

Spec. No. 245-B  
Date: October 8, 1945  
Revised: Dec. 18, 1945  
Revised: Dec. 3, 1946

MODEL SPECIFICATION

ENGINE, AIRCRAFT: MODEL V-1710-143 & -145

ALLISON DIVISION  
General Motors Corporation  
Indianapolis, Indiana

ALLISON MODEL V-1710-G6R & G6L

ALLISON DIVISION  
GENERAL MOTORS CORPORATION

This amendment supplements and should be attached to Allison Division Model Specification No. 245-B, revised December 3, 1946, covering AAF Model V-1710-143 and -145 aircraft engine (Allison Model V-1710-G6R & G6L).

1. Amended Note (2) of Table I of Par. E-7a(1) on Page 8 to read as follows:

"Oil inlet temperature shall be  $185^{\circ}\pm 5^{\circ}\text{F}$  for 2700 RPM and below and  $221^{\circ}\text{F}$  maximum for all 3200 RPM ratings."

2. Amended Par. E-25 on Page 12 by rewriting the first two lines of the first sentence to read as follows:

"The coolant liquid outlet temperature shall be  $121^{\circ}\pm 2.8^{\circ}\text{C}$  ( $250^{\circ}\pm 5^{\circ}\text{F}$ ) for operation at 2700 RPM and below and shall not exceed  $135^{\circ}\text{C}$  ( $275^{\circ}\text{F}$ ) at 3200 RPM, except that for . . . ."

The authority for the above changes is Amendment No. 19 dated 19 February 1947 to Letter Contract dated 17 December 1945, designated W33-038 ac-13849.

## MODEL SPECIFICATION

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 ALLISON DIVISION of GENERAL MOTORS CORPORATION  
 Allison Model V-1710-G6R & G6L

A. APPLICABLE SPECIFICATIONS

A-1. The specifications listed on pages 28 and 29 except as revised herein shall form a part of this specification.

A-1a. Army-Navy Specifications

AN-9500c Engines, Aircraft; General Specification  
 AN-9501c Engines, Aircraft; Model Specification

B. TYPE AND MODEL

B-1. This specification covers the requirements for the V-1710-143 and -145 engines.

B-1a. General Description The V-1710-143 (right hand propeller rotation) and -145 (left hand propeller rotation) are 12-cylinder, liquid-cooled, 60° Vee-type engines equipped with an integral propeller reduction gear. An outboard auxiliary stage supercharger is located directly behind the engine and is driven through a variable speed hydraulic coupling. The engine is equipped with a speed-density carburetor and the use of aftercooling or intercooling is not required.

C. MATERIAL AND WORKMANSHIP

C-1. The requirements for material and workmanship shall be as specified in Specification AN9500.

D. GENERAL REQUIREMENTS

D-1. See Section E.

E. DETAIL REQUIREMENTS

E-2. The following Allison Division Drawings form part of this specification.

56251	Engine Assembly, Complete (Showing acc.dr. oil seals)	-145
56252	Engine Assembly, Complete (Showing acc.dr. oil seals)	-143
56250	Installation Drawing (Showing clearances for engine accessories and their removal)	
56967	Priming Lines Assembly	
56771	Speed Density Carburetor Bendix Stromberg Model SD-400-D3	
42354	Contact Assembly, Spark Plug (Terminal) Lubrication System Diagram (To be included with Service Manual)	
56364	Radio Shielding Assembly - 143 (G6R)	

56261 Radio Shielding Assembly - 145 (G6L)  
 Complete list of AN Standard Parts used on engine  
 furnished as separate section of Parts List.  
 Photographs, front, rear, top, bottom and both  
 sides (To be furnished with Qualification Test  
 Report.)

E-3a. (Ref. AN-9500, Par. D-3a) Changes in Design  
 The requirements of the last sentence shall be interpreted as  
 follows: Parts formerly made by vendors and returned to the prime  
 contractor or the prime contractor's affiliate plants and/or  
 transferred between the prime contractor's affiliate plants  
 will not be considered as vendor changes.

E-4a. Qualification Test The qualification test shall  
 be conducted at the contractor's plant in accordance with Speci-  
 fication AN-9502 with the following exceptions:

- (1) (Ref. Par. F-3b) Radio Interference Level The  
 requirements of this paragraph shall not be  
 applicable.
- (2) (Ref. Par. F-3e) 150-Hour Endurance Run In lieu  
 of the schedule outlined in paragraphs F-3e(1) to  
 F-3e(8) inclusive and Section F-3f(2) the follow-  
 ing schedule for qualification test shall be fol-  
 lowed.

