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MODEL SPECIFICATION

ENGINE, AIRCRAFT: MODEL V-3420-23

ALLISON DIVISION
General Motors Corporation
Indianapolis, Indiana

ALLISON MODEL V-3420-B10

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 Allison Division of General Motors Corporation
 Allison Model V-3420-B10

A. APPLICABLE SPECIFICATIONS

A-1. The specification listed on pages 20 and 21 except as revised herein shall form a part of this specification.

B. TYPE AND MODEL

B-1. This specification covers the requirements for the V-3420-23 engine.

B-1a. The V-3420-23 (B-10) engine is a 24 cylinder liquid-cooled double Vee type engine equipped with an outboard reduction gear with coaxial counter rotating propeller shafts. It is equipped with an integrally mounted auxiliary stage supercharger which is driven through a variable speed hydraulic coupling. Automatic controls are provided for controlling manifold pressure and auxiliary stage speed.

C. MATERIAL AND WORKMANSHIP

C-1. The requirements for material and workmanship shall be as specified in Specification AN-9500.

D. GENERAL REQUIREMENTS

D-1. See Section E.

E. DETAIL REQUIREMENTS

E-2. Drawings and Data. The following Allison Division drawings shall form a part of this specification:

53206	Engine Assembly, complete showing accessory drive oil seals
53205	Installation drawing (showing clearances for engine accessories and their removal)
43012	Priming System Assembly
42870	Carburetor - PR5BE3- Bendix-Stromberg
53466	Spark Plug Assembly - Champion C-34S*
44099	Spark Plug Assembly - AC - LS86
42354	Contact Assembly - Spark Plug Terminal Lubrication System diagram (Included in Service Manual)
53237	Shielding Assembly
53626	Assembly, Auto Engine Power Control. Photographs.

E-3 Acceptance

E-3a Model Test The engine shall be model tested in accordance with AN9502 with the following exceptions:

- (1) (Ref. Par. F-1 General) The model test shall be conducted at the Contractor's plant.
- (2) (Ref. Par. F-3 Test Methods) Two engines shall be used for the tests required by this specification. One of the engines shall be used for dynamometer runs to determine altitude performance, automatic control operation and other tests which may be required. The other engine shall be used for the endurance test only. The calibration engine shall be modified to incorporate a single propeller shaft reduction gear assembly mounted on the nose of the engine similar to the V-3420-17 (A18R) engine. The power section shall be identical to the endurance engine except for the necessary modifications to install and operate with the integrally mounted reduction gear.
- (3) (Ref. Par. F-3e(2) 150-Hour Endurance Run) The following schedule for model testing shall be followed. All testing shall be accomplished on a sea level stand. During Runs No. 1 to 9, inclusive, the auxiliary stage air shall be wasted and the engine shall be operated at an air flow through the power section equal to that required at the specified altitude to give the specified power. During these runs, the auxiliary stage shall be loaded by a weight of air equal to that flowing through the power section. During Runs No. 10 to 16, inclusive, the engine shall be run at the specified horsepower with the interstage duct installed and the speed of the auxiliary stage determined by the auxiliary stage automatic control.

150 HOUR ENDURANCE SCHEDULE

Run No.	Ref. Par.	Hours	Alternate Periods	Specified HP	Specified ALT	Specified RPM	Aux. Stage Engagement
1.	F-3d(1)	7	3 1/2	2100	10,000	2600	{Slip for Normal H.P. at 10,000 ft.
			3 1/2	1890	10,000	2520*	
2.	F-3d(1)	3	1 1/2	2100	17,000	2600	Minimum Slip
			1 1/2	1890	17,000	2520	Minimum Slip
3.	F-3d(3)	15	15 min.	2300	20,000	3000	Minimum Slip
			30 min.	Prop. Load	20,000	55-65% Mil.	Minimum Slip
4.	F-3d(4)	7	3 1/2	2100	10,000	2600	{Slip for Normal H.P. at 10,000 ft.
			3 1/2	1680	10,000	2420*	
5.	F-3d(4)	3	1 1/2	2100	17,000	2600	Minimum Slip
			1 1/2	1680	17,000	2420	Minimum Slip
6.	F-3d(5)	7	3 1/2	2100	10,000	2600	{Slip for Normal H.P. at 10,000 ft.
			3 1/2	1470	10,000	2315*	
7.	F-3d(5)	3	1 1/2	2100	17,000	2600	Minimum Slip
			1 1/2	1470	17,000	2315	Minimum Slip
8.	F-3d(6)	7	3 1/2	2100	10,000	2600	{Slip for Normal H.P. at 10,000 ft.
			3 1/2	1260	10,000	2185*	
9.	F-3d(6)	3	1 1/2	2100	17,000	2600	Minimum Slip
			1 1/2	1260	17,000	2185	Minimum Slip

*During the 10,000 ft runs, the same coupling oil control tube setting shall be used for the low speed runs that is used for the 2600 RPM runs.

Run No.	Ref. Par.	Hours	Alternate Periods	Specified HP	Specified ALT	Speed RPM	Aux. Stage Engagement
10.	F-3d(1)	15	2 1/2	2100	SL	2600	As determined by controls
			2 1/2	1890	SL	2520	As determined by controls
11.	F-3d(2)	15	5 min.	2600	SL	3000	As determined by controls
			10 min.	Idle	SL	Idle	As determined by controls
12.	F-3d(4)	15	2 1/2	2100	SL	2600	As determined by controls
			2 1/2	1680	SL	2420	As determined by controls
13.	F-3d(5)	15	2 1/2	2100	SL	2600	As determined by controls
			2 1/2	1470	SL	2315	As determined by controls
14.	F-3d(6)	15	2 1/2	2100	SL	2600	As determined by controls
			2 1/2	1260	SL	2185	As determined by controls
15.	F-3d(7)	15	Continuous	882	SL	1456*	As determined by controls
16.	F-3d(8)	5	Continuous	2100	SL	2860	As determined by controls

*Note (1) The speed for Run No. 15 shall be as low as can be obtained with the propeller available for testing but not lower than 1456 RPM.

Note (2) The speed changes required by Par. F-3e(2) of AN 9502 shall not be made.

