percent aromatic fuel and the adhesion between tube and braid is seriously reduced.

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As neoprene and buna N are the only current synthetics which show any promise for these applications, tests were discontinued and separate specifications established. Army-Navy Aeronautical Specification AN-ZZ-H-456 describes a buna N hose, identified by a solid white stripe and a broken red stripe, for use on aromatic fuel lines. Army Air Forces Specification 26577 describes a neoprene hose, identified by a solid white stripe and a solid red stripe, for use on oil and coolant lines.

In the event that new synthetics are introduced, present polymers are modified, or combinations of two or more synthetics appear promising, research will be resumed, as it is considered desirable to have one hose for all fuel, oil, and coolant lines.

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SECTION 5

WOOD AND GLUE PROJECTS

WOOD & GLUE

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EVALUATION OF GLUES AND GLUING TECHNIQUES

604-202	Forest Products Laboratory Madison, Wisconsin
Expenditure Order No.	Mfg. or Activity charged with Development
None	W 535 AC-43-13723
Classified Project No.	Contract No.

DESCRIPTION: When new glues are developed or formula changed, the technique of application changes. Information on properties and characteristics are required to maintain specifications conforming to developments and to guide the aircraft manufacturer in his selection of adhesives.

PURPOSE: To evaluate wood working adhesives for wood aircraft construction. To develop information on the proper methods of application to produce consistently reliable joints.

AUTHORITY: Chief, Engineering Division.

REMARKS: Approximately 100 synthetic resin glues have been investigated to determine operating characteristics, conformance with pertinent specifications and suitability for aircraft purposes. Methods of analysis for filler and acidity have been investigated with a view to improving existing specifications for resin glues. Some of the results have been included in a proposed Federal specification for urea resin glues. The information developed has also been used in preparing a proposed AAF specification for low-temperature phenolic resin glues. It has been demonstrated that the addition of toxic chemicals to casein glue will increase the resistance of the joints to attack by molds and other micro-organisms. Time-temperature curing cycles required by low temperature phenolic resin glues have been investigated to provide tentative guides for manufacturers and inspectors in the use of this class of adhesive. Investigation has disclosed that the gluing characteristics of glazed wood surfaces can be definitely improved by sanding.

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INSPECTION OF VENEER AND PLYWOOD

604-202 Expenditure Order No.	Forest Products Laboratory Madison, Wisconsin Mfg. or Activity Charged with Development
None Classified Project No.	W 535 AC-43-13723 Contract No.

DESCRIPTION: Control of the quality of wood in aircraft parts demands the elimination or strict control of those defects that affect strength. Some of these defects are not readily detected by visual examination while others are readily visible but require unusual experience and judgment to separate the portions containing permissible defects from the portion containing defects that would cause rejection.

PURPOSE: To develop methods for detecting obscure defects and to define accurately the defects or characteristics that may be admitted in wood products for aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: Comparisons in specific gravity were made between matched specimens of solid wood, veneer, and plywood. A field method was developed for determining specific gravity from increment cores or auger chips from trees or logs. A tentative formula was developed by means of which it may be possible to compute the specific gravity of plywood from specific gravity determinations made on the tree or log, thus facilitating selection of stock suitable for aircraft plywood. Work was continued in the development of a simple mechanical test for the detection of cross-grain in veneer. Bending around a circular mandrel, whose diameter is a function of the veneer thickness, offers promise as a simple method of testing for objectionable cross-grain. Methods for detecting compression wood in veneers and lumber were refined and demonstrated in field trials. Noble fir dried according to AN-W-2a may become discolored by chemical stain. Tests have shown that such chemical stain does not affect strength properties. The following reports have been prepared, during the last six months, for the information of inspectors and manufacturers:

- No. 1585 Guide to Determining the Slope of Grain in Lumber and Veneer, September 1943.
- No. 1586 Compression Wood, Importance and Detection in Aircraft Veneer and Plywood, September 1943.
- No. 1329 Chemical Stain in Noble Fir, October 1943.

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SEASONING OF AIRCRAFT LUMBER

604-202 Expenditure Order No.	Forest Products Laboratory Madison, Wisconsin Mfg. or Activity charged with Development
None Classified Project No.	W 535-AC-43-13723 Contract No.

DESCRIPTION: Production schedules demand that aircraft lumber be dried as rapidly as possible without injury to strength and other properties. Commercial kilns and commercial drying schedules do not consistently conform to these two requirements. Consequently, drying schedules must be developed and limitations of commercial kilns defined in order to produce suitable stock as rapidly as possible.

PURPOSE: (1) To determine the suitability of representative kilns in different parts of the country for the drying of aircraft lumber, (2) to provide instructions for the proper operation of such kilns for the drying of aircraft lumber, and (3) to provide basic data for the modification of drying schedules whenever such modification appears possible.

AUTHORITY: Chief, Engineering Division.

REMARKS: Following kiln studies and conferences in the Pacific Northwest, a survey was made of the kiln operations in the East and Middlewest. This survey indicated that very few, if any, of the kilns were being operated according to Specification AN-Q-2a and that some of the kilns lacked the equipment for such operation. A plan for certification of dry kilns and kiln operations was developed. Personnel was assigned to conduct investigations necessary for certification until such time as the Inspection Division can assume the function. Certification studies have begun at facilities in the Los Angeles area. Plans and tentative procedures are embodied in the following reports:

1. Policies relative to making certification studies of kiln drying facilities.
2. Detailed outline to be used in the training of AAF representatives and kiln operators in the kiln drying of aircraft lumber.
3. Outline of a 3-day course in kiln drying to be given in certain areas.
4. Suggestions and instructions for kiln operators drying aircraft lumber.

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INTERPRETATION OF SPECIFICATIONS

None	Materials Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: In dealing with a variable, natural material such as wood and wood products, specifications cannot be so written as to cover all possible variations. When variables not completely covered by specifications are encountered, there arises the problem of so interpreting the specifications as to safeguard the quality of the product and yet avoid retarding production and wasting materials.

PURPOSE: To assist inspection agencies in the enforcement of specifications and to assist manufacturers of wood aircraft in the interpretation of pertinent specifications. To prepare or to assist in the preparation of manuals and directives that will aid in the application and interpretation of specifications pertaining to the use of wood in aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: The proper care in the control of gluing operations and the proper seasoning and selection of aircraft lumber continue to offer the greatest number of problems in the production of wood aircraft. Numerous investigations have been made of fabricating techniques used by manufacturers in producing wood aircraft parts in an effort to improve the quality of the work. The Wood Aircraft Fabrication Manual has been revised and prepared for issuance as ANC Bulletin 19, Wood Aircraft Inspection and Fabrication. The ANC Handbook on the Design of Wood Aircraft Structures has been revised and prepared for issuance as ANC Bulletin 18, Design of Wood Aircraft Structures. A specification for mold-resistant casein glue was proposed and issued as AAF Specification 14122. A specification for low-temperature phenol, resorcinol, and melamine glues has been proposed for issuance as an AAF specification.

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SECTION 6

PLASTIC LIAISON PROJECTS

PLASTIC LIAISON

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LAMINATED PHENOLIC PLASTIC MATERIAL, PAPER BASE

604-201
Expenditure Order No.

Materials Laboratory
Mfg. or Activity charged with Development

None
Classified Project

None
Contract No.

DESCRIPTION: Determination of the mechanical and physical properties of high strength paper base laminated phenolic plastic material. This material develops sufficiently high mechanical properties that its use for some structural applications in aircraft is a possibility.

PURPOSE: To determine the properties for design uses and the preparation of applicable specifications.

AUTHORITY: Chief, Engineering Division.

REMARKS: Tensile, compressive, bend, shear, impact, fatigue, water absorption, specific gravity, dimensional stability, and radius of bend properties have been determined of several manufacturers' products. Although an Army Air Forces specification has been prepared, development work to improve this type of material is being carried on.

EFFECT OF NATURAL AND ACCELERATED WEATHERING ON THE PROPERTIES OF PLASTIC MATERIALS

604-222
Expenditure Order No.

Materials Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: Samples of representative plastic materials were obtained from manufacturers. The materials will be subjected to accelerated weathering and natural weathering. The exposure to natural weathering is being done at Wright Field and in Florida. All materials are to be tested as received, after accelerated weathering, and after natural weathering.

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PURPOSE: To determine the effect of climatic conditions on the physical and mechanical properties of plastic materials.

AUTHORITY: Chief, Engineering Division.

REMARKS: The program, as outlined, should determine what plastic materials are suitable for use on exposed parts of aircraft. A serious limitation of all plastic materials is their tendency to change dimensions with changes of temperature and humidity.

LOW DENSITY CORES FOR SANDWICH TYPE STRUCTURES

604-223
Expenditure Order No.

Materials Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: Balsa wood has been successfully used as an elastic stabilizing medium for high-strength skins. The cooperation of plastic manufacturers has resulted in the development of expanded synthetic foams which show considerable promise for the same purpose.

PURPOSE: To develop suitable synthetic rigid type low density materials for use in sandwich type structures.

AUTHORITY: Chief, Engineering Division.

REMARKS: Double-skin or sandwich structures have been successfully tested. The Mosquito airplane is the best example up to the present time. Bomb-bay doors for the Halifax are also double-skin. The trend of design seems to be toward double-skin types for two basic reasons. They are: (1) reduction of the number of parts required, and (2) a more economical use of material since failure is more apt to be a "stress failure" rather than an "instability failure".

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HIGH STRENGTH LAMINATED PLASTIC MATERIAL, COTTON FIBER FILLED

604-213	Fibre Products Laboratory New Brunswick, New Jersey
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The Fibre Products Laboratories, New Brunswick, New Jersey, have developed a process for producing oriented sheets of cotton fibers, without involving any spinning or weaving. By making a laminated plastic material with the oriented fibers as filler, it is possible to produce high strength materials of low specific gravity which may be used for structural applications. This firm has been given a development contract to cover development, testing, and evaluation of such plastic materials.

PURPOSE: To develop a high strength laminated plastic material for structural application. It is believed that it may be possible to develop a material of higher strength and less brittleness than paper base materials.

AUTHORITY: Chief, Engineering Division.

REMARKS: The initial report has been received. Equipment has been set up in an air conditioned room and arrangements have been made to complete all testing except final evaluation at Rutgers University.

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SECTION 7

WELDING PROJECTS

WELDING

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FLASH WELDING

607-1-27
Expenditure Order No.

Materials Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: Flash welding is the fusion under pressure and temperature of two similar cross sections. The temperature is obtained by high voltage through the cross sections.

PURPOSE: To study the properties of flash welds in alloys used on aircraft and to report on the effects of stress relieving after flash welding.

AUTHORITY: Chief, Engineering Division.

REMARKS: This investigation was carried on since some of the aircraft manufacturers do not stress relieve joints after welding. The tests which were made to determine the effects of stress relieving after welding on the endurance limit have been completed. The endurance limit was increased from 28,000 psi in the as welded condition to 38,000 psi after stress relieving at 950° F. Small surface defects such as tool marks and grinding marks caused a considerable reduction in the endurance limit of the welded joint.

ELECTRIC SPOT WELDING

604-1-19
Expenditure Order No.

Renssalaer Polytechnic Institute, Troy, N. Y.
Mfg. or Activity charged with Development

None
Classified Project No.

W535 AC-32686
Contract Number

DESCRIPTION: Spot welding is affected by numerous conditions which were studied to improve welding procedures.

[redacted]

PURPOSE: To study the different variables in the spot welding of aluminum alloys.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project has been in progress for more than three years and a total of 14 reports have been received on the various phases of spot welding, including methods of cleaning, consistency studies, and electrode pressure cycles. The latest reports cover the surface treatment of aluminum alloys in solutions at room temperature and the effect of spot welds on the sheet efficiency. Cleaning solutions were developed which operated at room temperature and eliminated the extra cost of heating the solution. It was found that cracked spot welds in stressed attachments caused a considerable reduction in the elongation of the sheet in the tensile tests.

SPOT WELDS UNDER FLUCTUATING LOADS

607-1-15
Expenditure Order No.

Materials Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Vibration tests are performed on spot-welded and riveted joints of aluminum alloys.

PURPOSE: To obtain data on the performance of spot welds under vibration.

AUTHORITY: Chief, Engineering Division.

REMARKS: The work on this project was delayed so that the fatigue machine could be modified to permit an increase in the speed of the tests. The speed was increased from 70 cycles per minute to 350 cycles per minute. Riveted and spot-welded specimens of aluminum alloys are now being tested. The results obtained at this date indicate that the endurance limit of a spot-welded joint is much lower than that of a similar riveted joint.

SECTION 8

STRUCTURAL AND MECHANICAL TEST PROJECTS

STRUCTURAL & MECHANICAL

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ALUMINUM ALLOY SHEET

604-214
Expenditure Order No.

Materials Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: This material, designated R-301 alloy and submitted by the Reynolds Metals Company, consists of a core similar to 14S alloy with a protective high strength cladding similar to 61S alloy, except that the cladding contains no copper.

PURPOSE: To investigate the properties of a high strength aluminum alloy for possible aircraft structural use.

AUTHORITY: Chief, Engineering Division.

REMARKS: The full hard temper is obtained by aging solution treated material for 18 hours at 320°F. Extensive testing of 0.040 inch and 0.064 inch thick full hard material aged at Wright Field resulted in minimum tensile values as follows: 58,100 psi yield strength; 64,800 psi ultimate strength; 8.0% elongation in 2 inches. The minimum compressive yield strength appeared to be 61,200 psi, based upon 8 tests. The material in thicknesses of 0.040 inch and greater appears satisfactory for use in aircraft, except that difficulties may arise due to the material being susceptible to intergranular corrosion. Material in thicknesses less than 0.040 inch should be tested prior to its approval for general use in aircraft. The manufacturer delivered sheet in gages of 0.020 inch, 0.025 inch and 0.032 inch to Wright Field in December, 1943. Tests on this material are in progress.

PROPERTIES OF ALUMINUM ALLOY EXTRUSIONS

604-226
Expenditure Order No.

Materials Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: Large aluminum alloy extrusions of intricate shapes now being used often have certain areas where some of the material has recrystallized resulting in a large grained structure. The properties

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of the coarse grained portion are different from those of the fine grained material.

PURPOSE: To determine the metallurgical, mechanical, fatigue and corrosion resistant properties of aluminum alloy extrusions.

AUTHORITY: Chief, Engineering Division.

REMARKS: Alcoa extrusion No. 27043 was chosen as the extrusion shape for investigation. Delivery has been made of full length extrusions of 14ST, 24ST and XA75ST material. The same extrusion, using Reynolds Metals Company R303 material, has been ordered. Tests are in progress. Mechanical properties and fatigue strength will be determined in all directions for both the fine grained and coarse grained portions of the extrusion.

FREE MACHINING ALUMINUM ALLOY

604-208 Expenditure Order No.	Materials Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The Reynolds Metals Company claims to have developed a new aluminum alloy, designated R317T, which has a superior combination of machinability and strength.

PURPOSE: To determine the tensile, fatigue and notched fatigue properties, the machinability and corrosion resistance of R317T alloy.

AUTHORITY: Chief, Engineering Division.

REMARKS: Various sizes of round bar in both rolled and extruded R317T stock have been received. Tests are in progress. Results will be compared with values for 17ST and 24ST material.

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STRESS CORROSION OF MAGNESIUM, ALUMINUM AND STEEL ALLOYS

604-215	Materials Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Stress corrosion, as generally related to aircraft structural material, is the spontaneous cracking of metal while exposed to the atmosphere under stress. Because of the trend toward imposing greater stresses on aircraft structural material due to more severe forming and/or higher design loads, stress corrosion is being encountered with increasing frequency. Since stress corrosion in the atmosphere often requires exposure of a year or more, it is highly desirable to develop an accelerated test.

PURPOSE: To investigate the susceptibility to stress corrosion of various magnesium, aluminum and steel alloys, and to develop an accelerated laboratory test for this purpose.

AUTHORITY: Chief, Engineering Division.

