TL. 114-54/10

SECRET

HEADQUARTERS
AIR RESEARCH & DEVELOPMENT COMMAND
Post Office Box 1395
Baltimore 3, Maryland

TR NO: 54
26 October 1954
SEE AMENDMENT AT END DATED 17/JAN/1955

TECHNICAL REQUIREMENT

I. DIRECTED ACTION

Preparation of necessary Project Development Plan(s) or revision of existing Development Plans to satisfy the requirements established herein and submission to Headquarters ARDC, ATTENTION: RDTPA, is directed. (UNCLASSIFIED)

II. GENERAL INFORMATION

1. Title of Requirement: Aeronautics (UNCLASSIFIED)

2. Title of Technical Program: Aeronautics (UNCLASSIFIED)

3. Center Designation: The Wright Air Development Center is responsible for the major portion of the development to meet this requirement. Other centers will participate as required, assuming responsibility in accordance with existing ARDC regulations, policy statements and other applicable directives. (UNCLASSIFIED)

4. Importance: At present this is the only requirement in this technical program. (UNCLASSIFIED)

5. Related Work:

   a. The NACA is engaged in research in aeronautics.

   b. The Army and Navy and private industry are engaged in research and development in certain phases of aeronautics.

   c. Universities and other research agencies perform research in phases of aeronautics. (UNCLASSIFIED)

6. Participation and/or Coordination: The NACA, Army, Navy and the using commands will all participate and/or coordinate as required in phases of the development work to meet this requirement. The Air Force Operational Commands will be solicited for suggestions and ideas relative to operational problems which may be solved through research in Aeronautics. A mutual exchange of technical information will be effected between the government agencies participating in this work. (UNCLASSIFIED)

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7. References:

ARDC Program Guidance for preparation of FY '55 Research and Development Program dated 8 December 1952, Tab F, pages 36-47. (UNCLASSIFIED)

III. REQUIREMENT

1. There is a requirement to obtain by 1960 the technical knowledge necessary to initiate the design of aircraft whose significant performance and design parameters are stated in the following paragraphs. (UNCLASSIFIED)

2. An estimate of the speeds, altitudes and temperatures which may be attained by operational manned aircraft is shown in the following table:

FIGHTER TYPE

Date	Mach No.	Altitude (ft)	Unrefueled Radius-NM	Equilibrium Temperature°F	Soaking Time
1955	1.5 (2.0)	60,000	500(300)	175(220)	1 hr.(10 min)
1960	2.0 (3.0)	80,000	520(330)	300(500)	1 hr.(10 min)
1965	3.0 (3.5)	90,000	550(360)	500(700)	1 hr.(10 min)
1970	3.5 (3.7)	100,000	590(390)	700(750)	1 hr.(10 min)

BOMBER TYPE

1955	.95 -	55,000	3700 -	150 -	1 hr.(10 min)
1960	2.0 (2.5)	70,000	2700(2300)	220(400)	1 hr.(10 min)
1965	2.5 (3.0)	80,000	2700(2300)	400(500)	1 hr.(10 min)
1970	2.7 (3.2)	90,000	3200(2700)	430(550)	1 hr.(10 min)

NOTES: (1) Parenthetical figures are to be used together. Parenthetical figures represent a "dash" capability.

(2) Parenthetical radius figure is the total radius obtainable if dash speeds are employed at any time during mission.

(SECRET)

3. Current approach and touchdown speeds are as high as 160 knots. It is expected that approach and touchdown speeds for aircraft designed for conventional operation will approach 200 knots by 1965. If boundary layer control is incorporated during design, landing and approach speeds will be reduced by approximately 15%. Unit construction indices of 60 for fighters, 100 for bombers and 40 for cargo

2. Launching and Alighting Gear

a. To provide the optimum in launching and alighting gear for high-speed high-density aircraft requires that continuous effort be applied to insure a comprehensive integration of all factors affecting landing and take-off requirements.

(1) Problems dealing with the ground flotation capability of aircraft have been mounting. The establishment of the Unit Construction Index in conjunction with the Corps of Engineers is seen as a very significant means for lessening these difficulties. Additional work is indicated in the direction of soil stabilization programs which reportedly allow for significant improvements to the sub-grade characteristics of the treated soil.

(2) The inadequacy of certain tires on high-speed research aircraft and the limited service life of others demands improvement. High capacity equipment capable of testing and isolating such deficiencies prior to service testing must be employed. Additional research should be undertaken to more clearly establish the relationship of cause, rate and heat distribution process in high speed tires.

(3) Continued studies and applications in the use of anti-skid equipment should be made.

(4) Studies and laboratory analysis are required to provide additional know-how relative to the causes of wheel shimmy. Primarily, only cut and try methods have been used in the elimination or lessening of this problem. The interrelation of all known factors should be accomplished in order that load distribution, dampening and friction characteristics for tires can be optimized.