150-HOUR ENDURANCE SCHEDULE

Run No.	Time Hours	Alternate Periods	BHP	Speed	NACA Alt.-Ft.	BSFC
1.	1.5	Continuous	1000	2700	27,700	.79
2.	1.5	Continuous	900	2620	27,700	.74
3.	1.5	Continuous	1000	2700	27,700	.79
4.	1.5	Continuous	800	2510	27,700	See Par. E-4a(4)
5.	4.5	Continuous	1000	2700	27,700	.79
6.	1.5	Continuous	700	2400	27,700	Best Econ.
7.	1.5	Continuous	1000	2700	27,700	.79
8.	1.5	Continuous	750	2200	Crit. Alt.	Best Econ.
9.	5.0	1/2 Hour	1250	3200	30,000	1.03
		1/2 Hour	Prop. Load	1760-2080	30,000	Best Econ.
10.	15.0	5 minutes	1600	3200	S.L.	.83
		10 minutes	Idle	Idle	S.L.	Idle
11.	5.0	1/2 Hour	1600	3200	S.L.	.83
		1/2 Hour	Prop. Load	1760-2080	S.L.	Best Econ.
12.	24.0	3 Hours	1100	2700	S.L.	.72
		3 Hours	990	2620	S.L.	.65
13.	20.0	2 1/2 Hrs.	1100	2700	S.L.	.72
		2 1/2 Hrs.	880	2510	S.L.	Best Econ.
14.	20.0	2 1/2 Hrs.	1100	2700	S.L.	.72
		2 1/2 Hrs.	770	2400	S.L.	Best Econ.

Run No.	Time Hours	Alternate Periods	BHP	Speed	NACA Alt.-Ft.	BSFC
15.	21.0	3 Hours	1100	2700	S.L.	.72
		3 Hours	900	2525	S.L.	Best Econ.
16.	5.0	Continuous	900	2525	S.L.	Best Econ.
17.	15.0	Continuous	462	1512	S.L.	Best Econ.
18.	5.0	Continuous	1100	2970	S.L.	.75

- NOTE (1): Runs No. 1 to 9 inclusive shall be made on a simulated altitude stand with standard altitude air temperature and pressure at the inlet to the auxiliary stage and with the exhaust discharging into standard altitude pressure. The speed of the auxiliary stage (or hydraulic coupling slip) shall be determined throughout the test by the automatic controls, except during runs where it is necessary to override or impose non-standard conditions on the controls to obtain the specified power.
- NOTE (2): During the S.L. runs the auxiliary stage air inlet shall be maintained at 75 to 90°F.
- NOTE (3): The 42% power 56% speed run shall be made at 42% power and at the lowest speed (but not less than 56%) obtainable with the propeller and ram available for stable testing.
- NOTE (4): During all runs the coolant solution and temperature shall be as stated in Paragraph E-25 of this specification.
- (3) (Ref. Par. F-4c) Carburetor Air Temperature  
The temperature of the air entering the engine shall be as specified in Notes 1 and 2 following the 150-hour endurance schedule.
- (4) (Ref. Par. F-4g) Fuel and Oil Consumption  
The specific fuel consumption for the qualification test shall be as listed under "BSFC" in the 150-hour endurance schedule. The fuel consumption for Run #4 shall be at Best Economy unless the airflow exceeds that determined by the requirements of Par. E-7a(1)a in which case the fuel consumption shall be determined by the F/A ratio curve in Run position.
- (5) (Ref. Par. F-4i) Inspections and Adjustments  
In addition to the normal cleaning and adjustments the spark plugs may be cleaned before the 15 hour take-off period, Run #10.
- (6) (Ref. Par. I-2) Deviations The requirements of this paragraph shall not be applicable.

E-4b. 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. Par. F-3c) Air Flow The requirements of this paragraph shall not be applicable.
- (2) (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 run at 90% normal sea level manifold pressure on propeller load  
  
One-half hour at 100% normal sea level rated manifold pressure at normal rated speed.  
  
During the last ten minutes of the 100% normal manifold pressure run, the auxiliary stage coupling control shall be adjusted by throttling the air stack to give minimum slip and the manifold pressure reduced to prevent damage to the engine. During the 89% normal rated speed 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-4b(2) above.
- (4) (Ref. Par. F-5a(3)) Penalty Run At the option of the contractor, penalty runs affecting any one of the major assemblies (engine or auxiliary stage) may be run with other "workhorse" or standby assemblies.
- (5) (Ref. Par. F-5c(1)) One-Hour Final Run The one-half hour normal manifold pressure run shall be made first followed by the one-half hour at 89% normal rated speed on propeller load. The oil consumption shall be measured during the 89% normal rated speed 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 prevent damage to the engine.
- (6) (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-4b(2) and E-4b(5) above.