- (4) (Ref. Par. F-4a(1) Knock Rating of Fuels) The fuel used for model testing shall conform to Grade 130 AN-F-28 Amendment No. 2.
- (5) (Ref. Par. F-46 Carburetor Air Temperature) During the altitude runs (No. 1 to 9) on the sea level stand, the carburetor air temperature shall be that observed at the specified altitude during the altitude calibration when operating with standard atmospheric conditions at the auxiliary stage inlet but not less than 70°F. During the sea level runs with the interstage duct installed (No. 10 to 16), the auxiliary stage inlet air shall be 70°F. to 90°F.
- (6) (Ref. Par. F-4g Fuel and Oil Consumption) The specific fuel consumption for the normal power 110% normal speed run (No. 16) shall be increased by .03 lbs./BHP/Hr. above the guaranteed value for normal power and speed. During the altitude runs (No. 1 to 9) on the sea level stand, the fuel air ratio shall be that determined from the fuel air vs. air flow curve established by the sea level guarantees.
- (7) (Ref. Par. F-4i Inspection and Adjustments) In addition to the normal cleaning and adjustments, the spark plugs may be cleaned before the 15-hour take-off period, Run No. 11.

F-3b Acceptance Test The acceptance of this engine in production shall be based upon tests run in accordance with AN-9503 with the following exceptions:

- 1) (Ref. F-1 General) Production acceptance test running of each engine shall be accomplished without employing the Intermediate Coupling and Extension Shaft Center Bearing Assembly, Allison Part No. 54404.
- (Ref. Par. F-5a(1) Two Hour Initial Run) In lieu of the requirements of this paragraph, the following runs shall be made in the order listed: One hour run at 89% normal rated speed on propeller load, one-half hour at 90% normal sea level manifold pressure on ~~propeller load and one-half hour at 100% normal sea level rated the manifold pressure~~ During the last fifteen minutes of the 90% normal manifold pressure and the last ten minutes of the 100% normal manifold pressure runs, the auxiliary stage coupling

- control shall be adjusted for minimum slip and the manifold pressure reduced to a limit with a safe operation margin to prevent damage to the engine. During the first part of these runs, the auxiliary stage coupling control shall be adjusted to give maximum slip. During "minimum slip" operation, the air stack shall be throttled. During the 100% normal manifold pressure run, the oil consumption shall be measured.
- (3) (Ref. Par. F-5a(1)a Clutch Shift Run) The requirements of this paragraph shall not apply. Hydraulic coupling operation shall be checked by the changes in speed and power during the runs specified in paragraph E-3b(1) above.
 - (4) (Ref. Par. F-5a(1)b Take-off Run) During the take-off run, the auxiliary stage coupling control shall be set to obtain the slip required for take-off manifold pressure.
 - (5) (Ref. Par. F-5a(3) Penalty Run) At the option of the contractor, penalty runs affecting any one of the major assemblies (engines or outboard reduction gear) may be run with other "workhorse" or standby assemblies.
 - (6) (Ref. Par. F-5c(1) One Hour Final Run) The 1/2 hour normal manifold pressure run shall be made first followed by the 1/2 hour 90% normal manifold pressure run. The last ten minutes of the normal manifold pressure run shall be made with the auxiliary stage coupling control set for minimum slip and the manifold pressure reduced to a limit with a safe operation margin to prevent damage to the engine. During the first twenty minutes of the first run and during the last one-half hour run, the auxiliary stage coupling shall be set for maximum slip.
 - (7) (Ref. Par. F-5c(2) Clutch Shifts) The requirements of this paragraph are not applicable. Hydraulic coupling operation shall be checked by the runs specified in paragraphs E-3b(2) and E-3b(6) above.
 - (8) (Ref. Par. F-5c(3) Take-off Check) The take-off check shall be made as specified in E-3b(4) above and shall be made prior to the final run of Par. F-5c(1). Following the take-off check, the engine shall be shut down and inspected for coolant, oil and fuel leaks.
 - (9) (Ref. Par. F-5c(4) Magneto Check) The magneto check shall be made starting at a speed of 2300 RPM instead of 85% normal rated speed. The auxiliary stage coupling shall be set as per above Par. E-3b(4) (Ref. F-5a(1)b) slip.
 - (10) (Ref. Par. F-6j Multistage Superchargers) In lieu of the requirements of this paragraph, the tests outlined under Par. E-3b of this specification shall be applicable since the auxiliary stage air shall not be wasted.
 - (11) (Ref. Par. F-9 Preparation for Storage) The engine shall be prepared for storage in accordance with Par. E-14 of this specification.

E-4. Dry Weight of Complete Engine The total dry weight of the engine shall not exceed the value listed below.

Basic engine including integral superchargers, supercharger drive mechanism, coolant pumps and piping on the engine, engine lubrication system, oil pumps, starter connection including starter dog, tachometer drive, fuel pump drive, generator drive, power take-off drive, vacuum or hydraulic power pump drive and all piping and controls between engine parts -

Basic Engine	2572
Carburetor and Injection Nozzle	50
Air Intake screen and gasket included with basic engine.	
Magnetos	28
Ignition Distributors and Radio Shielded Ignition Assembly complete with Cable	66
Spark Plugs	12
Priming system on engine	2
Cooling Air Deflectors	None
Accessory Drive covers	2
Automatic Controls	18
	<hr/> 2750 lbs.

Outboard Reduction Gear Assembly, including gun syn. drive (but not including gun syn.) hydraulic power pump drive.	390
Extension shafts and support bearing	135
TOTAL DRY WEIGHT OF ENGINE	<hr/> 3275 lbs.

E-5. Performance Characteristics. The ratings specified herein, and the curves specified herein and shown on pages 17, 18, and 19, shall constitute the power and specific fuel consumption guarantees unless otherwise specified on the curve sheet. The terms used and the standard conditions shall be in accordance with the applicable definitions contained in either Specification AN-9502 or AN-9503.

E-5a. Ratings. The engine shall be rated as follows, using fuel conforming to Grade 130, Specification AN-F-28 Amendment No. 2 and oil conforming to Spec. AN-VV-O-446, Grade 1120, and coolant conforming to Specification AN-E-2 (Ethylene Glycol.)

- 2100 BHP at 2600 RPM at sea level
- 2100 EHP at 2600 RPM at 17,000 feet normal rated altitude.
- 2600 BHP at 3000 RPM take-off for 5 minutes.
- 2300 BHP at 3000 RPM military rating at 20,000 feet for 15 minutes.
- 3120 RPM rated over speed dive r.p.m.

Note: Military rating shall be 15 minutes duration for flight and 15 minutes for type test purposes.

E-5b. Curves. The following curves shall be furnished as part of this specification.

E-5b(1) Horsepower vs. altitude at rated speeds up to and including the guaranteed altitude of the engine as shown on page 17.

- E-5b(2) Estimated horsepower at full throttle vs. altitude as shown on page 18.
- E-5b(3) Specific fuel consumption at low powers and low speeds and a table of guaranteed fuel consumption as shown on page 19.
- E-5b(3)a The data furnished on the above curves shall be based upon standard temperature and pressure at the entrance to the auxiliary stage. Since intercooling is not required, the requirements of paragraph E-5b(3)a of AN-9501 are not applicable.