REMARKS: The necessary facilities are nearly completed for a comprehensive investigation of stress corrosion with some 200 specimens scheduled to be exposed, commencing 1 January 1944, under various conditions of stress and corrosive environment. The alloy sheets to be investigated initially are 10 heats AMC 52 SH, 10 heats AMC 57 SH (both alloys from American Magnesium Corp.), 8 heats J1H, 2 heats MH (both latter alloys from Dow Chemical Company); bare 24 ST, Alclad 24 ST, Alclad 24 ST 81, Alclad 24 ST 86, bare XA 75 ST, Alclad XB 75 ST (the latter six alloys from Aluminum Company of America); R301 (from Reynolds Metals Company).

PLASTIC BACKING MATERIALS FOR SELF-SEALING FUEL TANKS

604-206	Materials Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
MX-233	None
Classified Project No.	Contract No.

DESCRIPTION: Determination of the mechanical properties and Erichsen deformation properties of a number of plastic backing materials for self-sealing fuel tanks. These materials are employed between the

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self-sealing tank and the aluminum alloy wing structure (1) to prevent flowering of the metal, due to gunfire, from penetrating and holding open the tank, and (2) to support the tank between stringers, especially under the force of bullets on exit from the tank and the resulting hydraulic pressure. The plastic material must not flower, shatter, crack or disintegrate and it must have sufficient stiffness.

PURPOSE: To attempt to find a correlation between properties as shown by laboratory tests and results of firing tests of installations.

AUTHORITY: Chief, Engineering Division.

REMARKS: Work is completed for materials at room temperature. Materials which had been found to be satisfactory in firing tests and also those found to be unsatisfactory were tested. Tensile, bend, shear, Izod impact on notched and unnotched specimens, and specific gravity tests were made. The characteristics under deformation in the Erichsen test were observed. Materials having Izod impact values above a certain minimum, and certain ductility characteristics, shown by the Erichsen test, are satisfactory in firing tests. Materials not meeting both requirements are unsatisfactory. This will not eliminate the need for firing tests, but it is possible that unsatisfactory materials may be eliminated by laboratory tests. A specification is being prepared. Further work planned includes impact and Erichsen tests at low temperature before and after water immersion.

FLASH WELDED CENTRIFUGAL STEEL CASTINGS

604-207 Expenditure Order No.	Materials Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: Centrifugally cast tubes 4-1/2 inches O.D. x 3/4 inch wall and 6-5/8 inches O.D. x 3/8 inch wall of S.A.E. 4140 and S.A.E. 4340 steels. Tubes of similar size and material are flash butt welded together.

PURPOSE: To determine mechanical properties and metallurgical characteristics of flash-welded centrifugal steel castings.

AUTHORITY: Chief, Engineering Division.

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REMARKS: The tubes have been cast by the American Brake Shoe and Foundry Company and the welding has been performed by the A. O. Smith Corporation. Heat treating procedure has been established. Radiographic examination and preliminary hardness and tensile tests have been completed.

EFFECT OF SHOT PEENING ON FATIGUE STRENGTH

604-225 Expenditure Order No.	Materials Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: There is evidence that a certain amount of cold working of the surface of a part increases its fatigue strength. Such cold working may be accomplished by causing small pellets to impinge upon the surface; this is "shot peening". One of the major problems involved is the control of the intensity of peening.

PURPOSE: To compare, by fatigue tests, the properties of polished specimens with those having been shot peened to varying degrees.

AUTHORITY: Chief, Engineering Division.

REMARKS: Equipment available on the market for shot peening specimens and small parts for laboratory study have been investigated. One machine has been developed by General Motors Corporation which will be available within 90 days. Several ferrous specimens have been machined, which will be either superfinished or shot peened. Fatigue tests will be made of these specimens.

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Aero Med. Res.
Lab. Projects

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SECTION 1

OXYGEN PROJECTS

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DEMAND OXYGEN MASK

660-82	Aero Medical Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Demand oxygen masks consist of a facepiece with an expiratory valve mounted in it, a connecting tube for oxygen supply and necessary parts for suspension. Among many requirements of demand oxygen masks, fit, comfort and simple suspension are major considerations. Three main types are under laboratory and field tests: A-10 A, A-14, XA-13 and XA-15.

PURPOSE: To develop a demand oxygen mask superior in fit, comfort and suspension.

AUTHORITY: Chief, Engineering Division.

REMARKS: The A-14 mask was made standard and arrangements made so that the overseas personnel of the AAF were supplied first with the mask. A number of minor changes have been made in the mask which was stimulated by reports received from personnel using the mask in combat areas. The A-10 revised mask has been changed to approximate the nasal construction of the A-14 mask and released as a substitute standard for procurement when supply of the A-14 mask was insufficient. Procurement of the XA-13 mask was initiated and 800 of three sizes are to be used in field tests both as demand mask and as pressure breathing mask. The medium and small sizes have been received from the production moulds. A pressure demand oxygen mask has been developed by Dr. A. H. Bulbulian of Mayo Clinic, Rochester, Minnesota, and the laboratory tests on the first models indicated that procurement of a production type should be initiated. The problem of freezing in demand oxygen masks has been thoroughly investigated at the Aero Medical Laboratory and by the General Electric Company at Bridgeport, Connecticut. Heaters have been designed which are light and necessary only under extreme low temperature conditions.

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OXYGEN COMBINATION INDICATOR

660-84	Aero Medical Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The oxygen combination indicator is one composite instrument which incorporates the present four standard oxygen instruments, namely; pressure gage, pressure signal assembly, warning lamp, and flow indicator. Development of this indicator was undertaken to reduce the total physical volume occupied by the present instruments in the airplane installation and, accordingly, to facilitate and improve the installation of the oxygen supply lines.

PURPOSE: To design, develop, and test the composite instrument which will incorporate the present four standard oxygen instruments.

AUTHORITY: Chief, Engineering Division.

REMARKS: Sample combination indicators have been fabricated and are now undergoing laboratory and service tests. Present efforts are directed to have the instrument housed in a standard instrument case, no larger than the AN-10401 size case, and limited to approximately 3 inches in depth. All indications--pressure gage, flow indicator, and warning light--will be incorporated on one dial and only two plumbing connections will be provided, one for the flow indicator and one for the pressure gage and signal assembly.

PORTABLE LOW PRESSURE DILUTER-DEMAND OXYGEN ASSEMBLY

660-72	Aero Medical Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Reports from combat theaters indicate a definite need for a "walk-around" oxygen assembly which will possess a longer duration than the present assembly.

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PURPOSE: To develop a larger portable cylinder and a better designed portable regulator, including a mechanism for diluting the cylinder oxygen with air automatically at altitudes where 100% oxygen is not needed.

AUTHORITY: Chief, Engineering Division.

REMARKS: This problem is being approached in three ways:

1. Develop a diluter adapter plug-in assembly which can readily be attached to any standard Type A-13 portable pure demand oxygen regulator.

2. Incorporate such a plug-in assembly as a permanently attached unit tested and calibrated on the regulator by the manufacturer.

3. Incorporate a diluter-mechanism as an integral part of an entirely new designed light-weight portable oxygen regulator assembly.

HIGH PRESSURE CYLINDERS

660-93 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The type of cylinders to be improved were air borne carbon dioxide cylinders to be used in connection with life rafts and fire extinguishers.

PURPOSE: To provide shatterproof air borne cylinders of minimum weight and cost and of such construction to increase cylinder manufacturing facilities and permit the use of less critical materials.

AUTHORITY: Chief, Engineering Division.

REMARKS: Extensive tests conducted have resulted in a light weight, shatter-proof, unreinforced pack raft cylinder of welded construction and made of low carbon steel. Another construction of same capacity is being made by wrapping small tubing about a core.

A cylinder for A-3 raft has been developed of an unreinforced welded construction and is being made of low carbon low alloy steel which is heat treated in a manner which provides a shatterproof construction.

The welded construction developed consists of a double weld, both made by hydrogen atomic means, the prime weld being a fusion of abutting cylinder surfaces and the reinforcing or overlying weld being one using filler rod and applied over the fused material.

LIFE RAFT INFLATION GEAR

660-94 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The equipment to be improved was used as a means for inflating life rafts and consists in addition to a container of a valve, inflation medium, check valves, connectors and means to attach the gear to the raft.

PURPOSE: To provide gear and inflation medium which produces inflation of life rafts at -65°F or at temperatures encountered at high altitudes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Certain improvements have been made in inflation equipment heretofore supplied such as complete redesign of pack raft valve and modification of other equipment and further developments will include redesign of A-3 life raft gear and preparation of a specification for suitable inflation medium.

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SIX-CYLINDER OXYGEN SERVICING TRAILER

660-74
Expenditure Order No.

Aero Medical Laboratory
Mfg. or Activity charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: This trailer is designed to transport six commercial size oxygen cylinders for recharging aircraft oxygen supply systems. The trailer body is similar to that of the standard F-1 Utility Trailer, and is provided with the necessary fittings, regulator, purifier, and connections to permit recharging of both low and high pressure oxygen systems. Development of this trailer was undertaken because of the inadequacy of the present two-cylinder recharger cart.

PURPOSE: To design, develop, and test a servicing trailer capable of transporting six commercial size oxygen cylinders and suitable for recharging both high and low pressure oxygen systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: Owing to the large volume of the oxygen supply systems in present multiplace aircraft, it is necessary that the recharging trailer be capable of carrying an adequate oxygen supply volume, not less than six commercial size cylinders. Also, in view of the dispersed location of aircraft at airfields in the combat zones, the trailer must be sufficiently rugged and durable to traverse all types of terrain. A sample experimental trailer is now undergoing final service tests at the AAF School of Applied Tactics, Orlando, Florida.

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PHYSIO-
LOGICAL

SECTION 2

PHYSIOLOGICAL PROJECTS

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THE HUMAN CENTRIFUGE

696-11
Expenditure Order No.

Aero Medical Laboratory
Mfg. or Activity charged with Development

MX-322
Classified Project No.

(535) AC-40235
Contract No.

DESCRIPTION: The human centrifuge is a turntable forty-eight feet in diameter with two cockpits at opposite points twenty feet from the center of rotation. The cockpits are suspended from beams emanating from a central shaft and traveling in a horizontal plane. One cockpit is equipped with a pilot's seat and the other with a prone position rest. Both are equipped with controls for subject response to visual and auditory stimuli. Near the center are seats and controls for an observer who administers the stimuli and is responsible for the safety of the subject. The machine has a safety factor of three when radial centripetal acceleration with 700 pounds gross load in each cab is 20 "g". The device is rotated by a D.C. mill type motor rated at 250 H.P. at 845 R.P.M. acting through a gear box of 15.6 to 1. Predetermined acceleration patterns are made possible by a photoelectric pick-up device.

PURPOSE: To permit the Materiel Command to safely study the occurrence and prevention of effects of increased "g" in flying personnel.

AUTHORITY: Chief, Engineering Division.

REMARKS: The original cab for use with subjects in the sitting position was replaced in August 1943 by a larger more highly stressed, more accessible cab in accordance with advice from the Aircraft Laboratory. The present cabs, each loaded to 700 pounds, were successfully tested at 20 "g".

As of 27 December 1943, 120 subjects have ridden the centrifuge, some of them on as many as 15 occasions. In routine runs for appraisal of anti-"g" devices, the "g" is reached in between two and three seconds and maintained for 10 seconds. Various "g"-patterns in which acceleration is repeated several times in quick succession, is attained more slowly, or is maintained for periods up to 60 seconds have been studied.

A design for a more elaborate superstructure which will permit study of negative "g" followed by positive "g" has been submitted by the S. Morgan Smith Company of York, Pennsylvania, and recommended by the Aero Medical Laboratory for approval.

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HIGH ALTITUDE INDOCTRINATION

696-34	Aero Medical Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: The most important part of the indoctrination schedule is a high altitude flight in the low pressure chamber during which the trainees make practical use of oxygen and emergency equipment under close supervision of trained personnel. This is supplemented by lectures and films on the physiologic effects of altitude and the equipment for alleviating those effects.

PURPOSE: To device methods for instruction of flying personnel in the physiologic principles of high altitude flight.

AUTHORITY: Chief, Engineering Division.

REMARKS: After certain fatal crashes of P-47 airplanes in flight at 40,000 feet, a Wright Field Investigating Board strongly recommended that a more rigid program of indoctrination be developed to train flyers more intensively in the use of oxygen equipment. Earlier Training Programs provided an excessive amount of time for didactic lectures and classification of personnel with regard to their ability to withstand physiologic effects (bends) of high altitudes, with but little opportunity for the actual use of oxygen equipment.

On 11 December 1942 a new indoctrination schedule for high altitude flyers was established in the Aero Medical Laboratory to meet the needs arising at Patterson and Wright Fields. Since that time much of this schedule has been incorporated in the Air Surgeon's Directive governing the units of the Altitude Training Program of which Wright Field is not a member.

A program of training was also recently initiated at Wright Field for flight personnel such as B-29 squadrons operating pressurized cabin aircraft, and this has been further systematized for use at newly founded B-29 bases and in the course now being taught at the School of Aviation Medicine of Randolph Field.

At present an indoctrination course is being developed in cooperation with the Parachute Unit of the Equipment Laboratory to teach the use of parachutes and methods of escape from high and low levels.

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ANTI-"G" DEVICES

696-37
Expenditure Order No.

Aero Medical Laboratory
Mfg. or Activity charged with Development

MX-389
Classified Project No.

43-32661-E
33-0844-2950-E
Contract No.

DESCRIPTION: Anti-"g" devices under study by the Materiel Command consist of suits in which are incorporated rubber bladders in non-distensible casings. These bladders are inflated with pressurized air during increased "g" and apply pressure to parts of the body below the heart. Two general types of suit are under study. (1) The gradient pressure suit, made by the Berger Brothers Company, New Haven, Connecticut, applies pressure to the regions of the ankles, calfs, thighs, and abdomen. Air from the positive pressure side of the vacuum instrument pump is automatically metered to the suit during increased "g" by a "g"-compensated valve. (2) The Clark-Wood arterial occlusion suit developed by the Mayo Aero Medical Unit with the David Clark Company, Worcester, Massachusetts, applies pressure to the abdominal area and to the thighs. Pressure in the thigh cuffs is great enough to occlude the femoral arteries as well as the leg veins. An electrically driven pump which will develop 10 p.s.i. pressure at 35,000 feet with sufficient output to inflate the suit quickly and the requisite automatically "g" compensated valves have been developed by the Cornelius Company, Minneapolis, Minnesota.

PURPOSE: To critically evaluate the performance of devices designed to prevent the effects of increased "g" on flying personnel.

AUTHORITY: Chief, Engineering Division.

REMARKS: Centrifuge experiments, detailed in Memorandum Report ENG-49-696-51B, entitled Evaluation of Anti-"g" Suits, Report No. 2, showed that the gradient pressure suit offered between 1 and 2 "g" protection against effects of increased "g". Service tests at the AAF Proving Ground Command at Eglin Field, Florida, in September and October 1943, demonstrated that the protection offered by the suit was adequate for modern fighter aircraft, and that its pilot acceptability was satisfactory. The device was demonstrated to the Army Air Forces Board, AAF Tactical Air Command, Orlando, Florida, on 16 November 1943. Action awaits complete testing of the oil vapor separator which removes oil from the air delivered to the suit.

The Materiel Command has cooperated with the Mayo Aero Medical Unit, Rochester, Minnesota, in development of the Clark Wood arterial

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occlusion suit. Centrifuge tests have shown that with full occlusive pressures, protection offered exceeds that offered by the gradient pressure suit. Tests in aircraft indicated that protection was adequate under those conditions. Leg parasthesias resulting when the thigh pressure was prolonged, together with failure of the Cornelius pump, have necessitated its return to the laboratory for further developmental work.

PROTECTION AGAINST DECOMPRESSION SICKNESS

696-18	Aero Medical Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Symptoms of decompression sickness, such as rashes, bends, chokes, collapse, occur sooner or later in most personnel at altitudes above 30,000 feet. Various pretreatments have been tried to prevent or reduce these symptoms.

PURPOSE: To test the efficiency of various types of pretreatments in reducing the number and intensity of symptoms of decompression sickness encountered at high altitudes.

AUTHORITY: Chief, Engineering Division.