- (7) (Ref. Par. F-5c(3)) Take-off Check The take-off check 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.
- (8) (Ref. Par. F-5c(5)) Radio Interference Level The requirements of this paragraph shall not be applicable.
- (9) (Ref. Par. F-5c(5)a) The requirements of this paragraph shall not be applicable.
- (10) (Ref. Par. F-6f(1)) Fuel/Air Ratio The requirements of this paragraph do not apply. Production testing of the S.D. carburetor shall be in accordance with procedures established by the engine and carburetor manufacturers and approved by the Government.
- (11) (Ref. Par. F-6f(4)) Carburetor Air Temperature Air temperature at the entrance to the auxiliary stage shall be maintained between 70° and 100°F.
- (12) (Ref. Par. F-6j) Multi-stage Superchargers In lieu of the requirements of this paragraph, the tests outlined under Par. E-4b of this specification shall be applicable since the auxiliary stage air cannot be wasted.
- (13) (Ref. Par. F-7a) The requirements of this paragraph shall not be applicable.
- (14) (Ref. Par. F-9) Preparation for Storage The engine shall be prepared for storage in accordance with Par. E-41 of this specification.
- (15) (Ref. Par. I-2) Deviations The requirements of this paragraph shall not be applicable.

#### E-6. Engine Weight

E-6a. Dry Weight of Complete Engine The total dry weight of the complete engine shall not exceed the value indicated below.

Basic engine, including integral supercharger, supercharger drive mechanism, propeller reduction gears, coolant pump and piping on the engine, engine lubrication system oil pumps, starter connection including starter dog, tachometer drive, generator drive, vacuum and hydraulic pump drives, propeller governor drive, and all piping and controls between engine parts. 1360.00 lbs.

Speed Density carburetor (including nozzle, water-alcohol regulator and throttle body)	41.0
Carburetor screens and gaskets	None
Ignition system (includes magneto, distributors and radio shielding and plugs)	53.0
Priming system on engine	2.0
Cooling air deflectors and baffles	None
Accessory drive covers	2.0
Automatic manifold pressure regulator	Mounted on Aux. Stage
Generator angle drive gearbox	12.0
Propeller extension shaft	None
Bearings, propeller extension shaft	None
Propeller gear reduction unit	None
Aftercoolers	None

TOTAL ENGINE LESS AUXILIARY STAGE 1470.0 lbs.

Independent mechanical driven auxiliary-stage supercharger and drive 107.0 lbs.

Automatic MP regulator and supercharger control 18.0 lbs.

TOTAL AUXILIARY STAGE AND CONTROLS 125.0

TOTAL DRY WEIGHT OF COMPLETE ENGINE 1595.0 lbs.

E-6b. Engine Components and Accessories The engine and all those parts which are included in the engine dry weight as defined by paragraph headed "Dry Weight of Complete Engine" are components. All other articles required to complete the power plant system, but not included as engine components, are accessories.

E-7. Performance Characteristics The ratings, curves, and guarantees specified herein are based on the terms and standard conditions defined in Specification AN9502 or AN9503.

E-7a. Guarantees

E-7a(1). The performance guarantees shall be as listed in the following table. When required, these guarantees shall be demonstrated only on a dynamometer stand under simulated altitude conditions. These data are based on the use of fuel conforming to Specification AN-F-33, and oil conforming to Specification AN-VV-O-446, Grade 1120 and a coolant solution as specified in Par. E-25 herein.



TABLE I

RATINGS AND SPECIFIC FUEL CONSUMPTION

Rating	BHP	RPM	Altitude	BSFC
Take-off	1600	3200	S.L.	.83
Military				
(a) S.L.	1600	3200	S.L.	.83
(b) Altitude	1250	3200	30,000	1.03
Normal				
(a) S.L.	1100	2700	S.L.	.72
(b) Altitude	1000	2700	27,700	.79
90% Normal	990	2620	S.L.	.65
80% Normal	880	2510	S.L.	Best Econ.
70% Normal	770	2400	S.L.	Best Econ.

NOTE (1): All ratings are at coolant out temperatures specified in Par. E-25.

NOTE (2): Oil inlet temperature shall be  $185^{\circ}\text{F} \pm 5^{\circ}$  for 2700 RPM and below and at  $203^{\circ}\text{F} \pm 5^{\circ}$  for all 3200 RPM ratings.

E-7a(1)a. Best Economy Operation The maximum power on normal sea level rated power and speed propeller load to which operation with best economy mixture strength is permissible shall be 900 BHP. (See Par. E-25.) The minimum power and speed for best economy mixture strength operation shall be 375 BHP at 1800 RPM.

E-7a(2). Fuel Consumption for qualification testing is shown in the table "150-Hour Endurance Schedule."

E-7a(3). Curves The horsepower vs. altitude curves at rated speeds up to and including the guaranteed altitude of the engine shall be as shown on page 20 of this specification.

E-7b. Estimated Curves The following estimated curves shall be furnished as part of this specification:

E-7b(1) Estimated Brake Horsepower vs. altitude showing lines of constant BSFC on pages 21 to 25 inclusive.

E-7b(2) Estimated specific fuel consumption vs. engine speed shown on curves as noted above in Par. E-7b(1).

