

R E S T R I C T E D

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ARMY AIR FORCES
SPECIFICATION

No. IX-28398-A
January 27, 1944
Superseding
No. IC-28398
August 16, 1939

**ENGINES, TEST FOR EXPERIMENTAL AIRCRAFT
(PRELIMINARY FLIGHT RATING)**

A. APPLICABLE SPECIFICATIONS.

A-1. The current issue of the following specifications in effect on date of issuance of proposals, forms a part of this specification:

Army-Navy Aeronautical	AN-F-28	Fuel; Aircraft-Engine, Grade 130.
Army-Navy Aeronautical	AN-VV-F-746	Fuel; Aircraft-Engine, General Specification (Method for Knock-Test).
Army-Navy Aeronautical	AN-VV-F-748	Fuel; Aircraft-Engine, General Specification For (Method for Supercharged Knock-Test).
Army-Navy	AN-9500	Engines, Aircraft; General Specification.
Army-Navy	AN-9504	Engines, Aircraft; Torsional Vibration Characteristics.
National Advisory Committee for Aeronautics Report	218	Standard Atmosphere Tables and Data.

B. TYPE.

B-1. This specification covers the test requirements for experimental aircraft engines which are to have a preliminary flight rating established specifically for tactical airplanes.

C. MATERIAL AND WORKMANSHIP.

C-1. Not applicable to this specification.

D. GENERAL REQUIREMENTS.

D-1. Preparation of Reports:

D-1a. Reports of tests under this specification shall contain essentially the following items:

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SPECIFICATION

D-1a(1). Title Page.

D-1a(2). Index.

D-1a(3). Object.

D-1a(4). Summary.

D-1a(5). Conclusions and Recommendations.

D-1a(6). Description. - Under this heading, there shall be prepared a brief general description of the engine and a detailed description of all features which differ from the previous model. A complete weight table shall be included in accordance with Specification AN-9500.

D-1a(7). Method of Test. - General description of test equipment and methods used in conducting the test.

D-1a(8). Record of Test. - Chronological history of all events in connection with all of the testing.

D-1a(9). Analysis of Results. - A complete discussion of all phases of the test, such as probable reasons for failure and unusual wear, comparison in performance with previous models and analysis of general operation.

D-1a(10). Calibration Data. - All data obtained during engine calibration shall be suitably shown by curves, each sheet of which shall show average entrance air temperature, type of spark plugs, ignition advance, specification numbers of fuel and oil, carburetor setting number, type of carburetion, coolant conditions, and atmospheric conditions.

D-1a(11). Summary of Endurance Test Data. - Unless otherwise specified by the Procuring Agency, tables showing averages, maximum and minimum, of the data designated in Paragraphs F-1a(1) to (4) inclusive.

D-1b. Number of Copies. - The Procuring Agency will designate the number of copies of the report that shall be prepared and where they will be sent.

E. DETAIL REQUIREMENTS.

E-1. Not applicable to this specification.

F. METHOD OF INSPECTION AND TESTS.

F-1. General. - Aircraft engines and test apparatus shall be subject to inspection by authorized Government representatives who shall be given all necessary facilities to determine conformance with this specification. Unless otherwise specifically authorized, all tests under this specification shall be conducted at the Procuring Agency's laboratory.

F-2. Test Apparatus:

F-2a. Power Absorption. - Calibrations shall be conducted on a type of power-absorbing dynamometer acceptable to the Procuring Agency, such as an electric cradle dynamometer or water brake. The type and model of propeller used for the reaction or rigid test shall be acceptable to the Procuring Agency.

F-2b. Oil Centrifuge. - An oil centrifuge, external of the engine, shall not be used.

F-2c. Instrument Calibrations. - All instruments, gages, scales and other equipment upon which the accuracy of the test results depends shall be calibrated often enough to assure laboratory accuracy.

F-2d. Revolutions Per Minute. - The crankshaft revolutions per minute shall be determined by means of a positive counter which will actually count the revolutions for a period of not less than one minute. A combination unit which counts the revolutions while measuring the time required to consume the specified weight or volume of fuel, is preferred.

F-2e. Fuel Flow. - Fuel flow measurements shall be made by either the volume or weight method. The quantity selected for the volume or weight method shall be such that each reading will cover an elapsed time of at least one minute. Flow meter readings for calculations of specific fuel consumption shall be used only when the flow meter, and the use thereof, has been approved by the Government. Regardless of the method used in determining fuel and oil consumption, all expressions of quantity shall be reported on a weight basis.