REMARKS: Until recently, aeroembolism (bends and chokes) has not presented a serious handicap to high altitude flight operations. Investigative efforts were wisely diverted at the beginning of the War to more urgent problems. Symptoms of aeroembolism rarely occur in flyers below 30,000 feet. In foreign combat theatres few missions have necessitated flights above 30,000 feet, while at domestic training and experimental test air bases few flights above 30,000 feet have involved peak altitude sojourns of long enough duration for development of bends. Aeroembolism may, however, become an important problem in relation to exposure to low barometric pressure after explosive decompression in damaged pressurized cabin aircraft in flight at extreme altitudes, during short periods of flight above 40,000 feet using the positive pressure oxygen system, and in long flights below 40,000 feet using the demand oxygen system in unsealed aircraft.

The causal factors of aeroembolism are unknown. By indirect

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deduction it is reasonable to assume that the painful symptoms of aeroembolism are due to the expansion of nitrogen bubbles that have failed to excape rapidly from the tissues into the blood vascular circulation during ascent to lower barometric pressure in high altitude flight. Various methods of denitrogenation in which body nitrogen is displaced by helium or pure oxygen by treatment prior to ascent have succeeded in preventing or delaying the onset of bends. No other measures have proved to be as effective.

It has been found that pre-oxygenation without exercise prior to flight affords as great protection against aeroembolism at 38,000 feet at room temperature as does pre-oxygenation with exercise. Symptoms of aeroembolism as severe as those at 38,000 feet can be induced at 30,000 feet by excessive exercise at altitude. The same subjects in actual airplane flight at 30,000 feet exhibit greater resistance to aeroembolism than they do in chamber flights at room temperature.

Military personnel previously tested at Ohio State University for tolerance to aeroembolism at 38,000 feet at room temperature have been tested in the refrigerated chamber at Wright Field at 38,000 feet at -40°C., and it was found that they exhibit a greater resistance to bends in the cold chamber. Only a few of these subjects have as yet been tested in actual airplane flight.

PHYSIOLOGICAL REQUIREMENTS OF DEMAND OXYGEN SYSTEMS

696-28 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The success of high altitude flying depends upon a properly functioning oxygen system. The currently used oxygen system is known as a demand system, which is fully automatic and provides the user with the proper amount of oxygen at all but extreme altitudes and under all conditions. The exact specifications for perfect performance of this type oxygen system depends upon facts supplied from studies on the physiology of breathing, more particularly the facts concerning breathing patterns of individuals under different conditions to which flyers are subjected in flight.

PURPOSE: To investigate the effects of high altitude on respiratory regulation and to determine the breathing pattern in relation to specifications for demand type oxygen systems.

AUTHORITY: Chief, Engineering Division.

REMARKS: To accomplish the purpose of this project an optical flow meter has been designed and constructed; This has been used to determine the performance of demand type oxygen regulators and is the most direct means of ascertaining the physiological adequacy of such equipment. This flow meter has also been adapted to tests of adequacy of bail-out equipment, resuscitators, and walk around bottles. Likewise, tests have been made on the performance of oxygen masks and pressure breathing equipment.

An investigation has been made of the characteristics of demand mask leakage. The relationship between inboard leakage of a mask and the area of leaks at various altitudes with the two types of demand regulators in use in aircraft has been determined.

Experiments have been conducted to determine the relationship between pulmonary ventilation and respiratory "dead space" of demand oxygen masks. Results of these tests are used in the design of serviceable masks.

Tests have been made to determine the minimum tolerable ventilation required in pressurized type aircraft. Results show that so far as the accumulation of carbon dioxide indicates tolerable limits, 2 cubic feet of air per person per minute appears adequate. Noxious gases and water vapor condensation have not been fully investigated in these tests.

Investigations as to the physiological effects of pressure breathing have been made to determine the optimum pressure required to give the maximum advantage at various altitudes. Eight inches appear to be the optimum and adequate to 45,000 feet altitude. Pulmonary ventilation, economy of oxygen, respiratory pattern, and maximum inspiratory flows have also been measured.

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OXYGEN REQUIREMENTS AT HIGH ALTITUDES

696-17 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: A continuous supply of oxygen is essential to life. An increased concentration of oxygen is required for increased altitude. The amount of oxygen used by the body increases with physical exertion during exposure to cold, during excitement, and after injury. It is important to know the exact amount of oxygen required during flight under varying conditions. A margin of safety must be allowed, but at the same time any excess supply of oxygen limits the effectiveness of any combat mission by using valuable space and adding weight. Thus a balance between safety and economy should be taken into account with this balance in favor of safety.

PURPOSE: To study the effects of physical activity and of altitude on pulmonary ventilation, maximal inspiratory flow, and pressure in relation to oxygen requirements of flying personnel.

AUTHORITY: Chief, Engineering Division.

REMARKS: Pulmonary ventilation, maximal inspiratory (peak) flow and pressure, and respiratory rate were measured on individuals at rest (sitting) and exercising at four grades of activity at ground level and at the simulated altitudes of 10,000, 20,000, 30,000 and 40,000 feet.

Pulmonary ventilation was determined in these experiments by measuring the drop in oxygen pressure in a D-2 or F-1 oxygen cylinder. An A-14 demand oxygen mask was used by the subject, and oxygen was delivered from the cylinder to the subject through an A-12 (Pioneer) demand oxygen regulator with automix Off. Maximal inspiratory (peak) flow and pressure, and respiratory rate were measured by use of an optical flow meter.

Pulmonary ventilation at ground level was increased by approximately 35, 170, 310, and 420 per cent, respectively, by the four grades of exercise.

Pulmonary ventilation is the same for a given degree of activity from ground level to at least 30,000 feet simulated altitude.

Pulmonary ventilation at 40,000 feet simulated altitude is higher for a given degree of activity than at ground level. The magnitude of this difference increases with degree of activity.

The ratio of maximal inspiratory flow to pulmonary ventilation is higher for a resting than for an exercising individual. This ratio for rest is 3.7 and for exercise is 2.8.

Relatively heavy exercise (5400 foot-pounds per minute) can be carried with safety by a normal individual using demand oxygen equipment at simulated altitudes at least as high as 30,000 feet.

Data contained in this report should be considered in setting up the minimal value of the maximal flow requirements of demand oxygen regulators.

CARBON MONOXIDE KITS

696-29 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: Carbon monoxide normally occurs in the exhaust fumes of aircraft engines. This gas is a source of potential danger when allowed to diffuse into the air breathed by flying personnel. Such a hazard increases with altitude. The deleterious effects of carbon monoxide on the human organism result from a dual action on the blood. The normal uptake of oxygen in the lungs, and the ability of the blood to give up oxygen to the tissues of the body are both affected by carbon monoxide.

Many fatalities in aircraft have been attributed to carbon monoxide poisoning. Proper methods of detection of this gas will reduce the hazards of flying.

PURPOSE: To devise and prepare equipment and methods for determination of carbon monoxide in blood. To train personnel in the technique of analysis.

AUTHORITY: Chief, Engineering Division.

REMARKS: The estimation of the concentration of carbon monoxide in the blood is the most direct means of evaluating the physiological hazards of exposure of flying personnel to carbon monoxide in aircraft.

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An improved and simplified method for determination of carbon monoxide has been developed. A small portable kit has been devised which contains all reagents and equipment required for analyses of carbon monoxide in blood.

About 40 individuals have been trained in the technique of analysis. It was found that a careful operator will obtain an accuracy of about 0.3 to 0.5 volumes per cent of carbon monoxide in blood employing this method and equipment as described.

The Flying Safety Command has made service tests of this kit and report that it is entirely satisfactory. It is also reported to be useful in surveys of possible hazards in various types of aircraft, particularly in P-47 aircraft. A number of kits have been distributed to flight surgeons and avaition physiologists for service testing. Ten kits have been sent to combat theaters.

The maximum concentration of carbon monoxide in aircraft that can safely be tolerated has been established as 0.01 per cent at ground level altitudes and 0.005 per cent when flying above 20,000 feet.

EMERGENCY SOURCES OF WATER

696-32 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: Potability of yields from portable water purification units was determined. The biological availability of the water content of raw fish was measured.

PURPOSE: To evaluate sources and methods for emergency supply of water.

AUTHORITY: Chief, Engineering Division.

REMARKS: A portable water purification unit developed by Bowser and Company of Fort Wayne, Indiana, was field tested in the temperate zone with satisfactory results. Purification units have been shipped to the Mediterranean and Alaskan theaters for further field trial.

Chemical analyses of the water yields from the Permutit Sea

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Water Desalting Bag, model 253, have been made. The chlorides were reduced to one-half per cent and the sulfates to very small amounts in treated sea water. A more complete analysis of the ion composition of the treated water is in progress. The treated water is slightly alkaline, to a degree believed not harmful. Biologic tests are in progress to determine the body's ability to handle this alkali.

It has been suggested from time to time that the water content of raw fish could substitute for drinking water. Further water balance experiments have been carried out with human subjects in which the chief source of water intake was in the form of raw fish meat. These observations have confirmed the results of previous experiments showing that the water contant of raw fish is not utilized by the body and cannot be used as a substitute for drinking water.

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SECTION 3

BIO-
PHYSICS

BIOPHYSICS PROJECTS

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MASKS, OXYGEN

695-25
Expenditure Order No.

Aero Medical Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Various types of oxygen masks, both partial and fullface, incorporating demand and/or pressure-demand principles of oxygen supply are being experimentally developed. Also, masks utilizing mask-contained regulators are under development.

PURPOSE: To design, develop, fabricate, and test partial and full-face demand and pressure-demand oxygen masks of all rubber, all plastic, or combination materials.

AUTHORITY: Chief, Engineering Division.

REMARKS: This project was designed primarily to apply the principles of facial size developed from an anthropometric survey of flying personnel to face pieces incorporated in oxygen equipment. Several projects are now in progress.

1. A pressure-demand type mask, termed XA-13, is in experimental production. It is of partial-face size. This mask may be used either as a demand mask, or may be modified by addition of valves into a pressure-demand type mask.

2. A full-face type, incorporating the pressure-demand principle is being investigated both in rubber and in plastic-rubber combination.

3. A full-face type, incorporating either a mask-contained demand regulator, or a mask-contained pressure-demand regulator is also under investigation.

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PRESSURE BREATHING OXYGEN SYSTEM

695-17 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity Charged with Development
MX-109 Classified Project No.	None Contract Number

DESCRIPTION: A physiological altitude ceiling is imposed on flyers by the necessity of having oxygen, even when pure oxygen is breathed, supplied under some partial pressure before it can be utilized by the body. To raise this ceiling, cabins can be pressurized and/or oxygen can be delivered under pressure during breathing.

A demand type oxygen system to be used for pressure breathing has been developed for use of flying personnel at altitudes of 40,000 to 50,000 feet. Two types of regulators have been developed and tested:

1. Portable regulator, Type A-16. A small, compact demand type regulator which delivers pure oxygen on demand at all altitudes and containing a manual control, spring loaded diaphragm calibrated in inches of water pressure has been developed. This regulator does not contain oxygen dilution mechanism.

2. Stationery regulator. Experimental investigation is being conducted to modify the standard A-12 regulator so that it will incorporate desired pressure breathing characteristics. Several A-12 regulators, so modified, have been tested but to date do not quite meet the desired specifications.

The development of a closed circuit oxygen system where the subjects breath oxygen under pressure from a vest and where exhaled CO_2 is chemically absorbed, has been sacrificed in order to concentrate on the less complex demand type regulator system.

All pressure breathing systems supply oxygen to the lungs of flying personnel at pressures up to 14 inches of water above that of the ambient air.

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PURPOSE: To determine the limits of usefulness of pressure breathing and to develop a pressurized oxygen system so that altitudes of 40,000 to 50,000 feet may be tolerated by humans without the use of pressurized cabins or pressure suits, or if pressure cabins are used, to provide emergency equipment for flying personnel in the event of failure of the pressure cabin.

AUTHORITY: Chief, Engineering Division.

REMARKS: Physiological studies at ground level and altitude have shown that young healthy men can easily tolerate 8 and 10 inches of positive pressure breathing. To date, pressure breathing equipment has been used by approximately 500 individuals, in a total of approximately 1000 man trips in the low pressure chamber to between 42,000 and 50,000 feet at the Aero Medical Laboratory and elsewhere. It has been used successfully for experimental flights in aircraft above 40,000 feet and has been used routinely by members of the 28th and 30th Photographic Reconnaissance Squadrons in operational and tactical flights to high altitudes.

VISUAL STUDIES

695-33 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity charged with development
None Classified Project No.	None Contract Number

DESCRIPTION: This is a general project covering a variety of associated studies relating to vision (including night vision).

PURPOSE: To study methods of improving the visual efficiency of flying personnel in military aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: The following outline suggests the various types of problems which have been studied or are being studied under this project:

1. The Army Air Forces - Eastman Night Vision Tester (Model 2) has been completed and distributed to Army Air Forces Classification, gunnery and research stations.

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2. The relationship between various types of night vision tests has been studied.

3. The effects of moderate anoxia on the contrast sensitivity of the eye have been studied and reported.

4. On the basis of 3. above, the Luckiesh-Moss - Army Air Forces Anoxia Demonstration Charts, Types AAF-1 and AAF-2, were designed. These charts have been manufactured in quantity and have been distributed to all Army Air Forces altitude training units for the indoctrination of flying personnel.

5. Studies of visual fields of various types of flying goggles and goggle-oxygen mask combinations are in progress.

6. Studies on visual distortion in transparent sections of aircraft are in progress.

INTEGRATION OF FLYERS' DIMENSIONS WITH AAF FLYING EQUIPMENT

695-35	Aero Medical Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Military aviation requires the closest integration between man and material, due to spacial limitations imposed by aircraft and to the extremes of altitude and temperature encountered. An aerodynamically and mechanically perfect airplane or gun-turret is useless if flyers cannot fit into it. Close fit of oxygen masks, clothing, and parachute harnesses is essential to survival. To effect such integration, several thousand AAF flyers -- cadets, gunners, fighter pilots, bomber crews, W.A.S.P.'s, and flying nurses -- have been measured. These measurements are being applied to the selection of personnel and to the design and dimensions of gun-turrets, airplanes, and personal equipment.

PURPOSE: To study applications of body size data for AAF flying personnel to the design and sizing of military aircraft and flying equipment.

AUTHORITY: Chief, Engineering Division.

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REMARKS: In addition to providing a source of information on body size in the AAF, there are four (4) main applications of this project:

1. General, including selection of personnel. Relation of body build to susceptibility to high-altitude "bends" is being studied, with the aim of establishing classificatory procedures for aircrew training.

Seven (7) head models and three (3) jointed plastic manikins have been constructed to represent physical types of AAF flyers, and three (3) W.A.S.P. manikins are under construction. These models have proved useful standards for design and sizing; the heads for oxygen masks, helmets, and goggles; and the manikins for cockpit mock-ups.

One-eighth scale, two-dimensional jointed manikins have been supplied to the Aircraft Laboratory and to plane designers for use in blueprints and drawings.

2. Aircraft gun-turrets. All standard and many experimental AAF turrets have been examined for gunner's comfort, efficiency, visibility and safety. Recommendations for improvement have been made, many of which are embodied in present production models. Such data on turrets have been utilized in the steel aircrew helmet program. A study of head and eye movement in sighting is being used in the design of turret sighting panels and gunsight movement. The present upper limits on height and weight of gunners have been established.

3. Airplanes. In cargo aircraft, dimensions and location of seats and windows have been furnished, and a troop seat designed. Mock-ups of experimental planes have been examined from the flyers' viewpoint. Studies on "Safety Engineering" (cockpit design, dimensions of escape hatches, etc.) are contemplated. Comfort, visibility, and range of movements in prone position have been analyzed and harnesses for this position devised.

4. Personal equipment. Tables of Sizes and Percentages of AAF Flyers have been worked out for various garments as a guide in the design, sizing, and procurement of AAF clothing. Oxygen clip tabs are being designed for outer garments. Parachutes for turret wear, and the size and adjustment of parachute harnesses have been analyzed.