E-7d. Specific Oil Consumption The specific oil consumption shall not exceed .025 lbs/BHP/hr. at sea level military power and speed and .020 lbs/BHP/hr. at sea level normal rated power and speed and .018 lb/BHP/hr. at 70% normal sea level rated power and 89% normal rated speed.

E-7g. Coolant flow and Heat rejection The following data shall apply to operation with coolant as specified in Par. E-25 of this specification.

E-7g(1). Normal Power Coolant Flow and Heat Rejection  
The following guarantee is given for coolant flow and heat rejection to the coolant when operating on a dynamometer, with a 60°F, 10 MPH air blast over the engine.

CONDITIONS

Power	S.L. Normal - 1100 BHP
Speed	Normal - 2700 RPM
Fuel Consumption	Guaranteed Specific
Oil Inlet Temperature	185°F
Oil Pressure	65 psi $\pm$ 2
Coolant Outlet Temperature	250°F
Coolant Flow	<b>140 to 155 GPM</b>

GUARANTEE

Coolant flow not to exceed **155 GPM**  
Heat rejection to coolant not to exceed 18,700 Btu/min.  
(440 HP)

E-7g(2). Sea Level Military coolant Flow and Heat Rejection  
The following guarantee is given for coolant flow and heat rejection to the coolant when operating on a dynamometer with a 60°F, 10 MPH air blast over the engine:

CONDITIONS

Power	S.L. Military - 1600 BHP
Speed	S.L. Military - 3200 RPM
Fuel Consumption	Guaranteed Specific
Oil Inlet Temperature	203°F
Oil Pressure	65 psi $\pm$ 2
Coolant Outlet Temperature	250°F
Coolant Flow	<b>165 to 180 GPM</b>

GUARANTEE

Coolant flow not to exceed **180 GPM**  
Heat rejection to coolant not to exceed 25,600 Btu/min. (605HP)

E-7g(3). Coolant Pump Characteristics In lieu of the coolant pump flow data required by AN-9501, paragraphs E-7g(3), E-7g(3)a, and E-7g(3)b, the curves shown on page 27 are submitted as the estimated performance of the pump furnished with the engine.

E-7b(2). Heat Exchanger Coolant Pump Characteristics  
The estimated performance of the pump shall be as shown on page 28.

E-7i. Oil Flow and Heat Rejection

E-7i(1). Normal Power Oil Flow and Heat Rejection The following guarantee is given for oil flow and heat rejection to the oil when operating on a dynamometer with a 60°F, 10 MPH air blast over the engine:

CONDITIONS

Power	S.L. Normal - 1100 BHP
Speed	Normal - 2700 RPM
Fuel Consumption	Guaranteed Specific
Oil Inlet Temperature	185°F
Oil Pressure	65 psi ± 2
Coolant Outlet Temperature	250°F
Coolant Flow	140 to 155 GPM

GUARANTEE

## (a) Engine Oil System

Oil flow not to exceed 160 lb/min.  
Heat rejection to oil not to exceed 5700 Btu/min. (135 HP)

## (b) Auxiliary Stage Oil System

Oil flow not to exceed 45 lb/min.  
Heat rejection to oil not to exceed 2040 Btu/min. (48 HP)

E-7i(2). Sea Level Military Oil Flow and Heat Rejection The following guarantee is given for oil flow and heat rejection to the oil when operating on a dynamometer with a 60°F, 10 MPH air blast over the engine:

CONDITIONS

Power	S.L. Military - 1600 BHP
Speed	S.L. Military - 3200 RPM
Fuel Consumption	Guaranteed Specific
Oil Inlet Temperature	203°F
Oil Pressure	65 psi ± 2
Coolant Outlet Temperature	250°F
Coolant Flow	165 to 180 GPM

GUARANTEE

## (a) Engine Oil System

Oil flow not to exceed 202 lbs/min.  
Heat rejection to oil not to exceed 7950 Btu/min. (187 HP)

## (b) Auxiliary Stage Oil System

Oil flow not to exceed 55 lbs/min.  
Heat rejection to oil not to exceed 5000 Btu/min. (118 HP)

E-8. Engine Performance The complete engine, except for components whose design is specified by the Procuring Agency, shall function satisfactorily up to and including an altitude of 44,000 feet provided the powers and speeds shown on Page 20 are not exceeded.

E-9. Torquemeter The engine shall not be equipped with a torquemeter.

E-11. Overall Dimensions The overall dimensions of the engine shall not exceed the following:

Length	103 inches
Width	29 9/32 inches
Height	38 5/8 inches

E-13. Crankshaft Torsional Vibration (Ref. AN-9500, Par. D-13) Conditions 7 and 8 of Par. E-3 of Specification AN9504 shall be met.

E-14. Pistons The engine shall be fitted with pistons of 6.00:1 compression ratio.