F-2f. Air Flow. - Air flow measurements, if made, shall be made by a method acceptable to the Procuring Agency, preferably by use of a smooth approach nozzle or venturi tube.

F-2g. Vapor Pressure Determination. - Vapor pressure shall be determined by means of standard vapor pressure charts from readings of wet and dry bulb thermometers (or other method acceptable to the Procuring Agency). When using atmospheric air, wet and dry bulb thermometers may be located either in the air entrance duct or adjacent thereto. When using conditioned air the location of thermometers for determining vapor pressure shall be acceptable to the Procuring Agency. Air Velocity over the wet bulb thermometer shall be sufficient to insure reasonable accuracy. The thermometers shall be so arranged that the air passing over the wet bulb will not subsequently pass over the dry bulb. The wick of the wet bulb shall be kept wet with distilled water only. The wick of the wet bulb shall be replaced whenever a perceptible quantity of oil, dirt, incrustation or other foreign substances shall be accumulated thereon.

F-2h. Temperature Measurements. - Cylinder head temperatures of air-cooled engines shall be taken on the lee side of the cylinder between the intake and exhaust valve at approximately the top of the combustion chamber or at the hottest spark plug gasket, of each cylinder. The cylinder barrel temperatures shall be taken on the lee side of the cylinder in the fillet

where the cylinder barrel joins with the cylinder hold-down flange. In the case of liquid-cooled engines the cylinder temperature shall be taken at the hottest spark plug gasket. All temperatures shall be reported in degrees Fahrenheit.

F-3. Test Methods:

F-3a. Preliminary Data. - The engine weight, if not previously obtained, photographs, and other pertinent engine data desired by the Procuring Agency shall be obtained preferably at the time the engine is being prepared for test. At the option of the Procuring Agency the engine may be disassembled for examination or measurement of parts prior to testing.

F-3b. Torsional Vibration. - Torsional vibration tests, ^{test stand} using the methods specified in Specification AN-9504, shall be made on the dynamometer prior to a 15-hour altitude endurance test and speeds corresponding to resonance periods shall be subsequently avoided, as far as practicable.

F-3c. Power Calibrations. - ^{at altitude test conditions} after installation on the altitude test stand, power calibrations shall be conducted at military rating with various speeds to determine the most satisfactory operating conditions. The Procuring Agency will determine, with the cooperation of the engine manufacturer, the conditions to be used for the endurance altitude test. ^{take off and cruise}

calibrations shall be conducted in case the entire 50 hour test is to be run on a reaction or rigid test stand.

F-3d. Fifty-Hour Endurance Test. - Following the power calibration, the engine shall be given the following 50-hour endurance test, the first 15 hours on the altitude test stand and the remaining 35 hours on either a reaction or rigid test stand.

under altitude test conditions

F-3d(1). The first 15 hours on the altitude test stand shall be composed of alternate periods of 30 minutes at military rated power and speed ratings selected by the Procuring Agency, and 30 minutes at 40 to 50 percent of military rated power and at a speed ^(to be determined from the propeller load curve). At the conclusion of the altitude test, the altitude testing equipment shall be removed and the engine calibrated under ground level atmospheric conditions for reaction or rigid test stand operation. ^{if such calibration has not been accomplished under paragraph F-3c.}

F-3d(2). Twelve and one-half hours on either a reaction or rigid test stand composed of fifty 15-minute periods divided into five minutes of take-off power and speed and ten minutes at maximum cruising conditions as established by the Procuring Agency, in cooperation with the engine manufacturer.

F-3d(3). Twenty-two and one-half hours of continuous operation at maximum cruising power and speed as established by the Procuring Agency, in cooperation with the engine manufacturer.

F-3e. Overspeed Test. - Overspeed tests on multi-speed or multistage supercharged engines shall be accomplished with lowest supercharger drive gear ratio only.

*of a speed obtained without
lock from motor prop without
change in propeller pitch.*

F-3e(1). Upon completion of tests called for in Paragraph F-3d and without intervening disassembly, the engine shall be subjected to 10 over-speed tests of 30 seconds plus or minus three seconds at 120 percent normal rated speed. 2760

F-4. Operating Test Conditions:

F-4a. For all testing, the fuel composition, grade of oil, limiting cylinder temperature and coolant outlet temperatures shall be as specified in the model specification.