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EFFECTS OF EXPLOSIVE DECOMPRESSION ON PERSONNEL

695-32	Aero Medical Laboratory
Expenditure Order No.	Mfg. or Activity Charged with development
None	None
Classified Project No.	Contract Number

DESCRIPTION: In pressurizing military aircraft to attain extreme altitudes, a persistent problem has been the possible effect on personnel of explosive decompression, as might occur in combat. Size of aperture caused by .50 caliber and 20 mm cannon ammunition, and firing tests on XB-29 and XB-32 mockups have been observed. Effects have been noted on scores of human subjects explosively decompressed at simulated altitudes from 20,000 to 45,000 feet, at pressure differentials of 2.75 and 6.55 pounds per square inch, and with varying decompression rates caused by variable size of aperture.

PURPOSE: To determine (1) the effects of explosive decompression on personnel in pressurized aircraft and thereby (2) the degree of pressure differential which may safely be employed.

AUTHORITY: Chief, Engineering Division.

REMARKS: Previously reported results using a water-filled pressure suit showed no observable harm after explosive decompression at a simulated altitude of 45,000 feet with a 2.75 p.s.i. differential which is theoretically equivalent to an 18" diameter hole in a cubic foot pursuit cabin or an 80" diameter hole in a 1000 foot bomber fuselage. Decompression rates were 100-125 p.s.i. per second. Mental and co-ordination tests were well executed immediately after explosion.

Subsequent work has been on actual aircraft.

The rates of decompression of the forward compartment of the XB-32 and the whole fuselage of the XB-29 pressurized to 6.55 p.s.i. were recorded during firing tests with .50 caliber and 20 mm. ball and HE ammunition. The most rapid rate of decompression encountered in these tests was about 20 p.s.i. per second. The largest hole from a single shot was theoretically 24 inches in diameter.

More than 100 explosive decompressions were carried out on 49 subjects utilizing a 45 cubic-foot mock-up of a P-38 cockpit as a pressure container in a low-pressure chamber at a simulated altitude of 35,000 feet. A pressure differential of 6.55 p.s.i. was equalized in 0.075 of a second, for a decompression rate of 87.7 p.s.i. per

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second when a membrane closing 12 inches in diameter was ruptured in these experiments. A 12-inch opening in a 45 cubic foot container is comparable to an opening 5-1/2 feet in diameter in a fuselage of 1000 cubic feet. These experiments demonstrated that the most rapid decompression rates that can be reasonably expected will not injure flyers nor cause failure in the execution of their duties.

A film depicting the apparatus and technique employed in these experiments, and the reactions of several subjects during the explosive decompressions, has been made, with sufficient prints to Army Air Bases training crews for pressurized aircraft.

STUDY TO DETERMINE THE PHYSIOLOGICAL
FEASIBILITY OF FLYING CLOTHING DESIGNED
FOR USE IN ALL CLIMATES.

695-14 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity Charged with development
None Classified Project No.	None Contract Number

DESCRIPTION: The great differences of temperatures between ground level and high altitudes (as great as 140° F. in some instances) present a very special problem in adequately clothing flying personnel. Since the effective heat insulation is a function of thickness of clothing, the problem of bulk and flexibility also arises.

Reports of frostbite from the 8th Air Force have shown that the gunners, and particularly the hands of gunners, have not had sufficient protection.

In July 1943 installation of the low pressure chamber was completed, and in September 1943 installation of the all-weather room was completed. In October an agreement with the Clothing Branch of the Equipment Laboratory was reached to cooperate in the physiological and flight testing of all clothing developed by them.

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PURPOSE: To investigate and to test the physiological and functional adequacy of clothing for flight personnel.

AUTHORITY: Chief, Engineering Division.

REMARKS: Deep body temperatures, skin temperatures, and the metabolic rates of subjects integrated with air movement and the ambient temperature are converted into a measure of clothing insulation, the "Clo" unit.

No insulative clothing is adequate for temperatures below -10° C. (27°F.) for longer than one hour with the subject at rest. If more insulation is added so as to increase the Clo value, the clothing becomes too bulky with the results that the bodily movements of the subject are impeded.

Protection against low temperature may also be obtained by adding electrical heat to clothing. As shown by skin temperature measurements, electrically heated flying clothing has proven adequate for temperatures as low as -40°C. (-40 F.) for better than three hours. But as yet no electrically heated gloves have proven entirely adequate at this temperature.

In studies of the dexterity of gloves by obtaining the time of trained subjects to field strip and assembly a .50 caliber machine gun, it has been found that with the subjects wearing reasonably flexible gloves and with little training there is no difference in the time taken to perform the above operations with the subjects gloved as compared with bare handed stripping of the gun.

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SECTION 4

MEDICAL SPECIALTY PROJECTS

MEDI-CAL SPEC-IALITY

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DENTAL FIELD EQUIPMENT

None
Expenditure Order No.

Aero Medical Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This project covers the development of Dental Field Equipment in the form of lightweight portable chests and mobile truck and trailer units.

PURPOSE: To provide adequate Dental Field Equipment peculiar to the Army Air Forces.

AUTHORITY: Office of the Air Surgeon, Washington, D. C.

REMARKS: Lightweight dental chests and mobile dental units have been urgently needed in the field by the Army Air Forces. The Air Service Command has developed and issued fifty experimental portable dental chests known as "Chest, Dental, Field, Aviation." Each chest, complete weighing only 80 pounds, contains an electric engine, a headrest which may be attached to a common chair, and other necessary items for efficient dental service in the field. This Laboratory has and is giving full cooperation to this project for present and future development.

Three Ordnance Maintenance trucks will be used in the development of mobile dental units. Each truck will contain a complete dental office, and these pilot models will be completed as rapidly as possible, service tested, and immediately shipped overseas. It is estimated that future needs will be approximately fifty mobile dental units.

FIRST AID KITS

None
Expenditure Order No.

Aero Medical Laboratory
Mfg. or Activity Charged with development

None
Classified Project No.

None
Contract Number

DESCRIPTION: This project covers the development, testing and standardization of all types of first aid kits carried in airplanes.

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PURPOSE: To provide suitable first aid equipment necessary for all flying personnel.

AUTHORITY: Office of the Air Surgeon, Washington, D. C.

REMARKS: 1. Conferences have been held, studies have been made, and service tests have been conducted in regard to the alteration of contents and the design of cases for the following first aid kits:

a. Kit, First Aid, Aeronautic.
b. Kit, First Aid, Pneumatic Life Raft.
c. Kit, First Aid, Jungle.
d. Kit, First Aid, Arctic.
e. Kit, First Aid, Parachute.

2. Approval is given of technical orders and publications connected with the use of these kits by Air Force organizations.

3. Information relative to the number of kits per plane, their position in the plane, and instructive charts for their use by personnel in the plane is also provided.

4. Studies are in progress to determine the medical requirements involved in the development of the following kits:

a. Crash First Aid Kit, for Ambulance Use (Proposed).
b. Individual First Aid Kit - Aviators (Proposed).

FROSTBITE

698-13 Expenditure Order No.	Aero Medical Laboratory Mfg. or Activity Charged with development
None Classified Project No.	None Contract Number

DESCRIPTION: A study of frostbite, with particular regard to the vascular and pathological changes and the treatment of (a) the acute phase, and (b) the late stages to prevent loss of function and late complications.

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PURPOSE: To determine the best method of treatment of frostbite.

AUTHORITY: Chief, Engineering Division.

REMARKS: 1. Conferences have been held and literature reviewed to determine the physiological and pathological aspects involved in frostbite, particularly of the type encountered in high altitude flying.

2. Pathological studies have been conducted on animals to determine the relative effectiveness of various proposed therapeutic methods.

3. Clinical studies are being conducted in connection with the Cold Weather Test Detachment at Ladd Field, Fairbanks, Alaska at the present time.

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SECTION 5

SERVICE LIAISON PROJECTS

SERVICE LIAISON

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AIRPLANE AMBULANCE EQUIPMENT

697-11	Aero Medical Laboratory.
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: 1. Airplane Ambulance litter support installations.
2. Airplane Ambulance Chests.
3. Medical Kits for air evacuation by airplane ambulance nurses.
4. Electrically heated sleeping bags for air evacuation of patients.
5. Liaison with other units developing oxygen and other equipment used in air evacuation of sick and wounded.

PURPOSE: To develop airplane ambulance equipment by means of which suitable cargo airplanes, helicopters, and gliders can be quickly converted for ambulance use with minimum interference with other functions of subject aircraft.

AUTHORITY: Chief, Engineering Division.

REMARKS: 1. A webbing strap type litter support installation, which weighs very little, stows easily, and is easily maintained under field conditions, has been developed in conjunction with the Aircraft Laboratory. This installation has been approved for all production C-47, C-46, C-54A, and C-87 aircraft and will soon replace earlier metal litter supports originally designed by individual contractors.

2. A stanchion type litter support installation for modification of Air Transport Command C-46, C-54A, and C-87 aircraft already in service has been inspected and approved in accordance with space and structural requirements specified by the Aero Medical and Aircraft Laboratories.

3. A standard of spacing of litter supports has been developed, in conjunction with the Aircraft Laboratory and Miscellaneous Projects Branch, Aircraft Projects Section in order that litters of Allied Nations can be accommodated and that litter support spacing corresponds to that proposed for tie-down patterns of the Sub-Committee on Standardization of the Joint Aircraft Committee.

4. Airplane Ambulance Chests and Chests for nurses involved in the evacuation of sick and wounded by air have been developed.

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5. Tests are being conducted to determine human requirements for electrically heated sleeping bags for cargo aircraft and casualty bags for combat aircraft.

6. Medical requirements for airborne Group Aid Station equipment and airborne prefabricated shelters for medical use have been determined.

7. Quick detachable litter support installations for various types of bomber aircraft have been developed and tested.

8. Liaison has been maintained with other specialized agencies in the development of oxygen for use in air evacuation of sick and wounded.

9. Liaison has been maintained with all military and civilian agencies involved in the development, testing, and standardization of subject equipment.

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Radio
Lab. Projects

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AIR-PLANE EQUIP-MENT

SECTION I

AIRPLANE RADIO EQUIPMENT

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COMMAND SETS

Fairchild Aviation , Jamaica, N.Y.
Colonial Radio, Buffalo, N. Y.
Bell Telephone Labs., New York, N.Y.

742-304
Expenditure Order No.

Mfg. or Activity Charged with Development

W-535-SC-575
W-535-SC-737
W-2126-SC-387
Contract Number

304A
Classified Project No.

DESCRIPTION: a. V H F, Low Powered Radio Transmitter and Receiver utilizing electronic oscillator to replace crystal control.
b. 8-channel, low powered VHF set, with channel changes based on changing crystal units.

PURPOSE: To provide command communication facilities in aircraft.

AUTHORITY: Letter OCSigO, 17 January 1942, file 413.44.

REMARKS: Delivery of a model VHF command set without crystal control is expected from Fairchild Aviation Corporation early in January 1944. Because development progress has been slow and crystals are now available in quantity, ARL has recommended that contract with Bendix Radio authorizing development work on command sets with reduced number of crystals be cancelled. Bendix is agreeable to the cancellation.

Development of 8-channel VHF components for the SCR-274-N have been underway at Bell Telephone Laboratories and Colonial Radio Corporation. The radio set is automatic in that channels may be changed by merely changing crystals. Preliminary models of the Western Electric design were flight tested at Wright Field 30 September 1943. Performance of the models were satisfactory, but the contractor has encountered delays in obtaining parts for the mechanical channel-selecting mechanism. It is anticipated that one model of Radio Set AN/ARC-e (XA-1) will be delivered to ARL in January 1944. Colonial delivered a model of AN/ARC-3 (XA-1) to ARL in October for test, and has been requested to modify the control box to place the buttons on the top and in the same order when mounted on either side of the plane, and an imporved noise limiter was also requested.

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LIAISON SETS

742-304	General Electric, Schenectady, N.Y. Wells-Gardner Co., Chicago, Ill. Collins Radio Co., Inc., Cedar Rapids, Iowa.
Expenditure Order No.	Mfg. or Activity Charged with Development.
304-B	W-535-SC-684 Noas-73238
Classified Project No.	Contract Number

DESCRIPTION: Liaison transmitter capable of being remotely controlled including frequency selection. Transmits on any one of eleven preset frequencies. Ten of the frequencies are in the frequency range of 2000 Kc to 18,100 Kc., and one is in the frequency range 200 Kc to 1500 Kc. Uses the BC-348 receiver.

PURPOSE: To provide communication between aircraft and ground station.

AUTHORITY: TWP-3 from OCSigO, date 25 March 1942.

REMARKS: Testing of eight ATC transmitters, incorporating the latest modifications was begun by ARL in September; nomenclature Radio Transmitter AN/ART-13 has been assigned. Procurement of 42,000 AN/ART-13 sets has been initiated with deliveries to start by diversion of 4000 sets now on Navy contracts. A sample receiver, to serve as a companion receiver to the ATC transmitter, is to be delivered by RCA Victor Division to ARL, early in January.

In December, contract was awarded General Electric Company to develop a new, crystal-controlled, liaison transmitter covering the frequency range 2-18 Mc. and providing CW emission only.

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INTERPHONE EQUIPMENT FOR MILITARY AIRCRAFT

Cruft Laboratory - Harvard SC-48 (NDRC)
Psycho-Acoustic Laboratory - Harvard SC-48 (NDRC)
Cambridge, Mass.
Mfg. or Activity Charged with Development

742-305
Expenditure Order No.

ARL-305
Classified Project No.

None
Contract Number

DESCRIPTION: Interphone equipment including interphone amplifiers, jack boxes, and radio range filters for the subject interphone equipment.

PURPOSE: To develop interphone equipment suitable for providing intraplane communication when used by personnel equipped with standard A.A.F. microphones and headsets.

AUTHORITY: Military Characteristics approved in letter from Chief, Signal Officer to Aircraft Radio Laboratory, dated 29 December 1939, file OCSigO 413.44 A.F (8-8-39).

REMARKS: ARL-161-2. Development of an interphone amplifier to replace BC-347-C and to operate from a 24-28 volt primary power source, without any additional high voltage power supply, has been completed. This amplifier uses three Type 28D7 vacuum tubes and provides approximately 1 watt power output and will satisfactorily operate up to 15 headsets (high or low impedance). A modified model of the ARL-161-2 has been made to include a manual sensitivity control which affords increases in sensitivity of 6, 8, 12 and 16 decibels. This amplifier has been sent to the ARL Audio Branch at Eglin Field for tests in aircraft.

Interphone Amplifier Compensated for Operation at Altitude. A development model amplifier, completed in July 1943, includes a pressure-operated switch provides for an increase in sensitivity at an altitude of approximately 20,000 feet. This amplifier is similar to ARL-161-2. Further development work on pressure-operated devices, which will afford two-step compensation, is under way.

Jack-Boxes. A development order has been placed for a jack box similar to BC-366 except that the case and cover shall be made of plastic material. This development is progressing slowly.

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A volume control suitable for use in circuits which will connect directly to the low impedance taps on the various radio equipment has been developed. No action on procurement has been taken pending final decision as to when low impedance circuits will be used.

Interphone systems. In September 1942, development work was started on a new interphone system for multi-place aircraft. An experimental model equipment was constructed in December 1942. In April 1943, a model of the system (AN/AIC-1 (XA-1)) was completed and installed in a B-17F airplane. This system is undergoing tests at Brooksville Field, Florida, Army Air Base. This equipment includes Interphone Amplifier ARL-161-2 and is provided with relay circuits which permit individual control of the interphone and radio channels.

The "A" and "B" boxes for one complete installation of the XA-2 system, which also employs relays, is being developed for tests in comparison with the "(XA-1)" system at Brooksville Field was complted in July 1943. This system differs somewhat operationally from the (XA-1). Upon completion of the equipment, it will be installed in a B-17 airplane for test at Brooksville.

Pre-Amplifiers. A developmental model of an AVC type pre-amplifier was completed in June 1943. This amplifier is designed to provide essentially constant output with a variation in input voltage of approximately 20 decibels (to compensate for loss in speech levels at high altitudes). This amplifier has been sent to the ARL Audio Branch Laboratory at Eglin Field, Florida, for test in aircraft.