E-15. Propeller Provision shall be incorporated for a double acting hydraulic governing system. The engine shall have a No. 50 single rotation propeller shaft end in accordance with the requirements of AN-N-1 except for deviations to the paragraphs listed below. The direction of rotation when viewed from the anti-propeller end shall be clockwise for the -143 (G6R) and counter-clockwise for the -145 (G6L). Provision shall be made for mounting a governor by a pad and drive in accordance with Par. E-33g of this specification.

The following are exceptions to AN-N-1:

- (1) (Par. E-1d(1)) Oil Seals - Nose to Shaft The requirements of this paragraph shall not be applicable.
- (2) (Par. F-3c) Oil Seals The requirements of this paragraph shall not be applicable.
- (3) (Par. I-3) Deviations The requirements of this paragraph shall not be applicable.
- (4) Fig. 6 and Table 4 Dimension EE shall be 5/8" instead of 1" For the two studs not intersected by the horizontal center line of the engine, and which appear in the upper right hand quadrant when viewing the engine from the propeller end. The spacer covered by dimension BE required on the aforementioned two studs which have been shortened will be removed.

E-16. Propeller Drive The propeller drive shall be equipped with a reduction gear ratio of 2.36:1.

E-17a(2) Supercharger Drain Valve (Ref. AN9500, Par. D-17a(2)) A fuel aspirator without a valve shall be the only provision made for automatic drainage of the induction system.

E-18. Impeller Gear The impeller gear ratios and diameters shall be as follows:

Engine stage 7.48:1 and 10 1/4 in. diamter.  
 Auxiliary stage 8.08:1 (no slip) and 12 3/16 diameter. (G6R)  
 Auxiliary stage 8.03:1 (no slip) and 12 3/16 diameter. (G6L)

E-19. Automatic Engine Regulators The engine shall be equipped with the following regulators.

- (1) Automatic manifold pressure regulator.
- (2) Spark retard mechanism actuated by the MP regulator to improve idling characteristics.
- (3) Auxiliary stage supercharger control which selects the hydraulic coupling slip.
- (4) Water-alcohol injection regulator.

NOTE: (1) The above controls listed as (1) and (3) are designed and set to protect the engine from detonation during operation at war emergency powers without water-alcohol injection. This setting makes it impossible to obtain minimum hydraulic coupling slip until the engine is at or near military critical altitude with the result that certain powers at lower than military rated speed cannot be obtained. (This characteristic is shown on the estimated altitude vs. power curves.)

NOTE: (2) Since the water-alcohol injection control equipment is not required to operate at rated powers, this equipment shall be installed but not operated during the qualification or production acceptance tests.

E-21a. Exhaust Flanges (Ref. AN-9500, Par. D-21a) The use of exhaust flanges in accordance with Allison Part #44018 (AMS-5080) or Part #34667 (AMS-5645) shall be a requirement in the installation of this engine. Exhaust flange gaskets if used shall conform to Allison Part #40751. The exhaust flanges shall not be furnished with the engine and separate procurement must be initiated by the airplane manufacturer. The exhaust flange nuts shall be furnished with the engine.

E-25. Coolant Temperature The coolant liquid outlet temperature shall be  $121 \pm 2.8^{\circ}\text{C}$  ( $250 \pm 5^{\circ}\text{F}$ ), except that for all operation with Best Economy mixture strength or in Long-Range Cruise position the coolant outlet temperature shall not exceed 220 F. The coolant used shall consist of 30% ethylene glycol conforming to Specification AN-E-2 and 70% water by volume.

E-25a. Coolant Pressure The maximum inlet pressure to the coolant liquid pump shall be 32 psi absolute.

E-27. Fuel Metering System The engine shall be equipped with one Bendix Stromberg Model SD-400-D3 Speed Density Carburetor. The speed density carburetor shall meter satisfactorily providing that vapor free fuel is supplied to the carburetor inlet and providing that the inlet pressure does not exceed 16 psi above atmospheric. In case of failure of the speed density pump unit, metering shall be satisfactory for emergency operation up to and including military power providing that vapor free fuel is supplied to the pump inlet at a pressure, adjustable to within  $\pm 2$  psi, between 20 psi and 30 psi above cross over duct pressure. The engine manufacturer and the carburetor manufacturer shall cooperate in obtaining a "run" and "long range cruise" setting as illustrated on Page 26. A final metering characteristic curve shall be submitted to the Government for approval prior to the acceptance test of the first production engine. All other requirements of Section D-27 of AN-9500 and E-27 of AN-9501 shall not apply.