F-4a(1). The knock ratings of the fuels specified for use in testing shall not exceed the minimum knock ratings specified in the fuel specifications by more than two octane numbers. For Grade 100 fuel, the maximum knock rating shall not exceed that of Iso-Octane plus 0.1 milliliter of tetraethyl lead per U. S. gallon, when tested in accordance with Specification AN-VV-F-746 and the rich mixture knock rating of the value of the fuel determined in accordance with Specification AN-VV-F-748 shall not exceed that incorporated in Specification AN-F-28 by more than 0.3 milliliter tetraethyl lead per U. S. gallon in the reference fuel.

F-4b. Oil Inlet Temperatures. - The oil inlet temperature with Grade 1120 oil shall be maintained at 85 degrees Centigrade plus or minus 3 degrees Centigrade (185 degrees Fahrenheit plus or minus 5 degrees Fahrenheit). The oil inlet temperature with Grade 1100 oil shall be maintained at 75 degrees Centigrade plus or minus 3 degrees Centigrade (167 degrees Fahrenheit plus or minus 5 degrees Fahrenheit), except for take-off and military rated power runs when the oil inlet temperature with Grade 1120 oil shall be maintained at 95 degrees Centigrade plus or minus 3 degrees Centigrade (203 degrees Fahrenheit plus or minus 5 degrees Fahrenheit), and the oil inlet temperature with Grade 1100 oil shall be maintained at 85 degrees Centigrade plus or minus 3 degrees Centigrade (185 degrees Fahrenheit plus or minus 5 degrees Fahrenheit).

F-4b(1). Oil Outlet Pressure. - The oil outlet pressure shall be maintained at 40 pounds per square inch during the testing specified herein, except for tests at less than 60 percent normal rated speed when it may be less as indicated by test conditions.

F-4c. Carburetor Air Temperature. - During all tests, except those under altitude conditions, the air temperature at the carburetor or air throttle entrance shall be maintained between 21 and 32 degrees Centigrade (70 and 90 degrees Fahrenheit) except for engines rated for use with external superchargers the temperature shall be as specified in the engine Model Specification but not less than 37.8 degrees Centigrade (100 degrees Fahrenheit). During tests under altitude conditions with single stage geared supercharged engines, the air temperature at the carburetor or air throttle entrance shall be maintained at the standard altitude value as closely as practicable. For engines equipped with multi-stage geared superchargers the temperatures shall be as specified in the engine model specification but not less than 32.2 degrees Centigrade (90 degrees Fahrenheit), when the auxiliary stage supercharger is in operation.

F-4d. Carburetor Air and Exhaust Pressure. - During portions of the test in which the engine power corresponds to a rating for which external or

multi-stage supercharging is required at sea level, the carburetor or air throttle entrance pressure and the exhaust pressure shall be maintained at values simulating operation at the particular power with the manner of supercharging to be employed. For engines intended for use with a turbine supercharger, but for which external supercharging is required to obtain take-off and military ratings at sea level, an absolute pressure of 32-33 inches of mercury shall be applied to the exhaust during all endurance operations at take-off and military power. 35
higher
in model spec.

F-4s. Speed. - At engine speeds greater than 95 percent military rated speed the engine speed shall be controlled to within plus or minus two percent of the stipulated speed. At engine speeds between 68 and 95 percent military rated speed, the engine speed shall be controlled to within plus or minus four percent of the stipulated speed. Unless specifically authorized by the Procuring Agency, no portion of the endurance run shall be accomplished with the propeller pitch controlled by a constant speed governor.

F-4f. Power. - Actual brake horsepower and not corrected brake horsepower shall be used for all endurance tests and the absolute manifold pressure shall be maintained to within plus 1-1/2 percent and minus zero percent of the value required to develop the specified power.

F-4g. Fuel and Oil Consumption. - The specific fuel consumption during each period of endurance run shall be maintained within limits of plus three percent and minus zero percent of the minimum guaranteed values specified in the model specification, for the corresponding powers and speeds. The specific oil consumption shall not exceed the value specified in the model specification.

F-4h. Accessory Drives. - Unless otherwise authorized by the Procuring Agency, actual accessories or suitable loading devices, the type of each to be acceptable to the Procuring Agency, shall be installed on all accessory drives and operated at normal loads during the 35 hours of endurance running specified in Paragraphs F-3d(2) and F-3d(3). Power calibrations of engine shall be made without loading accessory drives.