E-5e. Specific Oil Consumption. The specific oil consumption shall not exceed .025 lb/BHP/hr. at normal rated power and speed and at 70% normal rated power and 89% normal rated speed.

E-5h. Coolant Flow and Heat Rejection. The following guarantee is given for coolant flow and heat rejection to the coolant, when operating on a dynamometer for 5 minutes with a 60°F., 10 MPH air blast over the engine:

Conditions:

Power	Take-off 2600 BHP
Speed	Take-off 3000 RPM
Fuel Consumption	Guaranteed specific
Oil Inlet Temp.	203°F.
Oil Pressure	65 p.s.i.
Coolant Outlet Temp.	250°F.

Guarantee:

Coolant flow not to exceed 530 GPM
Heat to coolant not to exceed 36,500 Btu/min. (860HP)

E-5h(1). Coolant Pump Characteristics. In lieu of the coolant, pump flow data required by AN-9501, Paragraphs E-5h(1); E-5h(1)a; E-5h(1)b, the engine manufacturer will supply estimated coolant pump performance characteristics to the airplane manufacturer for preliminary design purposes. Characteristic curves required by AN9501 Par. E-5h(1); E-5h(1)a; and E-5h(1)b will be supplied prior to the 10th production engine.

E-5j. Oil Flow and Heat Rejection. The following guarantee is given for oil flow and heat rejection to the oil, when operating on a dynamometer for 5 minutes with a 60°F, 10MPH air blast over the engine:

Conditions:

Power	Take-off 2600BHP
Speed	Take-off 3000RPM
Fuel Consumption	Guaranteed specific
Oil Inlet	203°F.
Oil Pressure	65 p.s.i.
Coolant Outlet	250°F
Coolant flow not to exceed	530 GPM

Guarantee:

Oil flow not to exceed 375 lbs/min.
Heat rejection to oil 17,000 Btu/min. (400 H.P.)

E-6. Engine Performance The complete engine shall function satisfactorily up to 35,000 feet at the powers and speeds shown on Page 17.

E-7. Propeller The engine shall have a No. 50 and No. 70 dual propeller shaft end in accordance with the requirements of SAE Standard No. AS-91 except:

- (1) NN shall be the dimension of an adjustable nut, BB shall be an undercut on the nut instead of a radius and the front face of the nut shall not be held square with KK within .002 indicator reading. The limit on squareness shall be determined by the tolerances shown on Allison Dwg. 53563 (no revision letter) and 53272-G.
- (2) RR shall be 4-11/16 in. instead of 4.602 ±.010.
- (3) The tolerance of P shall be ±.015 instead of ±.010.
- (4) CC shall have a tolerance of ±.025 instead of ±.010.
- (5) The tolerance of I shall be ±.030 instead of ±.020.
- (6) J shall have a tolerance of ±.035 instead of ±.030.
- (7) K shall have a tolerance of ±.020 instead of ±.010.
- (8) The tolerance of N shall be ±.025 instead of ±.010.
- (9) The chamfer at the rear of the thread on the No. 50 shaft shall be 30° instead of 45°.
- (10) Each shaft shall have a blank spline.

Provision shall be made for mounting a governor as specified in Par. E-36g of this specification.

E-12. Overall Dimensions The overall dimensions of the engine shall not exceed the following:

Length	- - - - -	270 inches
Width	- - - - -	59-15/16 inches
Height	- - - - -	40-15/16 inches.

E-14. Preparation for Storage The engine shall be prepared for storage in accordance with AN-F-E-568 with the exceptions to paragraphs as listed below:

- (1) (Par. B-1a AN Aero Specification) The requirements of Specification AN-C-80 shall not be applicable.
- (2) Par. B-1b ANA Standard Drawings) The following Allison drawings shall apply in lieu of AN parts.
 - 36411 - Cap-No 50 Prop Shaft Thread
 - 43401 - Envelope - Engine Protector
 - 103704 - Protector - No. 70 Prop Shaft Thread

- (3) (Par. C-2 Auxiliary Oil Tank) The auxiliary oil tank shall not be included in the test stand equipment but shall be installed as part of the "motoring-in" equipment used subsequent to the clear fuel run.
- (4) (Par. F-2a(1) Operation Procedure) The requirements of this paragraph shall not apply. As soon as possible and not later than 8 hours after the clear fuel run, the engine shall be "motored-in" at 40 to 80 RPM crankshaft speed for a minimum of 5 minutes after the engine oil outlet temperature reaches 220°F. Also during this operation, dry air at approximately 30% relative humidity at room temperature heated to approximately 250°F. shall be circulated through the breather system.
- (5) (Par. F-3d Exhaust Ports and Manifolds) Dehydrating agent shall not be installed in the exhaust ports.
- (6) (Par. F-3h Intake Manifold) A one-pound bag of dehydrating agent shall be secured to the inside of the air intake cover.
- (7) (Par. F-3m Crankcase) A dehydrator plug AN 4061 shall be installed in a suitable opening of the crankcase.
- (8) The outboard reduction gear assembly, extension shafts, and support bearings shall be prepared for storage as nearly as practical in conformance with AN-F-E-568.

E-18. Propeller Drive The engine shall be equipped with a reduction gear ratio of 2.458:1. The direction of rotation when viewed from the antipropeller end of the engine shall be clockwise for the No. 50 shaft and counter-clockwise for the No. 70 shaft. The reduction gear shall be mounted outboard and driven by two extension shafts rotating at crankshaft speed. The gear box shall be lubricated from an external tank of approximately 3 gallons oil capacity which shall not be furnished with the engine. The maximum oil flow required for the reduction gear assembly shall be approximately 40 lbs/min. The reduction gear assembly shall function satisfactorily with lubricating oil in conformance with AAF Specification AN-O-3 Grade M at a maximum inlet temperature of 65.6°C. (150°F.) It is estimated that the heat rejection to the reduction gear oil at 40 lbs/min. oil flow and take-off power and speed will be 594 Btu/min. (14 HP).

E-19. Impeller Gear The impeller gear ratio and diameters shall be as follows:

Engine stage 6.82:1 and 10 inches
Aux. Stage 7.38:1 (no slip) and 12-3/16 inches.

E-20. Pistons The engine shall be fitted with pistons of 6.65:1 compression ratio.

E-23a(1). Spark Plugs The engine shall be fitted with AC-LS86 or Champion C34S*, Spark Plugs except that the date of manufacture shall not be marked on the plug.