E-30. 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 speed density carburetor. The valve shall be supplied with fuel from the carburetor at fuel booster pump pressure. The requirements of Par. D-30 of AN-9500 shall apply except that the lubricant for cold starting demonstration shall be Grade 1100 P of AN-O-5 Specification. The special starting fuel shall consist of a mixture of 40% isobutane and 60% isopentane. The engine shall start at 0°F with Specification AN-F-33, Grade 145 fuel and the lubricant diluted with AN-F-33 fuel. The engine shall operate satisfactorily at 230°F maximum coolant outlet temperature with a winterization coolant solution consisting of 70% ethylene glycol in accordance with Specification AN-E-2 and 30% water by volume.

E-31. Lubricating System The auxiliary stage supercharger shall be equipped with scavenge and pressure oil pumps which are independent from the engine. The unit is designed to operate from either the engine oil supply tank or a separate oil supply system.

E-31e. Scavenging System A five-minute run at room temperature conditions with temperatures stabilized at 90°F to 120°F "oil in" and 160°F to 180°F "coolant out" and at take-off power and speed when using an oil or diluted oil as specified in Par. D-31e of AN-9500 on an engine other than the qualification test endurance engine shall constitute the requirements for demonstrating satisfactory scavenging. For demonstration purposes the oil shall contain no gasoline.

E-31g. Oil Cleaner (Ref. AN-9500, Par. D-31g) Foreign matter removed by the oil strainer shall not re-enter the lubricating system except under operating conditions when the by-pass valve is open.

E-31h. Oil Pressure The main engine oil pressure at normal rated power and speed shall be 65 psi  $\pm$  5. The oil pressure connection shall be 1/8 NPT instead of 3/8. The engine nose section is lubricated from the main engine oil pump.

E-31k. Oil Tank Vent The requirements of Par. D-31k of AN-9500 shall be met except that pressures on the oil tank vent connection may exceed the 1/2 psi requirement during operation with diluted oil.

E-31o. Lubrication Points The various components of the assembly requiring lubrication other than from the engine lubrication system are as follows:

<u>COMPONENT</u>	<u>HOW LUBRICATED</u>
(1) Aux. Stage Supercharger	As described under Par. E-31.
(2) Aux. Stage Flexible Drive	Manual lubrication use Federal Spec. VV-O-611, Grade 2.

E-31q. Crankcase Breathers The requirements of Par. D-31q of AN-9500 shall be met except that pressure in the crankcase may exceed the 1/2 psi requirement during operation with diluted oil and a 3/4 female pipe tap shall be provided for connection to the front breather in lieu of a hose connection conforming to AND10058.

The breather shall likewise operate satisfactorily at take-off conditions with oil specification AN-VV-O-446 grade 1100 diluted 20% by volume with AN-F-33 fuel at an ambient temperature of 60° to 100°F. Satisfactory operation shall be defined as an oil loss of not over 3 quarts during operation at the following conditions. Gasoline loss shall not be included in the above three quarts.

Manifold pressure	Take-off
Speed	3200 RPM $\pm$
Period	5 minutes
Oil inlet temp. at start of test	80-90°F
Oil inlet temp. at end of test	Not over 140°F
Coolant out temp. at start of test	175° to 185°F
Coolant out temp. at end of test	Not over 230°F
Diluted mixture in oil system	13 1/2 gal. minimum

NOTE: A warm-up period of at least 10 minutes at approximately 1400 RPM shall be allowed.

It is desired that the airplane manufacturer locate the front and rear breather outlets to maintain a crankcase pressure measured at the front breather within the limits of +8 to -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 ventilation through the engine from front to rear. The breather lines installed in the airplane shall not be less than 7/8 I.D. (fittings .717 I.D.).

E-31a(1). Spark Plugs The engine shall be fitted with Champion RP43S spark plugs.

E-32b(2). Electrical Interference (Ref. AN-9 500, Par. D-32b(2)) The requirements of this paragraph shall not apply. The radio shielding shall conform to Allison Drawing #56261 and #56364 and shall be assembled in accordance with procedure submitted by the contractor and approved by the Government.

E-32b(3). Salt Spray Test (Ref. AN-9500, Par. D-32b(3)) The requirements of Par. D-32b(3) of AN-9500 shall not be applicable.

E-32b(4). Installation (Ref. AN-9500, Par. D-32b(4)) The requirements of this paragraph shall not be applicable.

E-32c. High Tension Ignition Cable (Ref. AN-9500, Par. D-32c.) The requirements of AN-J-C-56 shall not be applicable. The ignition cable shall conform to Specification AN-C-130.