A developmental model manual volume control which includes a 6-position switch for selecting gain values of 0, 6, 8, 12, 16, and 20 decibels, has been completed. This pre-amplifier has been sent to the ARL Audio Branch Laboratory at Eglin Field for use in determining the gain which will be optimum for various altitudes.

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TOW PLANE TO GLIDER

COMMUNICATION SYSTEM

.. .742-304
Expenditure Order No.

United Cinephone Company
Halstead Traffic Communication
Union Switch and Signal Co.
Mfg. or Activity Charged with Development

304-C
Classified Project No.

W-535-SC-703
W-535-SC-719
Contract Number

DESCRIPTION: Consists of an Interphone Adapter for extending the Interphone facilities from Interphone equipment RC-35 or RC-45 on the Tow Plane to the Glider. A three conductor cordage attached to the tow rope provides the electrical link.

PURPOSE: To provide Tow Plane to Glider Communication.

AUTHORITY: TWP-1 from OCSigO, dated 4 September 1942.
IOM from Materiel Command to ARL dated 21 August 1941.

REMARKS:

Three different systems are under development -- induction type, radio and telephone. Development contract with Halstead Traffic Communications Corporation was cancelled in October following tests with a FM induction field communication system because of the space and weight requirements.

Bench tests on a Union Switch and Signal Company model were begun in November. Flight tests were begun in November on a radio communication system model manufactured by United Cinephone Company. This is commercial equipment already in use by the Navy.

Production of AN/AIA-1 is being accomplished by Bell Sound Systems on Order No. 63-DAY-44. This is a telephone type set. Investigation and development work relative to interphone communication for "double tow" (one plane towing two gliders) and tows from a P-38 airplane have been initiated by ARL.

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HEADSETS FOR MILITARY AIRCRAFT

Cruft Laboratory - Harvard SC-48 (NDRC), Cambridge, Mass.
Psycho-Acoustic Laboratory - Harvard SC-48 (NDRC) Cambridge, Mass.
Bell Telephone Laboratories, N.Y.,
W.E.Shure Bros., Chicago, Ill.
Permoflux Corp.
Mfg. or Activity charged with Development.

742-303
Expenditure Order No.

Classified Project No.

W-535-SC-695 (Permoflux)
Contract Number

DESCRIPTION: Investigation of new technique of headset construction and establishment of standards of headsets response, articulation, etc. for headsets used in military aircraft.

PURPOSE: To develop headsets for use by personnel in military aircraft.

AUTHORITY: 3rd Ind., Chief Signal Officer to Aircraft Radio Laboratory, dated 24 May 1937, file OCSigO 413.44.

REMARKS: Cushion MC-162, part of Headset Hs-23 has been modified twice in order to provide greater output and slightly improved acoustical characteristics. Cushion MC-162-A, different in design from the MC-62, was developed in July 1940, and was standardized as a second type to be made available for issue for use with HS-23 early in 1941. Improvements in MC-162-A have been made within the past year. Specifications and drawings covering Cushion M-301, modeled after Harvard design 6B ear cushions, were prepared in July 1943. This cushion affords the best noise exclusion for any cushion developed to date and is more comfortable than other types, with the possible exception of Cushion MC-162.

A new headset, H-3/ARR-3, has been developed for special applications where an essentially flat response over the 100 to 6000 cps audio frequency range is required. Eighty of the 200 Headsets H-3/ARR-3 (XA-2) were received from Permoflux Corporation in July, 1943. Delivery on this order was progressing slowly in September with from 15 to 20 per cent of the headsets furnished being rejected for defects in the moving coil receivers. Although some of the receivers did not meet requirements, they were usable and were accepted because of the urgent need. In October 1943, the company was granted an extension of time to permit new tooling.

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In July, 1943, the Bell Telephone Laboratories, at the request of ARL, furnished 20 receivers of the ANB-H-1 type, which has been modified for optimum performance at approximately 40,000 feet altitude. Shure Brothers began making design changes in October in the cap for this receiver in an attempt to extend the upper range of the receiver.

An ARL Audio Branch Laboratory, Eglin Field, Florida, was established in April 1943 for the purpose of supplementing the work done at Aircraft Radio Laboratory.

Cruft Laboratory and Psycho-Acoustic Laboratory at Harvard University have been working on acoustics, as related to the problems of the Armed Forces, since 1943 under an NDRC contract. In 1943, a project (Project SC-38) was set up by the Signal Corps in order that the work being done at Harvard might be directed toward the solution of our immediate problems. Liaison is maintained between the laboratories at Harvard and Aircraft Radio Laboratory.

MICROPHONES FOR USE IN MILITARY AIRCRAFT

742-302 Expenditure Order No.	See "Remarks" Mfg. or Activity Charged with Development
ARL-302C Classified Project No.	W-33-038-SC-31 Contract Number

DESCRIPTION: Microphones are of the hand-held type, throat type and mask type, and include both carbon and magnetic devices. Microphone amplifiers and microphone adapters are also included in this project.

PURPOSE: To develop microphones for use by personnel in military aircraft.

AUTHORITY: 2nd Indorsement, Chief Signal Officer, to ARL, dated 21 February 1936.

REMARKS: Bell Telephone Laboratories have been furnished with three flying helmets for use in preparing a quotation (for Western Electric Company) on a quantity of 500 face pieces for Microphone M-1/A. The M-1/A will be designed so that it may be used either with or without the helmet. Articulation tests (in aircraft) of a developmental model Microphone T-43, without suitable harness, are on the program of the ARL Audio Branch Laboratory at Eglin Field. A development contract (W-33-038-SC-31) was placed with

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Western Electric on 2 September 1943 for 500 face pieces for Microphone T-43. In October, Bell Telephone Laboratories reported that they had completed the development of the suspension harness for the face piece of this microphone. A model on the developmental contract for 500 face pieces was submitted 10 November 1943 and flight tests were begun.

The manufacturers and laboratories interested in this development are as follows:

Cruft Laboratory - Harvard Project SC-48 (NDRC Cambridge, Mass.

Psycno-Acoustic Laboratory - Cambridge, Mass.

Bell Telephone Laboratories, New York, N. Y.
Western Electric Company, Jersey City, N. Y.

ANTENNA SYSTEMS AND EQUIPMENT FOR AIRCRAFT

742-301A Expenditure Order No.	Transcontinental and Western Airlines Purdue University Mfg. or Activity Charged with Development
ARL-301-E Classified Project No.	W-33-106-SC-70 W-33-038-SC-19 Contract Number

DESCRIPTION: Static discharger assembly AN/ASA-1A is a wick type discharger consisting of a cylinder 1/2" x 10" which silently discharges small currents into the air.

PURPOSE: To develop a means for discharging accumulated precipitation static charge on aircraft while in flight.

AUTHORITY: 1st Indorsement from AGO to CSO dated 1 September 1939 (8 August 1939).

REMARKS: Dust static tests made in an A-20-C airplane at Blythe Field indicated that severe static may occur in localized areas, but that these areas are so small as to preclude measurement of the charging rate of the dust, and probably could be easily avoided in flight.

The Army Air Forces decided to install NRL wick-type static dischargers in all multi-motored bombers and cargo carriers. The wick will be a Signal Corps item and installation was to be under

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ARL direction. This was assigned nomenclatures AN/ASA-1A, covering two types of mounting brackets.

A technical order for the operation and maintenance of these static discharger assemblies was in preparation in December and procurement information in connection with purchase of 196,250 Static Discharger Assemblies, AN/ASA-1A, was supplied.

ANTENNA SYSTEMS AND EQUIPMENT FOR AIRCRAFT

742-301A Expenditure Order No.	Ohio State University, Columbus, Ohio Mfg. or Activity Charged with Development
ARL-301A Classified Project No.	W-535-SC-595, Order#456-ARL-43 Contract Number

DESCRIPTION: Field patterns, propagation characteristics, measuring technique and antenna design.

PURPOSE: To develop the optimum in antenna systems and equipment.

AUTHORITY: 1st Indorsement AGO to CSO, dated 7 September 1939, (8 Aug. 1939).

REMARKS: On 5 September 1943, a contract was let to Ohio State University to make a study of field patterns and radiation characteristics of antenna. This study is scheduled for completion in March 1944.

VHF Homing Antennas. Ground tests were made on VHF homing antennas located on opposite sides of the fuselage of the laboratory arrangement which simulates radiation conditions on a P-40 airplane. Patterns obtained were unsatisfactory at some frequencies. Flight tests and patterns were made on two antennas located on sides of the fuselage of an AT-11 airplane. Results were not entirely satisfactory, and it now appears that the homing antennas will have to be located side by side in the clear on top of the fuselage, even though this limits the frequency range and requires critical terminating impedances.

Dummy and Phantom Antennas. Samples of dummy antenna for the SCR-522 were received from the Jackson Electrical Instrument Company in July and were found to be satisfactory with minor exceptions. Specifications for this antenna were completed in August but procurement was temporarily delayed because of objections to the requirement that exactly the same length of transmission line be used by the SCR-522-( ) in the phantom as would be used in the

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actual antenna of the airplane. This requirement is basic since transmission line length is a primary factor in determing both loading and tuning of transmitter. Nomenclature for this dummy antenna is A-30-( ) and is incorporated in test set I-96 used to test radio set SCR-522-( ). Three service test samples were delivered to ARL by the Jackson Electrical Instrument Company on 18 November 1943. No further work has been done on the antenna pending testing of the subject samples. Laboratory models of dummy antenna for the fixed antennas used with the SCR-274-N and SCR-287 were completed in August. Further experimental models of antennas for use in the range 225-285 mcs. have been constructed by the laboratory. It now appears that standing wave ratio of better than 1 1/2 to 1 can be achieved over this frequency range.

AUTOMATIC ALARM RECEIVER FOR AIRCRAFT

742-304E
Expenditure Order No.

ARL-304-E
Classified Project No.

Warwick Manufacturing Co.
Chicago, Illinois
Mfg. or Activity Charged with Development

1521-ARL-44
Contract Number

DESCRIPTION: An automatic alarm receiver for aircraft designed to receive a fixed 500 KC., MCW Signal. Upon receipt of signal a light is flashed on at the receiver and also at some remote indicator. Sensitivity such as to assure reception of distress signal from Radio Set SCR-578-( ) at a distance of 150 miles or more over water.

PURPOSE: To provide Automatic reception of distress signals from Radio Set SCR-578-( ).

AUTHORITY: 3rd. Ind. OCSigO to ARL, dated 8 July 1943.

REMARKS: In compliance with a 3rd Ind. from OCSigO to a basic request of the AAF, military characteristics were submitted to OCSigO in August for a fixed-tuned, 500 Kc, receiver to be used as an emergency alarm receiver in Army aircraft. Packard-Bell Company submitted a model receiver, but it was not satisfactory.

Development contract was awarded the Warwick Manufacturing Company and first model was delivered to ARL 15 November 1943 for test.

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RADIO NAVIGA-TION

SECTION 2

RADIO NAVIGATION EQUIPMENT

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RADIO COMPASS, LOW AND INTERMEDIATE FREQUENCIES

742-101A
Expenditure Order No.

Bendix Aviation Corp.,
Towson, Md.
Fairchild Aviation Corp.,
Jamaica, N.Y.
Mfg. or Activity charged with Development

ARL-101A
Classified Project No.

W-535-SC-611
W-535-SC-626
Contract Number

DESCRIPTION: Automatic radio compass equipment provides means for automatically indicating the direction toward a radio transmitting antenna when the radio station frequency is "tuned in". The equipment consists of receiver unit, streamlined loop antenna assembly for mounting outside of airplane, remote control boxes, remote bearing indicators, and a relay for switching remote control positions. Typical receiver units have a frequency range of 100 to 1750 KC.

PURPOSE: To develop a radio compass which will operate automatically to provide "homing" operation and also to permit the pilot or navigator to determine quickly and with reasonable accuracy radio fixed without changing the airplane from its desired course.

AUTHORITY: a. Military Characteristics for Radio Compass AN/ARN-6 approved at Signal Corps Technical Committee Meeting No. 230 on 14 September 1942.

b. Military Characteristics for Radio Compass AN/ARN-7 approved at Signal Corps Technical Committee Meeting No. 243 on 14 December 1942.

REMARKS: Development of an improved type of automatic radio compass is under way at both Fairchild Aviation Corp. and Bendix Radio. The new radio compass is called AN/ARN-6 and is a new development to meet the Joint Aircraft Committee Case 205 requirements, and will not be produced prior to 1944. One of the basic requirements of Joint Aircraft Committee Case 205 is that the automatic radio compass cover a frequency range of 100 KC to 1750 KC. To provide an interim equipment between the SCR-269 and the AN/ARN-6, the SCR-269 was modified to include a fourth band covering the 100-200 KC frequency range. This new equipment is called Radio Compass AN/ARN-7 and production has been started by Bendix. Deliveries will begin about February 1944.

Development contracts have been awarded to Bendix Radio and Fairchild Aviation for the AN/ARN-6. The Fairchild model was delivered to ARL for testing in December. Delivery date of the Bendix model has

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been tentatively set for February, 1944. The first satisfactory model will be approved for production as the new standard equipment.

RADIO COMPASS ADAPTER AN/ARA-1(XA-1)

742-101C	International Industries, Inc. Ann Arbor, Michigan
Expenditure Order No.	Mfg. or Activity Charged with Development
ARL-101C	2094-ARL-43
Classified Project No.	Contract No.

DESCRIPTION: A light weight modulator unit and accessories which can be used in conjunction with Radio set SCR-274-N receiver components to provide left-right radio compass facilities, modulator unit mechanically interchangeable with receiver components of the SCR-274-N single control tuning.

PURPOSE: Provides normal relatively non-directional reception suitable to radio range flying in addition to visual left-right compass reception or aural-null operation and to permit remote selection of the three types of reception.

AUTHORITY: Revised Research & Development Program 1943.

REMARKS: The two preproduction models of Radio Compass Adapter AN/ARA-1 (XA-1) on Order No. 2094-ARL-43 were delivered 18 June 1943 for testing. One model with a sample iron-core loop was installed in a C-39 airplane and flown to Washington, D. C., on 1 July 1943 for demonstration to interested Air Corps and Signal Corps officers. International Industries, Inc., completed its development contract (Order No. 2094-ARL-43) for ten sample compass modulator units. A letter was written to OCSigO recommending procurement of this unit for fighter airplanes, and as a stand-by unit for larger airplanes. The specification was written for Radio Compass (Adapter) AN/ARA-1(XA-1) for use on a proposed procurement of approximately 6,000 units, and forwarded to the Specification and Nomenclature Branch at the Laboratory. It is understood, however, that the proposed procurement for these units has been cancelled. The specification and drawings are being completed for use on any future procurement program.

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INSTRUMENT LANDING AND APPROACH SYSTEMS

742-102A Expenditure Order No.	Emerson Radio & Phonograph, Philadelphia, Pennsylvania. Warwick Mfg. Co., Chicago, Illinois. Bendix Aviation, Ltd. Baltimore, Maryland. Crosley Corporation, Cincinnati, Ohio. Mfg. or Activity Charged with Development
ARL-102A Classified Project No.	W-535-ac-699, W-535-ac-728 W-535-ac-729, W-535-ac-704 Contract No.

DESCRIPTION: Instrument landing system comprising a runway localizer to provide lateral guidance of aircraft into air field, and a straight line glide path for vertical guidance. The ultimate goal is a system for landing military aircraft without visual reference to the ground, and requiring a minimum amount of pilot skill and experience.

PURPOSE: To conduct research and development in the genral field of instrument landing to enable the Army Air Forces to follow closely the work being done by other agencies in the field in order to permit adoption of system suitable for Army use.

AUTHORITY: The present program is based on a recommendation made by the Signal Corps Technical Committees Meeting No. 170, June 19, 1939 and approved by 1st Indorsement from the Adjutant General's office to Chief Signal Officer dated 7 September 1939.

REMARKS: (a) Development work on AN/CRN-2, UHF Glide Path Equipment, has been completed and procurement initiated in January, 1943.