E-23b. Radio Shielded Ignition Assemblies The ignition distributors and magneto shall be designed to permit supercharging from the auxiliary stage supercharger outlet. The engine shall be equipped with Allison-designed radio shielded ignition assemblies with the following exceptions to Specification AN 9510:

- (1) (Ref. Par. A-1) The following specifications except as modified herein shall apply in lieu of those listed in AN-9510:

AAF Spec. 32427	High Tension Cable
AN-P-4	Plugs - Spark
AN-M-4	Magnetos
- (2) (Ref. Par. D-1b Accessibility) The requirements shall be met except that it shall be necessary to loosen part of the shielding assembly to replace the intake spark plug conduits or cable.
- (3) (Ref. Par. D-3 Marking) The high tension ignition cables shall be marked with the proper cylinder designation.
- (4) (Ref. Par. D-5 Bonding) The requirements of this paragraph shall not apply.
- (5) (Ref. Par. D-8 Nameplate) A nameplate shall not be provided.
- (6) (Ref. Par. E-1a Single Cable Conduits) Single cable conduit connections shall be as shown on Allison Drawing Nos. 44888 and 53166.
- (7) (Ref. Par. E-6 Weight) The requirements of this paragraph shall not apply.
- (8) (Ref. Par. E-7 Watertightness) The requirements of this paragraph shall not apply.
- (9) (Ref. Par. E-8 Capacitance) The capacitance between the shielding and each ignition cable contained therein shall not exceed 175 micromicrofarads.

E-23c. High Tension Ignition Cable. (Ref. AN-9500, Par. D-23c) High tension cable shall conform to AAF Specification No. 32427.

E-23d. Magnetos The engine shall be equipped with two Scintilla Type DFLN5 magnetos in accordance with AN-M-4 with the following exceptions:

- (1) (Ref. Par. D-1g(1)a Type Designation) The type designation shall be DFLN5, utilizing the "F" to denote a flange-type mount and omitting the numeral to designate the number of cylinders.
- (2) (Ref. Par. D-1h Distributor Block Cable Connection) The requirements of this paragraph are not applicable. The distributor blocks are not furnished with the magneto.

- (3) (Ref. D-1j Ground Terminal) Each magneto shall be provided with a primary ground terminal conforming to AN-3105 and terminal socket as shown in Figure 2 except that the terminal shall be secured by a hexagon nut.
- (4) (Ref. Par. D-3b Installation Instruction) The requirements of this paragraph are not applicable.
- (5) (Ref. Par. D-4g(4) Rain and Spray) Requirements of this paragraph shall not be applicable. The installation of this magneto on Vee-type engines requires and permits maximum ventilation in the breaker cover.
- (6) (Ref. Par. D-4h Endurance) The requirements of this paragraph shall be applicable except as modified by deviations to paragraphs F-6h(1).
- (7) (Ref. Par. E-2a Mounting Pad) The mounting pad and drive shall conform to the dimensions shown on the Allison Division drawing of the magneto, No. 53101.
- (8) (Ref. Par. E-2b Coupling) The coupling shall conform to the detail requirements indicated on the Allison Division drawing of the magneto, No. 53101.
- (9) (Ref. Par. F-5 Test Conditions) The requirements of this paragraph shall apply except that the tests specified at room temperature shall be performed at atmospheric temperature of 15°C. to 35°C. (Approximately 59°F. to 95°F.)
- (10) (Ref. Par. F-6a Conditioning) In lieu of the requirements specified, the following shall apply: The standard sphere gap as shown in Figure 3 set a 3 millimeters, unless otherwise specified, shall be used to calibrate test gaps used on all tests described below.
- (11) (Ref. Par. F-6h(1) Operating Run) In lieu of the requirements of this paragraph, the following shall apply: The magneto shall be run for 600 hours continuously, except when stopped for short intervals for servicing, in an ambient air temperature of 60°C. (140°F.) with the air passing over the magneto at 20 M.P.H., full spark advance, and rated maximum rotor speed with each lead connected to a standard test gap shunted by a normal load. No attention shall be required except by the breaker mechanism which may be reset and lubricated at 100-hour intervals. At the end of each hour, the primary current shall be short-circuited and grounded for a period of 5 seconds.

E-23d(1). Installation It shall be necessary to loosen the ignition cross-over tube nuts in order to remove the magneto.

E-23f. Cooling (Ref. Spec. AN-9500, Par. D-23f) Provision for cooling the spark plugs and the spark plug elbows shall consist of spark plug cooling manifolds as shown on Installation Drawing No. 53205. The airplane manufacturer shall make provision for circulating sufficient air through the cooling manifolds, and shall maintain engine compartment temperature suitable for operation of ignition parts when manufactured and installed in accordance with the following specifications:

Spark Plug - AN-P-4
 High Tension Cable - AAF Specification 32427
 Magneto - AN-M-4 (except as modified herein)

E-24c. Lubricating System After the model test with a mixture of equal parts of aviation gasoline and an oil having a viscosity of approximately 100 Saybolt Universal seconds at 98.9°C. (210°F.) supplied to the oil pump inlet at room temperature and under a head of three feet, the total flow of the oil into the engine due to the total leakage through both the engine and auxiliary stage pumps shall not exceed 0.5 pounds per hour.

E-24g. Oil Cleaner The engine shall be equipped with two Airmaze oil strainers. The engine power section shall be equipped with oil strainer Allison Part No. 44589 and the auxiliary stage with oil strainer Allison Part No. 53238. Foreign matter removed by the cleaners shall not re-enter the lubricating system under normal operating conditions.

E-24i. Oil Temperature Measurement Provision shall not be made for measuring oil inlet temperature.

E-24o. Lubrication Points The various components of the engine requiring lubrication other than from the engine lubricating system are as follows:

Outboard Reduction Gear Assembly - Separate Oil Tank
 (See Par. E-18)
 Extension Shaft Center Bearing - Manual Lubrication
 AN-G-3

E-24q. Crankcase Breathers Ample breathing capacity shall be provided in accordance with Par. D-24q of Specification AN-9500. It is desired that the airplane manufacturer shall locate the front and rear breather outlets to maintain a crankcase pressure measured at the front within the limits of +8 and -4 inches of water. It is also desired that the pressure at the front breather be held to 2 to 6 inches of water higher than pressure at the rear breather to provide proper ventilation through the engine from front to rear.

E-25. Fuel Metering System The engine shall be equipped with one Bendix-Stromberg Model PR58B3 injection carburetor in accordance with Specification AN-9515 except for the following:

- (1) (Ref. Par. D-10 Fuel Line Connection) The carburetor shall be furnished with one 3-bolt fuel inlet flange.