E-32d. Magnetos The engine shall be equipped with one Scintilla type DFLN5 magneto 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 magento, but shall be as shown on Allison Drawing No. 43568.
- (3) (Ref. D-1j. Ground Terminal) The 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)a. 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 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-6a. Conditioning) In lieu of the requirements specified, the following shall apply:- The standard sphere gap as shown in Figure 3 set at 3 millimeters, unless otherwise specified, shall be used to calibrate test gaps used on all tests described below.
- (10) (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, except when serviced, in an ambient air temperature of 60°C, (140°F), with the fair passing over the magneto at 20 MPH, 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-32f. 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 the Installation Drawing. 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	Spec. AN-C-130
Magneto	AN-M-4 (except as modified herein)

E-33. Accessory Pads and Drives The requirements of subparagraph "b" of Par. D-33 of AN-9500 shall not be applicable. The type of each accessory drive, the number used, and the gear ratio to the engine crankshaft, the maximum permissible torque in pound-inches for continuous operation, the maximum permissible static torque in pound-inches and the direction of rotation when looking at the end of the accessory drive shaft in the engine, shall be as follows:

ACCESSORY	TYPE	NO. USED	RATIO TO C.S.	MAX. TORQUE		ROTATION		MAX. FORCE ON ACCESSORY PAD
				LBS.-INS.	CONT.STATIC	C-CLOCKWISE	CC-COUNTER CL.	
Starter	I	1	1.00:1	---	16,200	C	-145 CC	8g
Generator	I-A	1	2.88:1	500	2,200	C	C	8g
Tachometer	II	1	.500:1	7	50	C	C	*(1)
Prop. Gov.		1	.843:1	125	2,300	C	CC	*(1)
V&H * (2)	II	1	1.316:1	250	1,650	C	C	8g
V&H * (3)	II	1	1.333:1	250	1,650	C	C	8g

- \*(1) Max. overhung moment not specified on applicable AND Drawing.  
 \*(2) Vacuum and hydraulic pump on angle drive gear box.  
 \*(3) Vacuum and hydraulic pump on accessory housing upper rear.

E-33a. (Ref. AN9500, Par. D-33a Starter) The starter mounting pad and drive shall conform to AND10004 Type I with the following exceptions:

- 1) One stud shall be off location by 15° to facilitate removal of the starter.
- 2) The studs shall be located by rectangular dimensions from the center line of the pad with ±.005 tolerance instead of by a stud circle with studs equally spaced.
- 3) The gaskets shall be 1/32 aluminum instead of as specified by AN4047, and shall have one hole off location by 15°.

E-33a(1). (Ref. Par. D-36a(1), Spec. AN9500) Starter Clearance shall not be provided in accordance with AND10304. (Clearance for installation and removal of a starter shall be as shown on the Installation Drawing.)

E-33b. Generator and Power Take-off One Type I-A pad and drive shall be furnished in accordance with AND10002.

E-33c. Fuel Pump The fuel pump mounting pad and drive shall not be furnished since the speed density carburetor incorporates the fuel pump.

E-33d. Gun Synchronizing Generators Provision shall not be made for mounting Gun Synchronizing Impulse Generators.

E-33e. Vacuum and Hydraulic Power Pump The requirements of this paragraph shall be met except that the studs on the AN4055 adapter shall have cotter pin holes.

E-33e(2). Accessibility (Ref. AN9500, Par. D-33e(2)) In lieu of the requirements of this paragraph the following shall apply. Clearance shall be provided back of the vacuum and hydraulic pump mounting pad on the accessory housing upper rear for installation and removal of a pump in accordance with AN6111-1. Clearance shall be provided back of the vacuum and hydraulic pump mounting pad on the angle drive gear box for installation and removal of a Pesco 1P-349N hydraulic pump.

E-33f. Tachometer Provision for installing a Type I tachometer drive assembly shall be incorporated in the engine but the drive

assembly shall not be furnished. One Type II pad and drive shall be furnished in accordance with AND10005 and located as shown on the Installation Drawing.

E-33f(1). Tachometer Accessibility The clearance requirements of Par. D-33f(1) of AN9500 and AND10310 shall not be met. Clearance back of the Type II pad shall be provided for installation of a tachometer generator in accordance with AN5531-1.

E-33g. Propeller Governor Drive Provision for mounting a propeller governor shall be made by a pad and drive conforming to AND10010. Clearance shall be provided for a governor as required on AND10307 except that clearance between the reduction gear breather and the center line of the governor pad shall be 3.63 instead of a 4 1/2 radius.

E-34c. Coating Threaded Parts (Ref. AN9500, Par. D-34c) Thread anti-seize compound shall be in accordance with AN-C-53 except where otherwise specifically approved by the Government.

E-40b(2). Finish Coat (Ref. AN9500, Par. D-40b(2)) The material for the basic engine shall be enamel in lieu of aluminum pigmented heat resistant varnish or lacquer.

E-41. Preparation for Storage (Ref. AN9500, Par. D-41) The engine shall be prepared for storage in accordance with AN-E-11 with the exceptions to paragraphs as listed below:

- (1) (Par. B-1a. AN Aero Specifications) The requirements of Specification AN-C-80 shall not be applicable.
- (2) (Par. B-1b. ANA Standard Drawings) The following Allison drawings shall apply throughout this Specification in lieu of the AN parts indicated:  
36411 - Cap - Propeller Shaft Thread in lieu of AN5012  
56385 - Bag, Engine Shipping in lieu of AN4086
- (3) (Par. C-1. General) In lieu of the requirements of this paragraph, the following shall apply. All equipment used for the preparation of aircraft engines for shipment or storage shall be of such type as to complete, to the satisfaction of the Government Inspector, the processes specified herein.
- (4) (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.
- (5) (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 final run, the engine shall be "motored-in" at approximately 600 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.