F-4h(1). When required by the Procuring Agency, the power take-off drive shall be loaded by a device adjusted to impose, when the engine is operated at normal rated speed, a torque within plus five percent and minus zero percent of the continuous torque rating specified for the drive in the specification under which the engine was built. At engine speeds higher than normal rated speed the torque imposed shall equal the said torque rating within limits of plus ten percent, minus zero percent. At engine speeds lower than normal rated speed, the torque imposed shall equal the said torque rating within the limits of plus five percent, minus 15 percent.

F-4h(2). When gun synchronizing impulse generators are installed, the impulse cable connections shall be spring loaded during the testing covered by Paragraphs F-3d(2) and F-3d(3).

F-4(3). When a propeller governor is installed it shall be adjusted to impose pressure upon any passages in the engine for conveying fluid to the propeller, of such magnitudes and during such portions of the test as the Procuring Agency may direct.

F-4h(4). If the endurance testing is accomplished with a propeller, a starter, the type to be specified by the Procuring Agency, shall be used to make all engine starts.

F-4i. Inspection and Adjustments. - Valve clearance adjustments, ignition breaker inspection and adjustment, spark plug cleaning and re-setting of gaps, oil cleaner inspection and cleaning and general external visual inspection of the engine, shall be made at the conclusion of 15 hours of operation on the altitude test stand. Replacement of spark plugs prior to the completion of the approval test shall be at the option of the Procuring Agency. Disassembly of the engine to any extent prior to the final tear-down inspection, except for the purposes stated above, shall be at the option of the Procuring Agency.

F-4j. The oil system shall be drained and filled with new oil at the start of the endurance test and thereafter at the discretion of the Procuring Agency.

F-4k. Intervals of endurance test operation of less than one hour's duration terminated by any engine failure, shall not be credited to the required test time. Endurance test time shall not be credited by increments shorter than 30 minutes, except when shorter periods are a test requirement.

F-4l. Actual horsepower output during the endurance runs shall be computed from the results of the power calibration, Paragraph F-3c. Specific fuel and oil consumption during the endurance run shall be calculated from this power.

F-4m. Overspeed Test Procedure. - Unless otherwise specified by the Procuring Agency, the overspeed tests shall be conducted as follows:

F-4m(1). All overspeed tests shall be made with a propeller.

F-4m(2). Dives shall be conducted preferably at the lowest manifold pressure which will give satisfactory firing of the engine.

F-4m(3). Overspeed tests shall be alternated with stabilizing runs of about five minutes duration each, at from 60 to 80 percent of normal rated speed. Acceleration and deceleration shall each be accomplished in a period not longer than ten seconds. The time for changing speed shall not be deducted from the specified duration time for overspeed tests.

F-4m. Data:

F-4m(1). During the 15-hour test on the altitude test stand, at least the following data shall be recorded for each 30-minute period:

Total endurance time
Dynamometer scale load
Revolutions per minute of the crankshaft
Absolute manifold pressure
Intake manifold temperature
Air temperature at entrance to engine
Absolute air pressure at entrance to engine

Absolute exhaust pressure
Liquid coolant temperature leaving engine
Oil temperature at inlet to pump
Oil temperature leaving engine
Oil pressure in pounds per square inch
Fuel pressure in pounds per square inch
Fuel consumption
Crankcase pressure
If air-cooled, the cylinder head or spark
plug gasket temperature and the base temperature
on the cylinder which has the highest temperature.

F-4n(2). During the first 12-1/2 hours operation at the reaction or rigid test stand, no more than initial and final 15 seconds of each ten minute period at the lower speed shall be used for deceleration and acceleration. At least the following readings shall be taken once during each period:

Total endurance time
Revolutions per minute of the crankshaft
Absolute manifold pressure
Intake manifold temperature
Air temperature at entrance to engine
Liquid coolant temperature leaving engine
Oil temperature at inlet to pump
Oil temperature leaving engine
Oil pressure in pounds per square inch
Fuel pressure in pounds per square inch
Fuel consumption
Crankcase pressure
If air-cooled, the cylinder head or spark plug
gasket temperature and the base temperature on
the cylinder which has the highest temperature.