(b) Design of an Air-Transportable Localizer Equipment, AN/CRN-7 has been completed with the assistance of Warwick Mfg. Co. and in May, 1943 a development contract with this company was initiated.

(c) Super-Regenerative Glide Path Receiver. In July, 1943, one Bendix Model super-regenerative glide path receiver was under test at ARL, and Emerson Radio and Phonograph Corporation was continuing development of a similar receiver. The sample Emerson-developed receiver, produced on a development contract, was submitted to ARL in November. It was tested and accepted on the development contract only, subject to several minor changes on the remaining receivers on order.

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Super-regenerative glide path receivers were delivered by Bendix Aviation, Ltd., on Order 2055-ARL-43 in August but were not entirely satisfactory for production purposes. Specifications were modified in April to permit immediate production of 27 receivers for use at AAFSAT, Orlando, Fla. These were ordered on contract W-535-SC-728. One ARL representative was sent to Bendix to expedite delivery of the sample on Orders 11942-WF-43 and W-535-SC-728. The latter was delivered on 20 September 1943. It was found that several improvements were necessary before production could proceed. The major defect was the vibration characteristic which caused failure of several tubes during the test. Delivery of the final preproduction sample of this receiver, R-47/ARN-5, was expected early in January, 1944.

(d) Super-Heterodyne Glide Path Receiver. Crosley Corporation informally submitted a sample of this type receiver to ARL on 4 September 1943, for test. The first model was accepted but additional development work was required on the remaining receivers on contract W-535-SC-704. The final preproduction model of this receiver R-57/ARN-5, was received in December, 1943.

AUTOMATIC FLIGHT CONTROL EQUIPMENT

742-102-D Expenditure Order No.	Aircraft Radio Laboratory Mfg. or Activity Charged with Development
102-D Classified Project No.	None Contract No.

DESCRIPTION: Electrical control of the direction of airplane flight by means of a signal from the SCR-269-( ) Radio Compass. The Signal is taken from the selsyn indicator system of the radio compass and inserted into the rudder and aileron control circuit of the C-1 autopilot. Operation of the device is such that the plane may be set to fly at any angle with respect to the incoming radio wave to which the radio compass is tuned.

PURPOSE: To develop equipment for automatic control of airplane flight.

AUTHORITY: By 1st indorsement dated 22 May 1943 from Chief Signal Officer.

REMARKS: Of the various systems under study and development, the automatic flight control equipment for use with the A-2 Gyro-pilot has been tested and modified. This equipment operates as a link between the

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outputs of the instrument landing equipment, Radio Receiver RC-103-( ) (localizer) and Radio Receiver R-47/ARN-5 (glide path) and the gyro-pilot. Tests indicate the equipment is partially satisfactory.

A final model of a Radio Compass adapter has been constructed and submitted to AAF to be used as a basic for procurement.

MARKER BEACON SYSTEMS, AIRBORNE AND GROUND EQUIPMENT

742-103
Expenditure Order No.

Air Track Mfg. Company,
College Park, Maryland.
Federal Tel. & Radio Corp.
Mfg. or Activity Charged with Development

ARL-103
Classified Project No.

W535-SC-401 , W535-SC-554
Contract Number

DESCRIPTION: Portable radio transmitting equipment to radiate 75 megacycle signals in a vertical fan-shaped pattern. Equipment includes a transmitter suitably modulated and keyed, a self-contained antenna, a monitor and alarm circuit. A simplified model without keying, monitor, or alarm circuit is supplied for battery operation.

Portable radio transmitting equipment to radiate vertically polarized VHF signals for reception by fighter aircraft. Equipment includes a transmitter, suitably modulated and keyed, gasoline-driven power supply, and directional antenna array.

PURPOSE: To develop portable marker beacon transmitting equipment suitable for use in conjunction with marker beacon receivers or UHF command sets in Army aircraft.

AUTHORITY: Military Characteristics recommended by Signal Corps Technical Committee No. 170, 19 June 1939, and approved by 1st Indorsement from the Adjutant General's Office to the Chief Signal Officer, dated 7 September 1939, (8-8-39) subject, "Military Characteristics of Signal Corps Equipment."

REMARKS: Former development has led to the production of Marker Beacon Transmitter BC-302. The characteristics of an improved Marker Beacon transmitter for instrument landing tracks were discussed with representatives of Air Track Manufacturing Company and Jackson Electrical Instrument Co. during July, 1941. Contracts to develop a transmitter were awarded to both manufacturers and when the models were presented,

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the design submitted by Air Track Manufacturing Company was selected for further development work. A contract to supply the Aircraft Radio Laboratory with ten improved transmitters was awarded 2 March 1942.

Tests were made on a vertically polarized marker for UHF radio ranges and later abandoned in favor of a horizontally polarized system. Tests indicated that the later system was satisfactory for use with the vertical mast antennas used with the SCR-522 receivers.

Military characteristics of Marker Beacon Transmitting Equipment AN/CRN-6(XA) were approved 7 June 1943 at SCTC Meeting No. 266. On June 1943, ARL was directed by OCSigO (SPSAR-2) to develop the marker beacon transmitting equipment necessary to meet the characteristics. In July, Aircraft Radio Laboratory began building a development model transmitter, using Radio Transmitter BC-625-A (part of SCR-522) as the basic element. (Work on Marker Beacon Transmitting Equipment RC-216 was discontinued as AN/CRN-6(XA) will serve the same purpose.

Lack of sufficient personnel and higher priority of other projects has resulted in a minimum of development work on this project. Principal effort has been made toward the development of an antenna which will meet the military characteristics.

RADIO LOCATOR BUOY AN/CRN-1

742-103-E Expenditure Order No.	Hughes Aircraft Corp., Culver City, Calif. Wells-Gardner & Co., Chicago, Illinois Mfg. or Activity charged with Development
ARL-103-E Classified Project No.	W-535-SC-635;W-535-SC-636 Contract Nos.

DESCRIPTION: A low frequency radio beacon housed in a water-tight case which can be dropped from aircraft by means of a parachute, to the sea, to mark a spot on the water, to which airplanes can home, by use of radio equipment normally carried in medium and heavy bombers. It is capable of operation for a period of 12 hours and then sinks.

PURPOSE: To develop an expendable homing beacon for aircraft.

AUTHORITY: Military Characteristics for Radio Locator Buoy AN/CRN-1 were approved at SCTC Meeting No. 239 on 16 November 1942.

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REMARKS: Project was initiated in the latter part of 1942 and two development contracts were made with Hughes Aircraft Corporation and Wells-Gardner & Company. The Wells-Gardner contract for 10 experimental models has been completed and tests have proven successful.

ARL-Wells-Gardner Buoy

In July development work on this project was centered in the improvement under Contract No. W-535-SC-636 of three new models according to Specification No. 271-1761. The new design case, submitted to ARL in August, was loaded with simulated weights and dropped into the Ohio River from 700 feet. As the container showed no signs of damage, it was scheduled for use in the three new models. Design of the parachute container was agreed upon between ARL engineers and representatives of General Textile Mills at a conference 9 September 1943. Development accomplishments of the past six months include: Discarding of Amglo light, reduction in antenna weight through use of aluminum tubing instead of steel, use of duraluminum for transmitter supports.

Hughes Buoy

Following tests at Langley Field in July, 1943, decision was made to redesign this buoy to increase the range and water stability and improve identification. Hughes Aircraft Corporation redesigned the equipment, under Contract No. W-535-SC-635, substituting plastic plywood for the metal and plexiglass case. First of three preproduction models was delivered to ARL 8 November 1943 and was given preliminary bench tests. The model was then taken to Washington, D. C., by ARL and Hughes personnel for demonstration before Army official and for drop tests at Langley Field. Because of antenna failures, modifications will be necessary before further tests are made. Prior to the antenna failure, however, a signal was received for 38 miles and performances seemed satisfactory.

U.H.F. AURAL RADIO RANGE

742-104A Expenditure Order No.	Federal Tel. & Radio Corp. Mfg. or Activity charged with Development
ARL-104A Classified Project No.	W-535-AC-450 Contract No.

DESCRIPTION: A two course aural ultra high frequency radio range AN/MRN-2 provided with periodic station identification, periodic sector identification and simultaneous voice broadcast. The entire equipment,

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including gasoline driven power supply, is housed in a truck type K-53. The design will be such as to allow complete setup in less than two hours. Complete monitoring equipment and a cone of silence transmitter are included. The equipment may be adjusted to work at any frequency between 100 and 156 mc when provided with an appropriate crystal. The carrier output rating is 100 watts.

PURPOSE: To provide a portable ultra high frequency radio range for use with military aircraft which are equipped with standard UHF receiver.

AUTHORITY: Military characteristics approved SCTC Meeting No. 211, 30 March 1942. Revised Meeting No. 232, 28 September 1942.

REMARKS: Specifications were prepared for procurement of service test models in accordance with the Military Characteristics recommended by the Aircraft Radio Laboratory and approved by the Signal Corps Technical Committee. The Aircraft Radio Laboratory proceeded with procurement of a service test model as directed by teletype dated 2 March 1942 from Chief, Signal Officer. A letter of intent was issued to the Federal Telephone and Radio Manufacturing Corporation on 3 April 1942, for two equipments in accordance with Aircraft Radio Laboratory Specifications No. ARL-120. A contract was let to cover the same on 15 June 1942.

Two model equipments AN/MRN-2 have been delivered on this contract by Federal Telephone and Radio Manufacturing Corporation. Successful laboratory tests were made and one equipment was sent to AAFTAC, Orlando, Florida, for further tests. Production on this equipment and the similar set, AN/CRN-5, is progressing satisfactorily and deliveries are expected in March, 1944.

U.H.F. OMNI-DIRECTIONAL RADIO RANGE

742-104B
Expenditure Order No.

Federal Tel. & Radio Corp.
Air Associates, Inc.,
Los Angeles, Calif.
Mfg. or Activity charged with Development

ARL-104B
Classified Project No.

W-535-SC-557
W-535-SC-556
Contract Nos.

DESCRIPTION: A continuously rotating radio beam with direction identified for each 15 degrees of azimuth. The directional identification is secured through transmission of an International code character. The sidebands only are transmitted on the beam while

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the carrier is broadcast on a separate non-directional antenna. The entire equipment including gasoline driven power supply is housed in a K-53 truck. The equipment is provided with periodic station identification and simultaneous voice broadcast. The equipment may be adjusted to operate at any frequency between 100 and 156 mc. when provided with an appropriate crystal. The carrier output rating is 100 watts. Nomenclature of this set is SCR-629-( ).

PURPOSE: To provide homing facilities in any direction for military aircraft which are equipped with standard UHF receivers.

AUTHORITY: Military characteristics approved at SCTC Meeting No. 170, 19 June 1939.

REMARKS: A complete portable equipment was developed and tested during 1941. This equipment became unusable with standard military receivers when the SCR-522 was adopted. New equipment was developed to provide service when using the SCR-522. Service test models which embody these later developments are now contracted for with Air Associates and Federal Telephone and Radio Corporation.

The Air Associates model was shipped to ARL for test 4 December 1943. Field tests on the Federal Model are in progress at that plant.

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RADIO CONTROL FOR BOMBS

SECTION III

RADIO CONTROL FOR BOMBS

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RADIO CONTROL SYSTEM FOR GLIDE BOMB

742-105D
Expenditure Order No.

Doolittle Mfg. Co., Chicago, Ill.
R. L. Drake, Piqua, Ohio
Emerson Radio Corp.
Bell Sound Systems, New York, N.Y.
Wells-Gardner Co., Chicago, Ill.
Bendix Aviation, Ltd., Towson, Md.
Mfg. or Activity Charged With Development

ARL-105C
Classified Project No.

W-33-038-sc-47, W-33-038-sc-7, W-33-106-sc-74, W-33-106-sc-80, W-33-106-sc-81, W-535-sc-639
Contract Number

DESCRIPTION: Radio transmitting and receiving equipment for the remote control of glide bombs.

PURPOSE: The purpose of this project is to furnish, by the medium of radio, control of glide bombs from the instant they are released until they hit the target.

AUTHORITY: Military Characteristics for this equipment approved by AGO in 1st Ind. Dtd 17 May 1941, to basic letter from OCAC to AG (29 April 1941).

REMARKS: On 30 April, 1941 a contract was granted to Jackson Instrument Company for 105 four-channel receivers to operate on 73 mc. On 9 May 1941, a contract was granted Doolittle Radio, Incl, for 16 transmitters to be used with the aforementioned receivers. This combination gave control of Right, Left, Up and Down. Contracts for both receivers and transmitters on the second procurement were awarded to Bendix Aviation, Ltd. The contract for 50 five-channel receivers was issued 6 March 1942. These units operate on the old assigned frequency of 73 mc. It was decided to go to 84 mc., and for this purpose a contract was awarded for 1000 six-channel receivers. In January, 1943, change orders were issued to Bendix Aviation, Ltd., ordering the production of equipment for use on 80, 82, 86 and 88 mc. as well as 84 mc.

Eight glide bombs with the Radio Receiving Equipment RC-185-( ) installed were dropped in demonstration and field test at Muroc Materiel Command Test Base, Muroc, Calif., in October. These tests indicated satisfactory operation of the impulse control system. Because of inadequate range facilities, all these drop tests were limited to altitude of approximately 10,000 feet. All glide bombs for service test are to be equipped with recording equipment to permit accurate analysis of the performance of the radio equipment.

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RADIO CONTROL SYSTEM FOR POWER DRIVEN BOMB

742-105E
Expenditure Order No.

Doolittle Radio, Inc.
Chicago, Illinois
Mfg. or Activity Charged with Development

ARL-105E
Classified Project No.

W-535-SC-516
Contract No.

DESCRIPTION: Radio control transmitting and receiving equipment for remotely controlling power driven aircraft; functions controlled include ailerons, rudder, elevators, throttle, landing gear, propeller pitch, mixture, arming and dropping the bomb, turning television on and off, altitude control, and operation of target seeking equipment.

PURPOSE: To develop remote radio control equipment which will provide complete radio control of a highly maneuverable, long range power driven bomb.

AUTHORITY: Military Characteristics for Power Driven Bomb equipment recommended by 1st Indorsement from AGO to Chief of AAF 26 February 1940, file AG-54-1 (23 January, 1940).

REMARKS: Development of the control equipment was initiated in September, 1941, and five radio control equipments were installed to permit tests on the General Motors bombs. Installations were made later in ten more bombs for testing the feasibility of the remotely controlled long range power driven bomb. Successful simulated tests were made on the various control functions using control equipment similar to RC-64 and RC-65 installed in a PQ-8 target plane. In May, 1943, tests were conducted at Muroc Lake, California and one bomb was directed within 75 feet of a target.

Tests were conducted in October at Muroc Materiel Command Test Base, using AN/ARW-1(XA-1) in YPQ-12A power driven bombs and AN/CRW-1(XA-1) in an AT-7 airplane. Good results were obtained.

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TELEVISION EQUIPMENT FOR REMOTE GUIDANCE OF BOMBS

Farnsworth Television & Radio Corp.,
Ft. Wayne, Indiana.
RCA Manufacturing Co.,
Camden, N.J.
Mfg. or Activity Charged with Development

742-105-H
Expenditure Order No.

W-33-106-SC-45
W-535-SC-546
Contract No.

ARL-105-H
Classified Project No.

DESCRIPTION: Small, light-weight television transmitting and receiving equipments for use with glide or power driven bombs.

PURPOSE: To provide visual information as an aid in the remote control and accurate guidance of radio controlled bombs.

AUTHORITY: Military Characteristics approved in 1st Indorsement, dated 17 May, 1941, to basic letters from OCAC to AG (28 April, 1941).

REMARKS: Television equipment for this purpose was originally designed and demonstrated by RCA early in 1941. Twenty units were procured and delivered in February, 1942, and eighty slightly modified units were delivered in August, 1942. These one hundred transmitting equipments (and ten associated receiving equipments) operate on a frequency of approximately 100 mc. In September, 1942, successful tests were made at Muroc Lake using only the television equipment as a visual means of directing a PQ-8 Target Plane.