- (2) (Ref. AN-9515b, Par. D-9) The normal operating fuel pressure shall be 17 ± 1 lb/sq. in. in excess of the pressure of the air entering the carburetor.
- (3) (Ref. Par. D-32a(2) and Par. D-32a(3) Density Compensation) Carburetors which compensate automatically for densities shall hold at constant air flow the fuel air ratios obtained at standard sea level conditions to within the following limits at carburetor entrance densities and temperatures given below:

DENSITY COMPENSATION		
<u>Density (#/cu.ft.)</u>	<u>Temp. °F.</u>	<u>%Limits</u>
.10 - .05	-40° - +170°	±3%
.05 - .03	-40° - +150°	±7%

- (4) (Ref. Par. D-32b(1)) The military power referred to in this paragraph shall be sea level military or take-off power. The military guaranteed fuel consumption at critical altitude shall not apply to this paragraph.
- (5) (Ref. Par. D-32b(2)C) In the range from a speed midway between minimum idling speed and 50% of normal rated speed to 30% of normal rated power, the mixture strength shall not be richer than a straight line drawn between the following points.
- (a) A point at the speed midway between the minimum idling speed and 50% of normal rated speed which is 12% richer than best power at this speed.
- (b) A point at the air flow corresponding to 30% of normal rated power on propeller load which is 9% richer than best power.
- (6) (Ref. Par. D-32b(2)D) In the range between the air flows corresponding to 30% of normal rated power and 65% of normal rated power on propeller load, the mixture strength in auto rich shall fall within the limits specified below:
- (a) The minimum mixture strength at any point shall not be leaner than best power.
- (b) The rich limit shall not exceed 9% richer than best power at the air flow corresponding to 30% of normal rated power and 6% richer than best power at the corresponding air flows from 40% to 60% of normal rated power. At 65% of normal rated power the mixture strength shall fall between 2% and 7% richer than best power.
- (7) (Ref. Par. D-32b(3)) With the mixture control in the automatic lean position and in the range between the air flows corresponding to 30% of normal rated power and 65% of normal rated power on propeller load the mixture strength of the reference carburetor shall fall within the limits specified below:

- (a) The minimum mixture strength at any point shall not be leaner than best economy.
- (b) The rich limit shall not exceed 9% richer than best economy at the airflows corresponding to 30% and 65% of normal rated power and 6% richer than best economy at the corresponding airflows from 40% to 60% of normal rated power.
- (8) (Ref. Par. F-4e(3) Metering Test of Production Carburetors) The requirements of this paragraph shall be met except that mixture readings in automatic lean shall not be checked at air flows corresponding to 40, 80, and 90% normal rated air flows.

The carburetor shall be checked for automatic altitude compensation at air flows equivalent to 50% of normal rated power airflow with the mixture control in the auto-lean position at air box pressure of 0, -4, -8, -16 inches Hg. less than atmospheric pressure.

The mixture ratio on production carburetor tests at altitude air box conditions shall be within $\pm 2\%$ of the reference carburetor at densities of .076 to .050 lbs/cu. ft. at any constant temperatures in the range of 65°F. to 85°F. and within $\pm 3\%$ of the reference carburetor at densities of .050 to .030 lb./cu. ft.

E-26. Engine Starting Provision shall be made for priming the engine with fuel from an electric priming valve, connected to the engine priming lines and mounted on the carburetor. The valve shall be supplied with fuel from the carburetor at the carburetor fuel inlet pressure as specified herein. In lieu of the requirements of Par. D-26 of AN-9500, the following shall apply:

"The engine shall be capable of consistent starting when its temperature has been stabilized in an ambient temperature of minus 30°F. when cranked at a minimum of 30 RPM. This shall be accomplished with the specified lubricant diluted 30% by volume using the fuel specified in the engine model specification. The pour point of the diluted oil shall be minus 40°F. or lower. The use of special starting fuel shall be permitted. Consistent starting shall be defined as a complete start following not more than two 30-second cranking periods. Starting demonstrations when required shall be made in a laboratory under controlled conditions."

The specified lubricant for cold starting demonstration only shall be Grade 1100P of Specification AN-O-5.

E-30. Coolant Temperature The cooling liquid outlet temperature shall be 121°C. (250°F.)

E-30a. Coolant Pressure. The maximum inlet pressure to the coolant liquid pump shall be 50 in. Hg. absolute.

E-31a(3). Supercharger Drain Valve (Ref. Spec. AN-9500 Par. D-31a(3)). A fuel aspirator without a valve shall be the only provision made for automatic drainage of the induction system.

E-32a. . Exhaust Flange (Ref. Spec. AN-9500 Par. D-32a) The use of exhaust port flanges in accordance with Allison Part No. 36549 and gaskets, part No. 40751 shall be a requirement in the installation of this engine. The exhaust flanges shall not be furnished with the engine and separate procurement must be initiated by the airplane manufacturer. The gaskets and nuts shall be furnished with the engine..

E-34c. Coating Threaded Parts. Thread anti-seize compound shall be in accordance with AN-C-53 except where otherwise specifically approved by the Government.

E-36. Accessory Drives. The gear ratio of each accessory drive to the engine crankshaft, the maximum permissible torque in inch-pounds for continuous operation, the maximum permissible static torque in inch-pounds, and the direction of rotation when looking at the end of the accessory drive shaft in the engine shall be as follows:

ACCESSORY AND TYPE	NO. USED	RATIO TO CRANKSHAFT	MAX.TORQUE		ROTATION CLOCKWISE-C COUNTER CL-CC
			CONTINUOUS IN.	STATIC LBS.	
Starter IV	1	1.000:1		24,900	CC
Generator I-A	1	3.000:1	600	3600	C
Power Take-off	1	3.000:1	1000	5100	C
Fuel Pump	1	0.912:1	25	450	CC
Gun Syn.Impulse Generator	2	0.407:1	20	200	C
Vacuum & Hyd. Power Pump on Eng. Type II	1	1.284:1	150	2250	CC
Hyd. Power Pump on Reduc. Gear Box	1	1.266:1	150	2250	CC
Tachometer Type I	1	0.500:1	2.5	12.5	CC
Tachometer Type II	1	0.500:1	2.5	12.5	C

E-36a. Starter The requirements of AND 10004 shall be met except that the studs shall be located by rectangular dimensions from the center line of the pad with ± 0.005 limits instead of a stud circle. The gasket shall be 1/32 Aluminum instead of AN 4058, but shall be otherwise dimensionally interchangeable with AN 4058.