F-4n(3). During the last 22-1/2 hours of the test on the reaction or rigid test stand, the following data shall be recorded at intervals not greater than 30 minutes:

Actual time of day
Total endurance time
Revolutions per minute of crankshaft
Torque (if obtained)
Absolute manifold pressure
Intake manifold temperature
Absolute air pressure at inlet to engine
Air temperature at inlet to engine
Crankcase pressure
Liquid coolant temperature at inlet to pump
Liquid coolant temperature leaving engine
Liquid coolant flow (if obtained)
Liquid coolant pressure at inlet to pump
Liquid coolant pressure leaving engine
Oil temperature at inlet to pump
Oil temperature leaving engine

Oil pressure (engine)
Oil pressure at inlet to pump
Oil pressure at outlet of engine
Oil flow
Oil scale reading
Fuel consumption
Fuel pressure
If air-cooled, the cylinder head or spark plug gasket and cylinder base temperatures of all cylinders.
If liquid-cooled, the temperatures of at least two cylinders taken at the hottest spark plug gasket.

F-4m(4). For each overspeed test and each stabilizing run at least the following data shall be recorded except as noted:

Tachometer R.P.M.
Absolute manifold pressure
Oil pressure (engine)
Oil temperature at inlet to pump
Oil temperature leaving engine
Oil flow, when measurement is practicable
Oil pressure at outlet of engine (stabilizing run only).
Crankcase pressure.

F-4m(5). Wet and dry bulb air temperature readings shall be taken at intervals not exceeding three hours.

F-4m(6). For the endurance testing at the reaction or rigid test stand the room barometer shall be read and recorded at intervals not exceeding three hours.

F-4m(7). The date, desired power and speed, model of spark plugs, supercharger gear ratio in use, type of air heater or hot spot and whether, in use or not, the engine model designation, and the Procuring Agency's and manufacturer's numbers of the engine shall be recorded on each log sheet.

F-4m(8). Notes shall be placed on the log sheets of all incidents of the run, such as change of spark plugs, valve clearance adjustments, leaks, vibration, and any other irregular functioning of the engine or the equipment.

F-4m(9). Corrections:

F-4m(9)a. To compensate for the variations in the temperature of the air entering the engine the manifold pressure required to develop the actual power output specified shall be calculated on the assumption that with constant manifold pressure the actual horsepower is inversely proportional to the square root of the absolute carburetor or air throttle entrance temperature. An alternative temperature correction may be used if based on substantiating test data acceptable to the Procuring Agency.

F-4n(9)b. All test values shall be on a basis of dry absolute manifold pressure which is obtained by subtracting the vapor pressure from the observed absolute manifold pressure.

F-4n(9)c. Correction of the Barometer or Mercury Manometer for Temperature. - The observed reading of a mercury column varies not only with changes in the applied pressure, but also with changes in the temperature of the mercury and of the scale. The observed readings must, therefore, be corrected to the values they would have if the mercury and scale were maintained at their standard temperatures. The correction given in Table 1 corresponding to the observed height of the mercury column and to the temperature indicated by a thermometer attached to the column, is to be added to or subtracted from the observed height to obtain the true height or, in the case of a barometer, the true barometric pressure. This correction shall be made for all readings greater than ten inches. Only the true barometer reading shall be recorded on the log sheet.

Dictionary terms
F-5. Tear-Down Inspection. - After completion of the above tests the engine shall be completely disassembled for examination of all parts and measurements as necessary to disclose excessively worn, distorted, or weakened parts. These measurements shall be compared with the contractor's drawing dimensions and tolerances, or with similar measurements made prior to the test when available.

F-6. General Inspection. - At convenient times prior to or during the progress of the test and during the tear-down inspection, the engine and its details of construction shall be examined to determine if the engine conforms to all requirements of the contract and specifications under which the engine was built.

F-7. Parts Failures. - If, during the test, a part fails, this part shall be replaced with a redesigned part or one of different material unless the Procuring Agency authorizes the installation of a new part of original design and material for one which failed due to faulty material or workmanship. The test shall be considered completed when every major part in the engine has been subjected to the complete test. At the discretion of the Procuring Agency redesign and re-testing may be required of any part which fails or indicates weakness after completing its test.

G. PACKAGING, PACKING AND MARKING FOR SHIPMENT.

G-1. Not applicable to this specification.

H. NOTES.

H-1. This specification establishes requirements for endurance testing of experimental engines particularly for military applications.

H-2. Definitions:

H-2a. Take-Off Speed. - Take-off speed is the speed designated by the contractor and accepted by the Procuring Agency.

H-2b. Military Rated Speed. - Military rated speed is the speed designated by the contractor and accepted by the Government.

H-2c. Take-Off Power. - Take-off power is the power designated by the contractor and accepted by the Procuring Agency.