(5) The ultimate in the direction of operating from small air-base facilities is seen to be vertical take-off and landing. Short of this achievement, however, there are considered to be two companion solutions. First, a capability for operation from natural or unprepared surfaces and, secondly, with the employment of auxiliary acceleration and deceleration devices. In the second instance, it is conceived that, with only limited compromises in aircraft performance, runway length requirements may be halved or quartered.

(a) Expeditionary type catapults and arresting gear designed to provide high performance land based aircraft with a short runway capability are forthcoming.

type aircraft will be required. As stated previously, the available runway lengths will continue at 5,000 ft. for fighter type aircraft and 10,000 ft. for bomber type aircraft. (SECRET)

4. There is a further requirement to vigorously pursue methods of providing increased performance of current aircraft over that stated above through special flight and operational techniques and equipment. (CONFIDENTIAL)

IV. GUIDANCE

The technical program guidance is stated in terms of current technical groupings since the programs are presently administered in this fashion. (UNCLASSIFIED)

1. Aircraft and Design Studies

a. The objectives of this program are as follows:

(1) To design, fabricate, instrument and test the special research aircraft or unique versions of existing aircraft as required to conduct the investigations and provide the data defined below.

(2) To investigate the aerodynamic, dynamic, thermodynamic and dynamic load problems associated with full scale flight in a previously unexplored range of performance.

(3) To establish basic design criteria and provide meaningful definition of the problem areas through appropriate design studies.

(4) To provide for correlation of wind tunnel and other test data and verify theoretical predictions by full scale free flight test. (CONFIDENTIAL)

b. The vital need for a program to insure the timely availability of full scale data has been established. It remains to organize our efforts into a continuous and vigorous program to provide these data. The research airplane program including the X-1A, B and E airplanes, the X-2 and the X-13 provides a portion of the required effort and should continue to be pursued in accordance with the priorities and the importance of the area being investigated. Particular emphasis is considered to be required on the full scale investigation of thin wing (4%) with the X-1E since the X-3 will not be capable of supporting the investigation much beyond Mach 1. (CONFIDENTIAL)

(b) Complete elimination of the landing gear as in the zero length launch and mat landing program.

(c) Evaluation of the use of a detachable rocket assisted take-off cart with landing accomplished on a skid type gear should be pursued. (CONFIDENTIAL)

b. Thorough consideration should be given to the following features of any such program.

(1) Equipment reliability

(2) Performance penalty to aircraft

(3) Time to become operational

(4) Logistics

(5) Mobility

(6) Vulnerability

(7) Techniques required of pilot

(8) All-weather capability

(9) Economics (UNCLASSIFIED)

3. Flight Operating Techniques

a. The objectives in the technological requirement area are as follows:

(1) To identify those performance deficiencies of present and planned aircraft which have persistently resisted solution by design improvement or which least lend themselves to conventional solution.

(2) To devise techniques and equipment which will overcome these deficiencies or which will provide a required capability.

(3) To demonstrate the technical feasibility of these techniques and equipment and make recommendations for their application to existing or planned weapon systems. (CONFIDENTIAL)

b. The principal effort in this area currently is oriented towards providing extended range for both fighter and bomber type aircraft. The technical problems which are known to require investigation include:

(1) Flight Refueling - Investigate the optimum conditions for refueling, considering first only the various weapon systems which will require refueling in flight, and then the planned combinations of tankers and refueling aircraft. Establish the practical performance limitations of flight refueling with the Flying Boom and the Probe and Drogue Systems. Develop flight refueling equipment to satisfy the speed, altitude and flow rate requirements of currently planned weapon systems.

(2) Wing Tip Coupling - Develop a method of coupling aircraft wing tip to wing tip which will be inherently stable over an acceptable operating range; or develop a reliable means of automatic control of the aircraft while in the coupled configuration. Establish the feasibility of extending this technique to other aircraft, the combination of which would provide the Air Force with an improved or a unique capability.

(3) Floating Wing Tip - Establish the technical feasibility of this technique by the design and test of floating wing tips for a low performance inexpensive airplane of some variety. Investigate the performance and physical characteristics of current weapon systems and identify one to which the application of floating wing tips would be most beneficial for consideration as a follow-on development.

(4) Towing - Complete the current investigation of fighter emergency towing. Initiate additional work of this nature only on the basis of an established requirement. (CONFIDENTIAL)

4. Aerodynamics

a. Provision of higher speed is primarily a matter of additional thrust and reduced drag. Anticipated thrust requirements are deliniated in the propulsion program. The provision of additional thrust normally causes a deterioration in altitude and/or radius. A pure decrease in drag, however, will lead to an improvement in speed and radius. This is true provided that the drag reduction has not been attended by an unreasonable weight increase. Laminarization of the boundary layer may provide large drag reductions but equipment weight must be minimized. Exploitation of the "area rule" and the "moment-of-area rule" may provide a drag reduction with a minimum weight penalty. Improvement in speed, altitude, and radius all depend upon a drag reduction. (CONFIDENTIAL)

b. Minimizing of runway requirements depends primarily upon the development of high lift and high thrust devices. In the former category, boundary layer control offers much promise. Systems