E-36b. Generator and Power Take-off The engine shall be provided with one Type I-A and one Type II-A drives in accordance with AND 10002 except as follows:

- (1) The oil hole plug shall be 1/16-27 NPT instead of 1/8 NPT.
- (2) The studs shall be located by rectangular dimensions from the center line of the pad with ± 0.005 tolerance instead of by a stud circle and angles.
- (3) The AN-4052 bushing shall not be furnished.
- (4) The gasket shall be 1/32 Aluminum instead of AN 4047, but shall be otherwise dimensionally interchangeable with AN 4047.

E-36d. Gun Synchronizing Impulse Generators Two drives shall be provided in accordance with Installation Drawing No. 53205, Sheet 2.

E-36d(1). Lubrication Provision shall be made for oil vapor lubricating the impulse generator by a hole through the shaft and a drain hole back into the engine. An oil shaft seal shall not be provided.

E-36d(2)a. The gun synchronizer mounting pads shall be located on the rear face of the outboard reduction gear and the face of the mounting pad shall be perpendicular to the longitudinal axis of the engine.

E-36e. Vacuum and Hydraulic Power Pump Two Type II vacuum and hydraulic power pump drives shall be furnished in accordance with AND 10001 except that the studs shall be located by rectangular dimensions from the center line of the pad with ± 0.005 limits instead of by a stud circle. The adapter flange AN 4055 shall not be furnished on the mounting pad located on the reduction gear box.

E-36g. Propeller Governor or Hydro Control Valve. The requirements of all items of Par. D-36g of AN 9500 shall be waived. In accordance with Materiel Command letter to Allison dated 8-17-43, EKC:djc-70-5P, a governor mounting pad shall be furnished conforming to AND 10010 except that the drive mechanism shall be omitted.

E-38a. Fuel Air Mixture Temperature Connection (Ref. AN 9500, Par. D-38a) Provision shall be made for taking fuel air mixture temperatures by connections located in the main stage supercharger outlet tee and also in each of the center manifolds. The size of the connections shall be 3/8 NPT instead of a 5/8-18 thread.

E-44. Automatic Controls Automatic Controls, designed to coordinate manifold pressure, auxiliary stage speed and magneto timing shall be furnished.

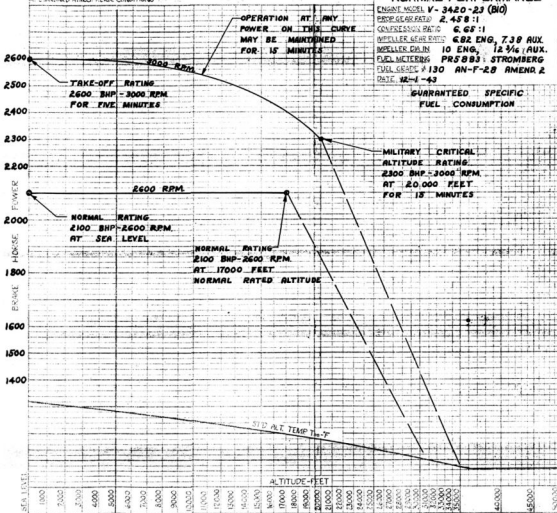
E-46. Torquemeter The engine shall not be equipped with a torquemeter.

ALTITUDE PERFORMANCE-HORSEPOWER AND MANFOLD PRESSURE

AIRCRAFT ENGINE

NORMAL PERFORMANCE

ENGINE MODEL V-3420-23 (BIO)
 PROP. GEAR RATIO 2.458:1
 COMPRESSOR RATIO 6.65:1
 IMPELLER GEAR RATIO 6.82 ENG, 7.38 AUX.
 IMPELLER DRAIN 10 ENG, 12 3/4 AUX.
 FUEL METERING PRS883; STROMBERG
 FUEL GRADE #130 AN-F-28 AMEND 2
 DATE 12-1-43



GUARANTEED SPECIFIC FUEL CONSUMPTION

SEA LEVEL PERFORMANCE, HORSEPOWER VS. MANFOLD PRESSURE WITH **AUTO RICH** MIXTURE STRENGTH UNLESS OTHERWISE NOTED

ALTITUDE PERFORMANCE - HORSEPOWER AND MANFOLD PRESSURE AT STANDARD ATMOSPHERIC CONDITIONS

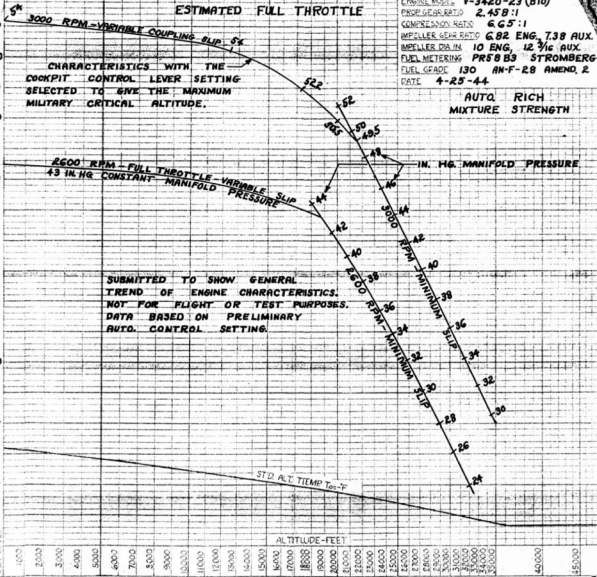
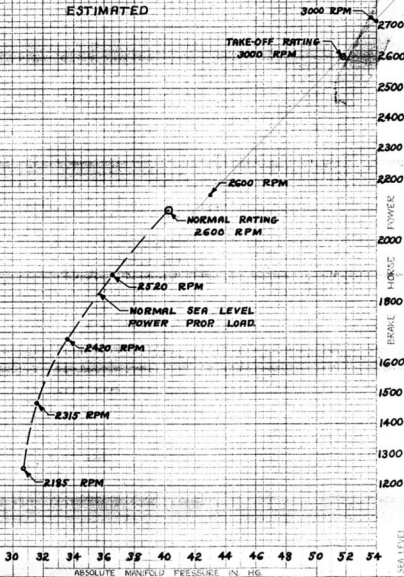
AIRCRAFT ENGINE
NORMAL PERFORMANCE

ENGINE MODEL: V-3420-23 (B10)
 PROPELLER GEAR RATIO: 2.458:1
 COMPRESSION RATIO: 6.65:1
 IMPELLER GEAR RATIO: 6.82 ENG, 7.38 AUX.
 IMPELLER DIA. IN: 10 ENG, 12 3/16 AUX.
 FUEL METERING: PR58B3 STROMBERG
 FUEL GRADE: 130 AN-F-28 AMEND. 2
 DATE: 4-25-44