H-2d. Military Rated Power. - Military rated power(s) is (are) the power(s) designated by the contractor and accepted by the Government. Military ratings shall be for 30 minutes duration.

H-2e. Military Rated Altitude. - Military rated altitude is the altitude at which military rated power is developed at military rated speed with full throttle under standard altitude conditions. (An engine with a two-speed or two-stage supercharger has two military rated altitudes).

H-2f. Manifold Pressure. - Manifold pressure is the absolute pressure in inches of mercury measured at the point specified by the accepted installation drawing of the engine. All test values shall be on a basis of dry absolute manifold pressure which is obtained by subtracting the vapor pressure from the observed absolute manifold pressure. (All manifold pressures shall be determined on test by a mercury barometer alone or with a mercury manometer).

H-2g. Military Rated Manifold Pressure. - Military rated manifold pressure is the absolute manifold pressure obtained with full throttle at military rated speed and military rated altitude under standard altitude conditions. This manifold pressure is the maximum manifold pressure used for military flight operations, except take-off, from sea level to military rated altitude. (An engine with a two-speed or two-stage supercharger may have two or more military rated manifold pressures.).

H-2h. Take-Off Manifold Pressures. - Take-off manifold pressure is the absolute manifold pressure required to develop take-off power at take-off speed under standard sea level conditions.

H-2i. Sea Level Engine. - A sea level engine is an engine which is designed for extended periods of full throttle operation at sea level.

H-2j. Altitude Engine. - An altitude engine is an engine which is designed for extended full throttle operation at altitude and for which full throttle operation at sea level is restricted or prohibited.

H-2k. Actual Brake Horsepower. - Actual brake horsepower is the actual horsepower output of the engine under the prevailing test conditions. This is sometimes referred to as "observed brake horsepower".

H-2l. Standard Conditions. - Standard conditions are the values of air temperature and pressure given in N.A.C.A. Technical Report No. 215. The standard of humidity, for the purpose of this specification, is zero vapor pressure at all altitudes. Standard conditions shall apply to carburetor or air throttle entrance pressure, temperature and humidity, and exhaust pressure.

H-2m. Carburetor or Air Throttle Entrance Pressure. - Carburetor or air throttle entrance pressure is the static absolute air pressure at the entrance (before the screen) to the carburetor or air throttle. It shall be determined on test by a mercury barometer alone or with a water or mercury manometer.

H-2n. Specific Fuel and Oil Consumption. - Specific fuel consumption is the weight in pounds of fuel consumed per actual brake horsepower per hour, and specific oil consumption is the weight in pounds of oil consumed per actual brake horsepower per hour.

H-2o. Mixture Adjustment. - The following definitions apply to any given speed and throttle position. "Full Rich" mixture adjustment is the adjustment in which the mixture control lever is the position giving maximum fuel flow. "Best Power" setting is the setting which gives the least fuel flow when maximum power is developed. "Best Setting" is that setting which results in a one percent drop in power from "Best Power" caused by a reduction in fuel flow.

H-2p. Maximum Power at Any Given Speed and Throttle Position. - Maximum power is the maximum actual brake horsepower which the engine will develop at any given speed and throttle position with optimum mixture strength.

H-2q. Propeller Load. - Propeller load horsepower is the horsepower represented by a curve drawn through the point of developed horsepower at designated speed and varying directly as the cube of the speed.

H-2r. Fuel-Air Ratio. - Fuel-air ratio is the ratio of fuel consumption to air consumption on a basis of weight rate of flow measurements.

H-2s. Main Stage Supercharger. - The main stage supercharger of a multiple stage supercharger is the stage discharging mixture directly into the intake manifold system.

H-2t. Auxiliary Stage Supercharger. - The auxiliary stage supercharger of a multiple stage supercharger is the stage through which the air passes before entering the main stage. Normally an intercooler and the carburetor are between the auxiliary and main stages.

H-3. Copies of National Advisory Committee for Aeronautics Report No. 218 may be obtained upon application to the Superintendent of Documents, Washington, D. C.

H-4. NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever and the fact that the Government may have formulated, furnished or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

(Copies of this specification may be obtained from the Office of the District Supervisor in the following Army Air Forces Procurement Districts: New York, Atlanta, Detroit, Chicago, Wichita and Los Angeles; or from the Commanding General, Army Air Forces, Materiel Command, Wright Field, Dayton, Ohio).

AHM:cmh 1-25-44

Spec. Rel. 1-10-44