should receive greater emphasis. Rational and simplified methods of calculating stresses in aircraft structures should be developed. (CONFIDENTIAL)

b. Theoretical and experimental research should be continued to establish flutter design criteria at high subsonic and transonic speeds for conventional designs of aircraft and missiles. Flutter problems associated with wing tip coupling, floating wing panels, external stores and spoilers should be further investigated. New and improved methods of predicting aeroelastic phenomena should be developed. Correlation between vibration measured in flight and the expected fatigue life of particular structural components should be developed. Means and methods to reduce vibrations caused by aerodynamic loads should be determined. New types of vibration absorbers, isolators and dampers should be investigated to solve some of the vibration problems associated with helicopters and convertiplanes. (UNCLASSIFIED)

c. Further, research and development of aircraft and missile structures is required. Methods and technique of resolving structural problems associated with aerodynamic heating, aeroelastic deformations should continue at a higher rate of endeavor. Metal-to-Metal bonding should be further developed to improve fabrication techniques and simplify the problems associated with quality control. Further developments should be continued with honeycombed bonded structures to improve reliability and obtain design criteria. New and improved sealing materials should be developed to meet the additional requirements pertinent to compartment pressurization and integral fuel and oil tanks. A means of constructing leak proof tanks without the use of large quantities of sealent should be developed. Transparent canopy panel and windshield assemblies should be further developed with special emphasis on high strength and optical characteristics. (CONFIDENTIAL)

d. There is an immediate need to develop better methods of testing aircraft subjected to elevated temperatures due to aerodynamic heating. It is essential that some of the present developments be completed in time for use in conjunction with the F-102 structural integrity tests and other weapon systems. These methods should be carefully analyzed from the standpoint of accuracy of tests, ease of conducting the tests, safety and costs. (CONFIDENTIAL)

V. OTHER INFORMATION

1. In the case of presently documented projects which are pertinent to this requirement, a written reply will be made identifying both

currently available for large aircraft are far too heavy for use in production aircraft. Systems for fighter type aircraft must be stabilized and improved before they may be committed, in good conscience, to combat aircraft. (CONFIDENTIAL)

c. In the high thrust category, an overpowered aircraft, such as that used for vertical take-off operations, leads to new and different problems. Such an aircraft is sufficiently overpowered that it may not be expedient to perform the cruise portion of the mission at the base of the drag rise. It may be more desirable, from the engine standpoint, to cruise at supersonic Mach Numbers (of the order of Mach 1.5 for early 1960 engines). An intelligent resolution of this problem again points to a requirement for drag reduction. (SECRET)

d. Most high performance, highly swept or delta wing aircraft are marginally stable or unstable in the approach and landing configurations. Artificial stabilization by electronic devices is not the ultimate solution. Sufficient inherent aerodynamic stability must be provided so the aircraft is, at worst, neutrally stable; the aircraft must not be divergent in any mode except possibly the phugoid. (CONFIDENTIAL)

e. At the high end of the speed scale, further intensive investigations of stability and control are required. Present indications are that the destabilizing effect of speed becomes uncontrollable above Mach 2. This is due, probably, to aeroelastic effects. These effects must be understood and controls must be designed to minimize the destabilization. (SECRET)

5. Aircraft Structures

a. To fulfill the requirement for a progressive improvement in airplane performance continuous research and development of aircraft and missile structures, as well as its associated problems, is required. This effort should, at a minimum, include work in the following areas:

(1) Structural design criteria should be kept up-to-date through theoretical studies, laboratory testing and the continuation of the flight data recording program. Bomber and cargo type aircraft which may require a change in criteria due to the rapid improvements in airplane performance should also be instrumented to determine whether a decrease in service life is required or a change in criteria for future designs. Related data recording and reading equipment should be developed. Greater amount of effort should be applied to determining the life expectancy of aircraft operating frequently at high stress levels. Problems associated with aerodynamic heating

projects and tasks by appropriate numbers. A brief explanation will be given to the effect that these tasks and projects are oriented in line with the program guidance, and if successful, will satisfy specific parts of this technical requirement. (UNCLASSIFIED)

2. Should this analysis of the present effort reveal that certain aspects of this technical requirement are not covered, proposals for initiating new projects will be made in accordance with ARDC Manual 80-4. (UNCLASSIFIED)

3. The overall classification of this document is assigned Secret in accordance with AFR 205-1, paragraph 23.c. Secret classification is assigned to performance data in Sections III and IV.

BY ORDER OF THE COMMANDER:

UNITED STATES AIR FORCE
HEADQUARTERS AIR RESEARCH & DEVELOPMENT COMMAND
OFFICIAL
AUTHENTICATION

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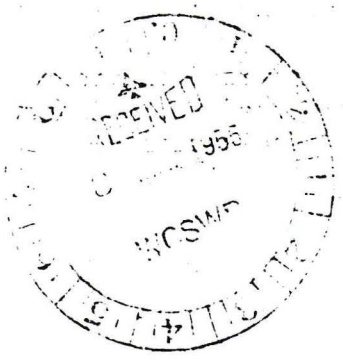

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