An improved version, the Block III equipment, is being procured from the RCA Victor Division, Radio Corporation of America, and its subcontractor, the Farnsworth Television and Radio Corporation, in the quantity of 500 transmitting equipments and 35 receiving equipments. The radio link operates over the frequency range of 264 to 312 megacycles. Extensive flight testing of equipment has been done and the equipment has now been approved for production. The RCA Victor Division has commenced production.

The Block III equipment is identical in design to equipment being purchased by the Bureau of Ships, Navy Department, for similar purposes.

Contract was negotiated with Farnsworth Television and Radio Corporation in July for the development of three transmitting equipments for the GB-1 Glide Bomb, designed for operation with SCR-550-( ).

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Flight tests of the Block III equipment (SCR-549-A and SCR-550-A) held at Eglin Field in August and September resulted in the achieving of satisfactory operation with the GB-1 Glide Bomb.

Tests were made in November at Muroc Lake, California, on the operation of Radio Set SCR-549-T2 installed in a YPQ-12A airplane. The television equipment operated satisfactorily when the aircraft was put through various maneuvers including a dive from 6,000 feet, a pull out and an accidental spin. Satisfactory transmission was obtained from a B-25D airplane installation to a ground station over a range of more than 60 miles, using the SCR-549-A in the GB-4 Glide Bomb and the SCR-550-A in the airplane in a test at Eglin Field in November.

Pilot runs on the Block III equipment were nearly completed in December at RCA Victor Division. Development has been delayed on a "small package" version of the same equipment, AN/AXT-1 (XA-2).

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MISC. RADIO EQUIPMENT

SECTION 4

MISCELLANEOUS RADIO

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ACOUSTIC TARGETS

742-105J Expenditure Order No.	Mission Bell Radio Mfg. Co., Inc., Los Angeles, California. Mfg. or Activity charged with Development
105-J Classified Project No.	OSRD Contract Contract No.

DESCRIPTION: The acoustical method for indicating firing errors makes use of the shock wave which accompanies any projectile whose speed exceeds the speed of sound. This shock wave actuates a small, short-wave transmitter carried in the airborne target. The resulting frequency-modulated signal from the transmitter is picked up by a receiver which actuates some convenient form of miss-indicating and hit-registering systems.

PURPOSE: This equipment was developed by the California Institute of Technology for use by the Anti-Aircraft Artillery as an aid in the training of Anti-Aircraft gunners, when firing on airborne targets.

AUTHORITY: Ltr., OCSigO to ARL, Dated 24 July 1943.

REMARKS: OCSigO in letter, dated 24 July 1943, directed ARL to start development and engineering work for procurement of acoustic targets which had been developed by Section 17.3 of NDRC at the California Institute of Technology. This equipment was to be procured for use by the Anti-Aircraft Artillery Board. Static firing tests were carried on at Eglin Field in September and at Ft. Myers, Florida, in October.

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INSTRUMENT AND STRAIN GAUGE TELEMETERING

Conn Instrument Co.,
Elkhart, Indiana.
Rudolph Wurlitzer Co.,
N. Tonawanda, New York.
Mfg. or Activity charged with development.

742-105K
Expenditure Order No.

105-K
Classified Project No.

NDRC Development.
Contract No.

DESCRIPTION: Consists of instruments mounted in a panel capable of picking up and transmitting image when used with Radio Transmitter SCR-549-A.

PURPOSE: To provide for transmission of essential instrument information from a radio controlled power bomb to its control plane.

AUTHORITY: Letter OCSigO to Director, ARL, 7 September 1943, SPSAR 413.44.

REMARKS: OCSigO directed ARL in letter, dated September 1943, to "start development and engineering work on a suitable means of transmitting information from various gauges and meters in an airplane to a suitable receiving station at some other point." Specifications are being written covering receiving and transmitting equipment. A satisfactory means of lighting an aircraft instrument panel for instrument telemetering using television methods has been developed and is undergoing ARL tests prior to actual flight tests.

ALTIMETER, RADIO ABSOLUTE

R. C. A. Mfg. Co.,
Camden, New Jersey.
Mfg. or Activity charged with development.

743-201
Expenditure Order No.

W-535-SC-633
NXS-2424
Contract No.

ARL-201
Classified Project No.

DESCRIPTION: The radio altimeter is a device which measures the time required for a radio wave to travel from an airplane to the earth

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and to be reflected back to the plane. This time is directly proportional to the altitude of the plane and is indicated on a cathode-ray tube or a meter calibrated in feet. The low altitude altimeter *AN/ARN-1 has an altitude range of 0-400 feet. Another, the *AN/APN-1 has a dual range, of 0-400 feet. The SCR-518 and the improved type SCR-718 are high altitude instruments with ranges to 40,000 feet.

PURPOSE: The purpose of this project is to develop radio altimeter equipment for airplanes to determine the absolute altitude of the airplanes above the ground and to develop test equipment for these altimeters for squadron use.

AUTHORITY: Military Characteristics recommended by SCTC Meeting No. 170, 19 June 1939 and approved by 1st Indorsement from AGO to CSO dated 7 September 1939 (8 August 1939).

REMARKS: SCR-718-A the improved version of SCR-518-A is now in production and will supercede the older set. The weight of the SCR-718-A has been reduced to 36 lbs. installed in a plane.

Radio Altimeter *AN/ARN-1 was procured thru the Navy Department on their contract NXS-2424. These sets are now being replaced by the dual indicating set *AN/APN-1, which is also being procured from the Navy Department.

Test Equipment used with altimeter are: Delay Line, TS-10/APN; Test Set, TS-16/APN; Test Set, TS-23/APN; Delay Line, TS-59/APN for high range of AN/APN-1.

The SCR-518-A employs pulse transmission and reflection to determine altitude. It has been standardized and quantity procurement was initiated 24 November 1941. Deliveries began 8 June 1942. Weight - approximately 95 pounds. Antenna drag at 250 MPH - less than 10 pounds. Accuracy of indication - within ± (50 ft. + 1/4%) of the altitude - highly reliable.

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ANTENNA SYSTEMS AND EQUIPMENT FOR AIRCRAFT

742-301D
Expenditure Order No.

Aircraft Radio Lab.
Mfg. or Activity charged with Development.

ARL-301-D
Classified Project No.

None
Contract No.

DESCRIPTION: Reduction of Radio Noise interference caused by Electrical Equipment.

PURPOSE: To develop the optimum in antenna systems and equipment.

AUTHORITY: 1st Ind. from AGO to CSO, dated 7 September 1939, (8 Aug 39).

REMARKS: Development and test of an input filter for the PE-94A and PE-94B Dynamotors was completed in July, 1943, and contracts were being negotiated with a filter manufacturer to furnish a complete filter kit containing an extra set of brushes of improved material, for both input and output leads.

Meanwhile, the Radio Noise Section was collaborating with the Electrical Branch of the Equipment Laboratory, Materiel Command, in the testing of filters installed on rotary inverters and other similar equipment to determine the radio noise produced and its effect on the various types of radio receivers connected to the power supply.

A P-39D airplane, having a 700-hour service record, was used for a comprehensive test of shielded versos unshielded radio wiring. The airplane, as received, was found to have a high noise level that seriously restricted the use of SCR-522 equipment. A complete rework of the ignition system dropped the radio noise to a low level, permitting full utilization of the sensitivity and range of the VHF equipment. The shielding on the radio wiring was then removed without rise in noise level.

Additional tests were conducted on reducing VHF radio interference in fighter aircraft by the addition of shielding to interconnecting wiring of the SCR-522, and no evidence was found to justify the installation of such shielding since ignition interference coupled into the radio by the antenna was the limiting factor. It was found that it was practicable to control ignition interference sufficiently by basic design or by maintenance of the ignition system to utilize full sensitivity of the equipment.

Radio noise tests were completed on all of the various types of Rotary Inverters (production models) in August, 1943, to determine

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compliance with existing specification requirement for conducted and radiated radio noise. The tests showed that with the exception of one inverter, requirements for radio noise were being met. All inverters then on production were being furnished with built-in filters.

An ARL study in October, 1943, of the nature of leakage from breaks or joints in an ideally shielded test model demonstrated that a longitudinal cut, that is a cut parallel to the flow of shield currents, causes practically no leakage, whereas a transverse cut caused leakage somewhat in proportion to the length of the cut.

RECORDER AND GROUND PLAYBACK EQUIPMENT

ARL-742-3001B2 Expenditure Order No.	Heller Magnograph, Los Angeles, Californis. S. A. Scherbatskoy, Tulsa, Oklahoma. Mfg. or Activity charged with Development.
ARL-3001B2 Classified Project No.	W-33-038-SC-16 W-33-106-SC-85 Contract No.

DESCRIPTION: This equipment, when it is completely developed, will incorporate the following features and/or functions:

Recorder a. Be light weight and compact; b. Operate on a primary power source of 24-28 volts d.c.; c. Provide at least 60 minutes of continuous recording; d. Provision shall be made to operate the recorder from the associated interphone push-to-talk microphone buttons.

Ground Playback a. Operate on 110 volt a.c., 50-60 cycles power source; b. Provide loud speaker operation; c. Be suitably packaged to facilitate portability and afford protection. Space for spare parts shall be included.

PURPOSE: To record instructions to student pilots, and to record observations made during reconnaissance flight.

AUTHORITY: Letter, OCSigO to ARL, dated 11 March 1943.

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REMARKS: Work on this project has included the investigation of practically every kind of recorder which conceivably could be adapted for use in military aircraft. As a result of these investigations it was concluded that systems utilizing magnetic recording are the most suitable for use in aircraft. Magnetic recording equipments which have been developed by the Heller Magnograph Corporation and the Armour Research Foundation (the latter being sponsored and manufactured by the General Electric Company) have been tested at this laboratory. Neither equipment in its present design will completely satisfy the requirements of the Military Characteristics. However, it is believed that either equipment can be further developed so that the existing faults will be corrected.

Airborne Recorders AN/ANQ-1 and Ground Playback GNQ-1 are now on order with both Heller Magnograph and S. A. Scherbatskoy. Both are magnetic wire or tape type. A Purchase Request is now being processed for AN/ANQ-2, disc type recorder and reproducer as interim equipment until the magnetic wire equipments become available.

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SECTION 1

EVALUATION PROJECTS

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TESTS AND ANALYSIS OF FOREIGN AIRCRAFT

None	Technical Data Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Airplanes of German, Japanese, Italian and British manufacture have been obtained for examination and test. Wherever practicable, the aircraft are placed in flying condition for flight testing, comparative trials, and any other investigation requiring a flyable aircraft of the type under consideration. Crashed aircraft, condition of which is beyond the limits of practicable repair, are treated as equipment and as such are considered a separate project.

PURPOSE: To make available for engineering study, information relative to foreign design practices in order to compare results with similar U.S. developments.

AUTHORITY: CTI-70, dated 5 July 1940 - Authority, Chief of Air Corps CTI-70 signed by A. J. Lyon, Major, A.C., Technical Executive, Materiel Division, OCAC, Washington, D. C.

REMARKS: All flyable foreign aircraft are treated in accordance with a pre-arranged program, which consists roughly of the following phases:

1. Flight test at Wright Field.
2. Examination and test as required by Wright Field laboratories.
3. Comparative trials by Proving Ground Command.
4. Instructional use by Technical Training Command.
5. Final disposition.

A Pilot's Operating Handbook on each type of airplane is prepared to assist in flight testing. To facilitate the distribution of the information obtained from the flight tests, examinations, comparative trials, etc., evaluation reports covering identification, offensive and defensive equipment, combat tactics, engine characteristics and performance, are prepared. These reports are made available to all interested agencies, especially those who have immediate need for such information, such as personnel in operational theaters. Reports covering the engineering aspects of the aircraft, such as research, design, and development, are prepared and distributed to all agencies interested in this phase of the investigation.

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Projects now under way include:

British aircraft:	Spitfire VII (single engine fighter).
	Mosquito (2 engine bomber).
German aircraft:	(2) FW 190 (single engine fighter).
	(2) Ju 88 (2 engine bomber).
	Me 109F (single engine fighter).
	Me 109G (single engine fighter).
	Me 410 (2 engine fighter).
Japanese aircraft:	Hamp (single engine fighter).
	Zeke (single engine fighter).

TESTS AND ANALYSIS OF FOREIGN EQUIPMENT

None	Technical Data Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract No.

DESCRIPTION: Equipment and component parts taken from captured German, Japanese and Italian Aircraft from Theatres of Operation, received for examination and test.

PURPOSE: The primary purpose is to distribute captured enemy equipment to Wright Field laboratories concerned with that particular type of equipment, for examination and test to determine salient features, and thereby to improve design and function of U. S. equipment. The secondary purpose is to supply information of an intelligence viewpoint concerning this equipment to the Informational Division and the Board of Economic Warfare, to include information which will aid in economic warfare, which is derived from study of the nature of the materiel, workmanship in its manufacture, and information found in nameplates.

AUTHORITY: Materiel Command Office Memorandum 43-12, 30 May 1943.

REMARKS: Memorandum Reports, upon completion of tests, are accomplished by the various laboratories. Enemy materiel needed by laboratories at Wright Field for examination is requested from the Informational Division, AC/AS, Intelligence, Hq., Army Air Forces, Washington, D. C., which arranges for shipment from Theatres of Operation. Duplicate items, and equipment

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not possible to test due to lack of parts, or poor condition, are left on exhibit in the Technical Data Storeroom, in Building 93, Wright Field.

Lists of enemy materiel received at Wright Field are published periodically by the Technical Data Laboratory and mailed to approximately 400 manufacturers.

These manufacturers were informed that it would be possible for them to examine and test items of captured enemy equipment in which they were interested. Thus it will be possible for them to note advancements in enemy manufacture, and will consequently improve their own equipment. The manufacturers will forward reports of their tests to the Technical Data Laboratory.

Items of captured enemy equipment are being tested at present by manufacturers and the Office of Economic Warfare, Washington, D. C.

Liaison is also manitained with the Naval Aircraft Factory, Captured Enemy Equipment Unit, at Philadelphia, Pa., providing an additional source of enemy equipment. Reports of tests completed by the Naval Aircraft Factory are forwarded to the Technical Data Laboratory.

INFORMATION CONCERNING OPERATIONS OF U.S. EQUIPMENT IN COMBAT THEATERS

None Expenditure Order No.	Technical Data Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The Materiel Command regularly receives reports written to contractors by their service representatives in combat theaters. These reports are a fertile source of information concerning the functioning and malfunctioning of U.S. Army Air Forces Equipment. Further information may be gained by interviewing these representatives when they return to this country.

PURPOSE: To collect, evaluate, and disseminate information on functioning of U.S. Army Air Forces equipment in the various theaters of operation, as well as to coordinate relations between manufacturers' representatives, Army Air Forces personnel and others concerned with this information; to maintain a reference file on data received from representatives abroad.

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AUTHORITY: General Orders #33, Headquarters Materiel Command, 16 June 1943.

REMARKS: All representatives returning from abroad report directly to Headquarters, Air Service Command, where they remain temporarily to be interviewed by personnel of the Air Service Command. The U.S. Equipment Unit is informed of their arrival and is responsible for arranging conferences between these representatives and Materiel Command personnel as well as representatives of manufacturers of similar articles who have not been able to send their representatives to the theaters of operation.

CHARACTERISTICS AND PERFORMANCE OF AAF AIRCRAFT

None Expenditure Order No.	Technical Data Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The Flight Data Unit, Evaluation Branch, Technical Data Laboratory, Engineering Division was established as a central coordination agency for all published data pertaining to the characteristics and performance of AAF aircraft.

PURPOSE: To prepare and publish official performance and characteristic data on AAF aircraft.

AUTHORITY: Letter from Headquarters of the Army Air Forces, dated 29 April 1943, subject, "Inaccuracies in Performance Data as Furnished in Monthly Chart - Airplane Characteristics and Performance".

REMARKS: In cooperation with the Project Officers and Engineers of the Production and Engineering Division, the Flight Data Unit is responsible for the preparation and publication of Monthly Charts on engineering Characteristics and Performance, Armament and Bomb Installations and firing angles also coordination of performance charts, tables and graphs including operational data included in Pilot's Handbooks. Complete files are maintained so that the latest authentic information on characteristics and performance of aircraft is available at all times.