AUTO RICH
MIXTURE STRENGTH

ESTIMATED

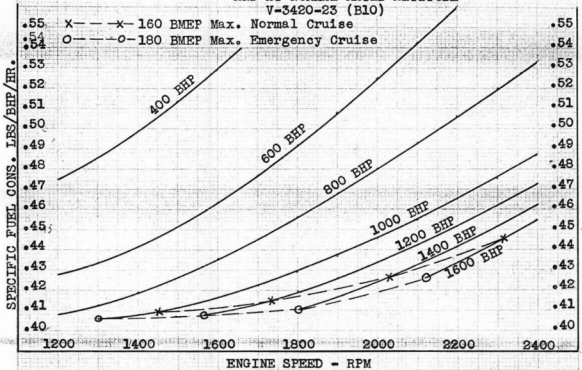
ESTIMATED FULL THROTTLE



CHARACTERISTICS WITH THE COCKPIT CONTROL LEVER SETTING SELECTED TO GIVE THE MAXIMUM MILITARY CRITICAL ALTITUDE.

SUBMITTED TO SHOW GENERAL TREND OF ENGINE CHARACTERISTICS. NOT FOR FLIGHT OR TEST PURPOSES. DATA BASED ON PRELIMINARY AUTO. CONTROL SETTING.

ESTIMATED BEST ECONOMY SPECIFIC FUEL CONS.
 BASED ON ENGINE REQUIREMENTS AT SEA LEVEL
 AND AT NORMAL RATED ALTITUDE
 V-3420-23 (B10)



Guaranteed B.S.F.C.
 on Normal S.L. Rated
 Propeller Load at
 Sea Level.

% Normal Power	LBS/BHP/HR
100%	0.63
90%	0.60
80%	0.54
70%	0.48
60%	Best Econ.

Take-off power -- 0.71

Military Power at
 Critical Alt. -- 0.75

Normal Power at
 Nor. Critical Alt. 0.67

The following specifications and drawings of the issue in effect as listed below and as modified herein shall form a part of this specification. Any revisions and/or amendments issued prior to date of bid for this model engine and after the particular dates listed below shall not be applicable.

<u>ANA Specs.</u>	<u>Rev.</u>	<u>Amend.</u>	<u>Dated</u>	<u>Title (In Brief)</u>
AN-VV-C-576	(a)	(1)	6-3-43	Compound - Corrosion Preventive
AN-F-E-568	(b)		10-22-43	Preparation for Storage
AN-GGG-P-363		(2)	5-9-42	Pipe Threads
AN-GGG-S-126	(a)		1-30-43	Screw Threads
AN-QQ-M-181	(a)	(1)	11-18-42	Magnetic Inspection
AN-VV-F-746		(1)	11-5-40	Fuel - Gen. (Knock Test)
AN-VV-F-748	(a)	(1)	3-23-43	Fuel - Gen. (Super Knock Test)
AN-E-2			7-23-42	Ethylene Glycol
AN-F-22			7-26-43	Fuel Grade 62
AN-F-26		(2)	11-15-43	Fuel Grade 91
AN-F-28		(2)	10-2-43	Fuel Grade 130
AN-VV-O-446	(a)		1-5-43	Oil Lubricating
AN-P-4		(2)	6-23-43	Spark Plugs
AN-O-5			4-27-43	Oil-Low Pour Lubricating
AN-M-4		(1)	1-19-44	Magnetos
AN-G-3	(a)	(2)	3-6-44	Grease Low Temp.
AN-C-53		(2)	12-21-43	Compound anti-seize
AN-QQ-P-421	(a)	(1)	11-12-42	Cadmium Plating
AN-O-3		(2)	1-7-44	E. P. Gear Oil
<u>Army-Navy Specs.</u>				
AN-9500	(b)		8-26-42	Engines - General
AN-9501	(b)		8-10-42	Engines - Model Spec.
AN-9502	(b)		8-11-42	Engines - Type Test
AN-9503	(b)		8-6-42	Engines - Acceptance Test
AN-9504		(1)	12-25-40	Engines - Torsional Vibration
AN-9510	(a)	(2)	6-19-42	Shielding - Radio
AN-9515	(b)		8-6-42	Carburetors
<u>AAF Specs.</u>				
32427		(1)	11-17-43	Cable-High Tension Ignition

<u>ANA Stand. Dwgs.</u>	<u>Rev.</u>	<u>Amend.</u>	<u>Dated</u>	<u>Title (In Brief)</u>
AN-4028			12-12-42	Markers- Ignition Cable
AN-4034			11-2-42	Data Plate
AN-4037			6-10-40	Oil Flange - 3 Bolt
AN-4044	(1)		8-1-42	Gasket- Vacuum Pump
AN-4045	(1)		8-1-42	Gasket- Vac. Pump Type I
AN-4047	(1)		8-1-42	Gasket- Generator
AN-4048			1-6-42	Oil Flange- 4 Bolt
AN-4055	(1)		8-11-42	Flange- Vacuum Pump
AN-4057			5-29-42	Gasket- Gun Synchr.
AN-4058	(1)		8-21-42	Gasket- Starter
AN-4059			9-2-42	Gasket- Fuel Pump
 <u>ANA Design Std.</u>				
AND-10001	(1)		10-3-42	Hyd. & Vac. Pump Pad - Type II
AND-10002			10-30-42	Generator Pad
AND-10003	(1)		9-5-42	Fuel Pump Pad
AND-10004	(2)		4-30-43	Starter Pad (All Types)
AND-10005	(1)		8-20-42	Tachometer Pad (Both Types)
AND-10006			8-24-42	Gun Synchr. Pad
AND-10010	(1)		6-12-43	Governor Pads
AND-10201	(1)		4-12-40	Carb. Screens and Gaskets
AND-10301	(1)		3-28-42	Vac. Pump Clearance - Type II
AND-10302	(1)		3-19-42	Hyd. Pump Clearance - Type II
AND-10303			9-2-41	Starter Clearance - Type IV
AND-10305			2-28-42	Generator Clearance
AND-10308			6-25-42	Gun Synchr. Clearance
AND-10310			12-5-41	Tachometer Clearance
AND-10320			2-16-42	Fuel Pump Clearance
 <u>SAE Standards</u>				
AS-91			7-1-43	Propeller Shafts; Dual Rotation

REVISION RECORD
Specification 234-B to 234-C
V-3420-23 (B-10)

Reference (a) Conference between Allison and Wright Field personnel
April 22, 1944

Reference (b) Allison letter of submittal of Specification 234-C to
Production Division dated April 29, 1944, WHK:mcc
(P35D29EE)

Specification 234-B was revised to the "C" Revision to incorporate changes which were agreed upon by Reference (a). Detailed changes were made to the paragraphs as listed below.