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AIRCRAFT IDENTIFICATION MATERIAL

None Expenditure Order No.	Technical Data Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: Silhouettes of U.S. and foreign aircraft are drawn showing top, bottom, side, front and perspective views.

All of the silhouettes are drawn to a standard arrangement and so far as possible to a uniform scale. The bombers, being so much larger than the fighters and some other types, are naturally reduced in size when reproductions are made.

PURPOSE: To provide material for readily identifying all types of domestic and foreign aircraft.

AUTHORITY: CTI-70, dated 5 July 1940 - Authority, Chief of Air Corps CTI-70 signed by A. J. Lyon, Major, A.C., Technical Executive, Materiel Division, OCAC, Washington, D.C.

REMARKS: The use of these silhouettes is extended to facilitate reference to different types of airplanes and to study their comparative features. This is of value not only from an engineering standpoint but also as an aid in the recognition of airplanes from a tactical or combat point of view. A quantity of 5,000 booklets containing silhouettes of U.S. airplanes was issued in December 1941. A revised booklet covering approximately 50 types of airplanes was prepared in September 1942 and to date more than 500,000 copies have been distributed. Silhouettes of British, German, Japanese and Italian airplanes have been prepared for use in evaluation reports.

Three-view silhouettes of 20 important German aircraft showing fields of fire were prepared and compiled in booklet form and published in September 1942. To date 20,000 copies have been printed and distributed.

For quick recognition of planes by essential details, charts based on the WEFT system of recognition have been prepared. These charts show partial view drawings emphasizing the Wing, Engine, Fuselage and Tail features of each plane. To date charts have been completed for all principal airplanes of U.S., England, Russia, Germany, Japan and Italy. Six thousand copies of each in small size (8" x 10") and 600 copies of each in large size (17" x 22") have been printed and distributed.

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The above WEFT charts have been compiled in book form, devided in two sections. One section showing planes by country, the other showing planes by types such as four engine bombers, two engine bombers, light bombers, two engine fighters, fighters and miscellaneous. Eighty thousand copies of this booklet have been printed on request.

Illustrations, silhouettes and photographs are being prepared of machine guns, cannons and bombs for the Monthly Chart, "Armament and Bomb Installations".

A booklet showing the Fields of Fire of all important U.S. aircraft is also being prepared.

CONSULTATION ON SCALE AIRPLANE MODELS

None Expenditure Order No.	Technical Data Laboratory Mfg. or Activity Charged with Development
Classified Project No.	None Contract No.

DESCRIPTION: Drawings, silhouette views, and photographs of foreign and U.S. planes are prepared for the use of manufacturers of airplane models.

The master copy of each model is minutely checked for correctness of dimensions, shape and overall accuracy.

PURPOSE: To provide combat arms and services and other interested parties with accurate scale models of various foreign and U.S. airplanes.

AUTHORITY: CTI-70, dated 5 July 1940 - Authority, Chief of Air Corps CTI-70 signed by A. J. Lyon, Major, A.C., Technical Executive, Materiel Division, OCAC, Washington, D.C.

REMARKS: For design purposes in illustrating comparative size and shape of U.S. and foreign airplanes, and for gunnery practice and aircraft identification purposes throughout the Army Air Forces and coordinating service branches, models of 78 individual airplanes have been provided.

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These models to 1/72" scale are manufactered from Plastic material by the injection moulding process. Detailed checking of the master model in each case is required to insure that the dies, and hence the production articles, are correct as to size and other details.

PILOT'S HANDBOOK OF FLIGHT OPERATING INSTRUCTIONS

None Expenditure Order No.	Technical Data Laboratory Mfg. Or Activity Charged with Development
None Classified Project No.	None Contract No.

DESCRIPTION: The Handbook Sub-Unit, Flight Data Unit, Evaluation Branch, Technical Data Laboratory, Engineering Division was established to review Pilot's Handbooks of Operating Instructions of all current production aircraft.

PURPOSE: To coordinate technical data in order to insure correct, clear, concise and consistent handbooks.

AUTHORITY: F.C. Memorandum 5-10, Army Air Forces, Materiel Command, Wright Field, dated, 11 December 1943, Subject, "Publications and Reproductions".

REMARKS: This unit works in close coordination with the various Project Officers to relieve them of the responsibilities of precise checking of the completed Pilot's Handbooks and to assist them in advising the contractor concerning these handbooks.

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PHOTOGRAPHIC ENGINEERING PROJECTS

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ULTRA-HIGH-SPEED PHOTOGRAPHY

903-15	General Radio Company Massachusetts Institute of Technology, Boston, Mass.
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: Ultra High-Speed Photography is divided into two general types:

1. Motion Picture - Frame speeds of 48 to 10,000 per second are employed on 8mm, 16mm, and 35mm film. This extreme frame speed permits the photographing of high velocity motion, such as gunfire effect on oxygen cylinders, carbon dioxide cylinders, or self-sealing gas tanks, as well as the action on jettisoned propellers, landing wheel drops, parachute drops, helicopter analysis, explosive decompression, human centrifuge, etc. The resultant pictures can be run at normal speeds for engineering study and actual mathematical measurement. One type of stroboscopic photography uses motion picture techniques and is useful for studies of motion where patterns of travel are desired.

2. Ultra High-Speed Still Photography - This technique makes use of the Edgerton super-speed light with exposures of 1/100 second up to 1/500,000 second. When a single photograph or series of a few is required, the Micro-Flash equipment is utilized. Exploding cylinders, gunfire and armor plate, brake and tire tests, hydraulic ramming effects, etc., are samples of projects using Micro-Flash technique. A variation of stroboscopic photography is used where a cyclic or rhythmic motion is desired.

PURPOSE: To develop equipment and techniques by which engineering data can be derived by photographic methods; the derivation of which is not practical or possible by any other method; also to provide specialized photographic service to all laboratories and other Army Air Forces activities.

AUTHORITY: Chief, Engineering Division.

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REMARKS: This project originated in the Equipment Laboratory in connection with the study of the effect of gunfire on oxygen equipment and was transferred to Photographic Engineering Branch, Technical Data Laboratory, as established under Engineering Division Office Memorandum 43-2AC, 5 June 1943. This directive expands the scope of the project to encompass the derivation of any engineering data by specialized photographic procedures. Many projects are now in work, among the more important of which are the following:

High-Speed Photography

18-AIRC LB-3	Gunfire Effect on Armor Plate
39-TECH DA-3	High Speed Shutter (NDRC)
40-TECH DA-3	Synchronizing Hand Camera
44-TECH DA-3	Electronic Timing Device
53-TECH DA-3	Super Speed Emulsions and High Energy Developers
54-TECH DA-3	Gunfire Analysis on Armor Plate Substitute
61-TECH DA-3	Temperature Effects on Photographic Emulsions
68-TECH DA-3	Lens Coatings
92-TECH DA-3	Gunfire Effects on Plastic and Glass Enclosures
111-TECH DA-3	8 x 10 Speedlamp Camera
96-TECH DA-3	Stereo High Speed Still Camera
10-ENG DIV-3	Helicopter Analysis
14-PROP LB-3	Anti-Icing Stroboscopic Studies
21-AIRC LB-3	Static Tests of Aircraft Accessories
22-AIRC LB-3	Dynamic Studies of Helicopter
23-AIRC LB-3	Elastically Suspended Engine Models
26-AIRC LB-3	Analysis of Landing Gear Drop Tests
30-AIRC LB-3	Low Speed Motion Camera
41-ARM LB-3	Gun Recoil and Shock Analysis on XA-38
42-AERO ME-3	Hydraulic Destruction Tests
45-TECH DA-3	Recording Timer for High Speed Cameras
67-POWER PL-3	Hydraulic Ramming Effects
69-AERO ME-3	Explosive Decompression
87-PROP LB-3	Deflection Study
88-PROP LB-3	Propeller Rupture
95-AIRC LB-3	Gunfire Projectile Deflection
100-TECH DA-3	Experimental Motion Picture Camera

COLOR PHOTOGRAPHY

903-15
Expenditure Order No.

Technical Data Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Non-tactical color photography.

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PURPOSE: To provide an efficient, inexpensive, and rapid color transparency and print service to other laboratories and components of the Army Air Forces.

AUTHORITY: Engineering Division Office Memorandum 43-2AC, 5 June 1943.

REMARKS: The Photographic Engineering Branch has had under investigation several methods of providing an inexpensive and rapid color print service, the more important of which are: Gasparcolor, Ansco Color, Ansco Direct Positive Color, and Eastman Azochrome. The importance of providing this service is illustrated by the necessity for reproducing charts prepared by Graphic Control Section in quantities less than would be justified by printing or lithograph. This also applies to color diagrams and charts illustrating electrical circuits, hydraulic systems, oxygen systems, etc., where a limited number of copies is required; additionally, for the preservation of historical records for the reproduction of aircraft designs, drawings, and paintings, making possible the preservation of the originals; for engineering investigations involving color changes, due to heat, corrosion, flame, and other phenomena associated with color changes; for the investigation and recording of skin diseases, reactions, and injuries, particularly of the extremities and eyes; also recording of the results of trauma, due to direct gunfire, indirect results of gunfire after hitting various pieces of oxygen equipment, armor vests, etc. Much autopsy material has been recorded for the Aero Medical Laboratory in this latter category. Some of the projects in the above category are as follows:

11-TECH DA-3	E-14 Emergency Sustenance Kit
34-EQ LB-3	Color Photographs of Flight Clothing
71-AERO ME-3	Biological Color Studies
84-TECH DA-3	Paint Discoloration on Aircraft
85-TECH DA-3	E-15 Emergency Sustenance Kit
98-MAT LB-3	Corrosion on Radiator Tubing
104-EQ LB-3	E-6, E-7, and Trading Kits
106-TECH DA-3	Architectural Views of Wright Field
107-PUB REL-3	Flying Magazine Photographs of Wright Field Laboratories and Activities
108-AERO ME-3	Aeromedical Equipment

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HIGH SPEED STUDY IN MOTION PICTURES OF OXYGEN CYLINDERS

660-73	Aero Medical Laboratory Technical Data Laboratory
Expenditure Order No.	Mfg. or Activity Charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: A series of Microflash still pictures and Ultra High Speed Motion Pictures.

PURPOSE: Determine the manner in which to photograph the behavior of oxygen cylinders under gunfire.

AUTHORITY: Materiel Command Office Memorandum No. 43-12, 31 May 1943.

REMARKS: The behavior of various shells and bullets has been determined by these studies, and improvement in the design of oxygen cylinders has resulted from firing tests and study of the high speed photographs taken thereof. To fully exploit Microflash photography of bullet impact, it has been found necessary to devise means of reducing the flash effect caused by incandescent metal particles which in the photographs obscure the phenomenon that it is desired to study. Investigations are proceeding on the use of various filters, super speed shutters, and polarizers, which will overcome the effect of the flash.

DEVELOPMENT OF BALLISTIC CAMERA
FOR PLOTTING GLIDE BOMB TRAJECTORIES

673-15	Equipment Laboratory Technical Data Laboratory
Expenditure Order No.	Mfg. or Activity charged with Development
None	None
Classified Project No.	Contract Number

DESCRIPTION: The Ballistic Camera is a synchronized strip camera, which, in combinations of several, both on the ground and airborne, will photographically record bomb trajectories.

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PURPOSE: To provide for accurate plotting of bomb trajectories.

AUTHORITY: Chief, Engineering Division.

REMARKS: Means are available to photographically produce bomb trajectories; however, severe limitations are present - such as small target area, difficult and prolonged calculations, inflexibility. It is to eliminate all these objections that a new approach is being made to provide accurate data on bomb trajectories. Several experimental cameras have been built, and the problems of resolution, of following, and interpretation have been worked out. A number of flight checks have been made to determine the workability of the equipment, and it is believed that a solution is close at hand. The Equipment Laboratory has contracted for the construction of the special cameras, which will be used to make the final determinations.

RECORDING CAMERAS

903-15
Expenditure Order No.

Technical Data Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Recording cameras are of several types at present - basically the Type A-4-A, the Eyemo, and the Solenoid Control Graflex, the principal feature of which is the automatic recording of recurrent or progressive data.

PURPOSE: To provide accurate recording of test data.

AUTHORITY: Chief, Engineering Division.

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REMARKS: Various laboratories have called upon the Photographic Engineering Branch to provide means of securing permanent record of various instruments, tests, and studies by automatic means. The more important current projects are as follows:

2-AERO MP-3	Recorder for Manometer
5-ARL-3	Cathode Ray Recorder
8-POWER PL-3	Engine Test Recorders
25-AIRC LB-3	Oscillograph Recording
29-AIRC LB-3	Synchronized Recording of Dive Tests
36-AERO ME-3	Human Centrifuge Recorders
64-STA DIS-3	Sedimentation Recorders
74-POWER PL-3	Piston Corrosion Study
77-POWER PL-3	Quantitative Study of Ice Accumulation
94-WEA OFF-3	Weather Chart Camera
97-ARL-3	Photo Observer

SPECIAL CAMERAS

903-15
Expenditure Order No.

Technical Data Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract Number

DESCRIPTION: Special cameras and photographic studies not classified otherwise.

PURPOSE: To provide specialized equipment and procedures not possible by any standard equipment or methods.

AUTHORITY: Engineering Division Office Memorandum 43-2AC, 5 June 1943.

REMARKS: Various requests have been and will be received to make determinations of special phenomena for which no standard equipment is available. Among such projects are the following:

62-EQ LB-3	Parachute Acceleration Data
43-AIRC LB-3	Air Foil Analysis

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6-STA DIS-3	1:1 Color Clinical Camera
37-AERO ME-3	Eye Camera
72-STA DIS-3	Stereo X-Ray Studies
78-STA DIS-3	Tongue Camera
4-MAT LB-3	Optical Properties of Transparent Enclosures
20-AIRC LB-3	Photoelastic Analysis of Plastic and Steel Aircraft Parts
32-AIRC LB-3	Photoelastic Structure and Sub-Assembly Analysis
81-TECH DA-3	Photomicrography by X-Ray
48-TECH DA-3	Mathematical Analysis by Three Dimensional Photography
70-EQ LB-3	Multiple Lens Observer for Automatic Radio Landing Device
79-TECH DA-3	Application of Vectograph to Engineering Study and Demonstration
80-TECH DA-3	Vectograph Process Improvements

EYE SHOOTING INSTALLATION ON NEW HUMAN CENTRIFUGE

None
Expenditure Order No.

Aero Medical Laboratory
Technical Data Laboratory
Mfg. or Activity Charged with Development

None
Classified Project No.

None
Contract No.

DESCRIPTION: This project involves two kinds of research photography:

1. Motion picture camera and lights for recording continuous behavior of subjects in the human centrifuge.

2. Automatic still camera with synchronized lights to make Microflash picture of eyes or other detail under high "G" conditions, in human centrifuge.

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PURPOSE: To provide observation and recording under physical conditions not permissible to the usual observer. Human behavior under high "G" is a rapidly changing phenomena and not accessible to study, except from photographic records.

AUTHORITY: Chief, Engineering Division.

REMARKS: An observer would be exposed to the same "G" effects as the subject because of the necessity for whirling the subject on the wheel of the centrifuge. Such observation would be questionable as to accuracy due to the possible simultaneous "gray out" or "black out" of the observer and the subject, and further the indications or symptoms are fleeting and of short duration. This equipment will be permanently installed on the Human Centrifuge at Aero Medical Laboratory for their continued research.

PROPELLER ICING

581-160 Expenditure Order No.	Propeller Laboratory Technical Data Laboratory Mfg. or Activity Charged with Development
None Classified Project No.	None Contract Number

DESCRIPTION: This project employs both synchronized and stroboscopic motion pictures.

PURPOSE: To make a photographic record for future study of propeller characteristics during icing.

AUTHORITY: Chief, Engineering Division.

REMARKS: Microflash and stroboscopic photographs have been taken to determine the manner of icing the blades. An attempt is now being made to record the quantitative amount of icing. This involves some highly technical equipment, which is currently under investigation.

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