Par. E-3b Acceptance Test In sub-paragraphs 2 and 6, the term "power was changed to "manifold pressure." This change was made at the request of Production Division representatives in order to permit acceptance testing in a more practical manner. In sub-paragraph 7, reference to Par. E-3b(1) changed to E-3b(2) and E-3b(5) changed to E-3b(6) in order to correct an error. In sub-paragraphs 8 and 9, reference to Par. E-3b(3) was changed to E-3b(4) to correct an error.

Par. E-4 Dry Weight of Complete Engine The following sentence was deleted in the first paragraph, "It is estimated that the distribution of the various component parts shall be as follows" This change was made to conform to Production Division request.

Par. E-5a Ratings The following was added to the end of the first sentence, "and coolant conforming to Specification AN-E-2, Ethylene Glycol" to complete specification information.

Par. E-6 Engine Performance This paragraph was changed to state that the engine would function satisfactorily up to "35,000 feet at the powers and speeds..." instead of "up to the military powers and speeds..." This change was made at the request of Materiel Command.

Par. E-7 Propeller Sub-paragraph 1, the last sentence which covers the squareness of the nut on the #50 shaft by referencing Allison part numbers was added at the request of Materiel Command in order to more fully complete the deviation taken.

Par. E-14 Preparation for Storage Sub-paragraphs 3 and 4 were completely rewritten to show the actual procedure which would be used rather than a "procedure agreed upon between the procuring agency and the contractor." The paragraphs as rewritten conform to the agreements reached on the procedure to be used on the V-1710 engines and incorporate the "motoring-in" method instead of operation on the test stands with the special lubricating oil mixture.

Par. E-18 Propeller Drive Y-3587 was changed to AN-O-3, Grade M. This change was made at the request of Materiel Command since Y-3587 oil has been cancelled and can no longer be procured by the Government. Further

Revision Record

discussion concerning this change can be found in the conference agreements notes covering Reference (a). The last line of the paragraph concerning the estimated heat rejection has been added in order to complete specification information.

Par. E-23a(1) Spark Plugs The last of the sentence, "except that the date of manufacture shall not be marked on the plug" was added as per conference agreements. Actually, the statement is a deviation to Par. E-2 of Specification AN-P-4. It was stated that this deviation should be taken in Production Division letter dated March 10 to Allison, RJA:brm.

Par. E-23b(6) Radio Shielded Ignition Assemblies Part No. 53102 was omitted from the deviation on Single Cable Conduits since this drawing now includes Part No. 53166 which adequately covers the deviation. Sub-paragraph 7 of Specification 234-B was deleted entirely at the request of Materiel Command. This deviation stated that the requirements of Par. E-5d of Specification AN-9510 would not be required. Further discussion on this item is contained in the conference agreements notes. Sub-paragraphs 8, 9, and 10 of Par. E-23(b) were re-numbered 7, 8, and 9.

Par. E-23c High Tension Ignition Cables The last line of this paragraph was deleted since it was a deviation to the sealing requirements of the ignition cable of Specification 32427. Amendment 1 to this specification revised the requirements so the sealing is no longer necessary.

Par. E-23d Magnetos Sub-paragraph 12 of Specification 234-B which was a deviation to Par. F-6h(2) stated that the ambient air temperature during the elevated temperature run would be 150°F. instead of 200°F. has been deleted. Reference to F-6h(2) was taken out at the end of Sub-paragraph 6. In sub-paragraphs 7 and 8, Allison Part No. 53101 was added to the end of the paragraphs to complete necessary information.

Par. E-24c Lubricating System The total leakage has been changed from 0.6 to 0.5 lbs/hr. for the total leakage of both pumps. It was felt by Production Division representatives that 0.3 lbs/hr. was adequate for the engine pump and 0.2 lbs/hr. for the auxiliary stage pump.

Par. E-24q Crankcase Breathers The paragraph has been changed slightly so that it now reads "desire" rather than "must" regarding the maintaining of crankcase pressures indicated. To correct an error, D-24c has been changed to D-24q. These changes were made at the request of Materiel Command.

Par. E-36a Starter The phrase, "but shall be otherwise dimensionally inter-changeable with AN 4058" has been added to the end of the paragraph at the request of Materiel Command.

Par. E-36b(4) Generator and Power Take-off The following phrase, "but shall be otherwise dimensionally interchangeable with AN-4047" has been added to the end of the sentence at the request of the Materiel Command.

Revision Record

Par. E-36d Gun Synchronizing Impulse Generators At the request of Production Division representatives, reference to AND 10006 has been deleted, and reference is made to Installation Drawing 53205, Sheet 2.

Par. E-36e Vacuum and Hydraulic Power Pump The following "from the center line of the pad with $\pm .005$ limits" has been added to the first sentence in order to complete the deviation.

Page 18. Estimated Power Curves The new power curves have been shown in order to complete the specification requirements. Complete information could not be given at all operating speeds since the data was not available. Information was taken from available test data and further developments in the controls and better calibration data will undoubtedly result in different data than that submitted herein.

Page 19. Specific Fuel Consumption Curves At the request of Production Division representatives, the following note "and at normal rated altitude" was added to the Fuel Consumption Curves showing low power and speed characteristics. The "normal power at normal critical altitude at .067" was added to table of Guaranteed B.S.F.C. The following note was removed from the page, "It is estimated that the values shown on this page will apply at the normal rated altitude of the engine."

Pages 20 and 21. List of Applicable Specifications:

AN-F-E-568 Rev. (a) changed to Rev. (b), date 10-22-43 changed from 12-4-42

Amendment 1 to AN-GGG-S-126 removed from the list to correct an error.

AN-E-2 added to the list.

Amendment 2 to AN-F-26 added and the date corrected.

Amendment 2 to AN-P-4 added and the date corrected. See Reference (b) for not listing Amendment 3.

Amendment 1 added to AN-M-4 and the date corrected.

Amendment 2 added to AN-G-3a and the date corrected.

AN-O-3 added to the list.

Amendment 1 to AAF 32427 added.

AN-4047, Rev. 1 added to the list.

AN-4058 Rev. 1 added to the list.

Rev. 1 added to AND-10201.

This record is submitted for convenience only. In case of discrepancy between the specification and revision record, the specification shall be considered correct.