- (6) (Par. F-3h. Intake Manifold) A one-pound bag of dehydrating agent shall be placed in the air inlet and the opening sealed with a gasketed cover.

F. METHODS OF SAMPLING, INSPECTION AND TESTS

F-1. The requirements for sampling, inspection and tests shall be as shown in Specification AN9500.

F-2b. Magnetic Inspection Magnetic inspection of steel parts shall be in accordance with AN-I-32 with the following exception to Par. D-1:

The liquid used as a vehicle for carrying the magnetic substance shall conform to Allison Division Engineering Spec. ES-6, Rev. A.

F-2c. Acceptance Tests The acceptance test shall be conducted in accordance with Specification AN9503 except as modified by Par. E-4b of this specification.

G. PACKAGING, PACKING, AND MARKING FOR SHIPMENT

G-1. The requirements for packing, packaging and marking for shipment shall be as shown in Spec. AN9500.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. There are no requirements applicable to the individual departments.

I. NOTES

I-1. Deviations The requirements of Par. I-1 of AN9501 and of Par. I-3 of AN9500 shall not be applicable.

ALLISON DIVISION OF G.M.C.  
ENGINE PERFORMANCE

STANDARD CONDITIONS WITHOUT RAM

ESTIMATED ALTITUDE PERFORMANCE

2200 RPM

LONG RANGE CRUISE

SFCO. NO245-A

MODEL V-1710-145 & -145 (GERAL)

PROP GEAR-RATIO 2.36:1

COMP RATIO 6.0:1

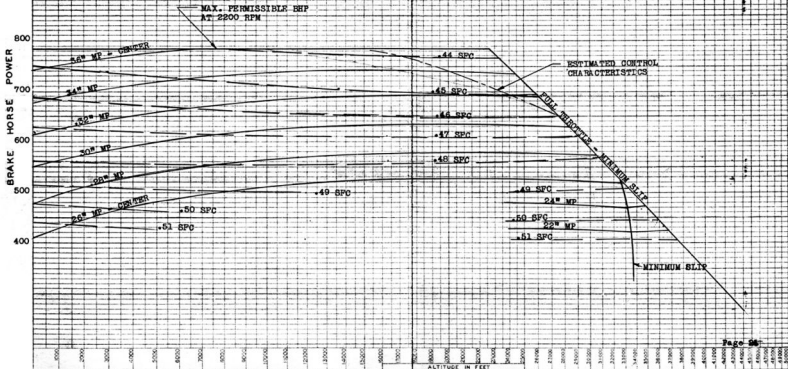
BLOWER RATIO 8.2:1 AUX 7:4:8 MAIN

IMPELLER DIAM 12.1 INCH 10.25 MAIN

FUEL MIXING Speed Density Carb.

FUEL GRADE 145 AN-P-33

DATE 10-10-45

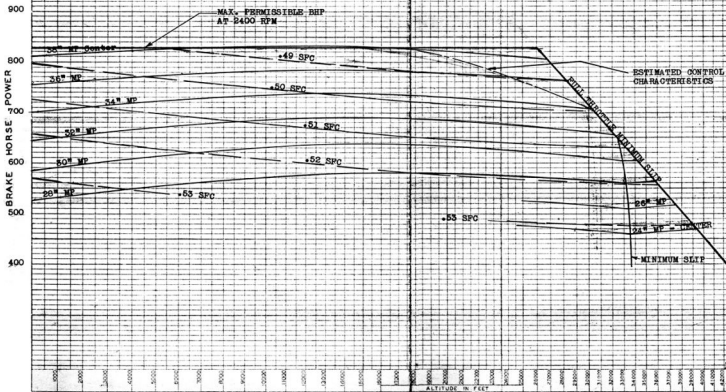


ALLISON DIVISION OF G.M.C.  
ENGINE PERFORMANCE

STANDARD CONDITIONS WITHOUT RAM  
ESTIMATED ALTITUDE PERFORMANCE  
2400 RPM  
LONG RANGE CRUISE

SPEC. NO. 245-B

MODEL V-1710-143 & -145 (068AL)  
PROP. GEAR RATIO 2.36:1  
COMP. RATIO 8.0:1  
FLOWER RATIO 8.05 MAIN 7.48 AUX 10.25  
IMPELLER DIAM. 12.18%  
FUEL METERING Speed Density Carb.  
FUEL GRADE AN-P-35, Gr. 145  
DATE 10-16-45



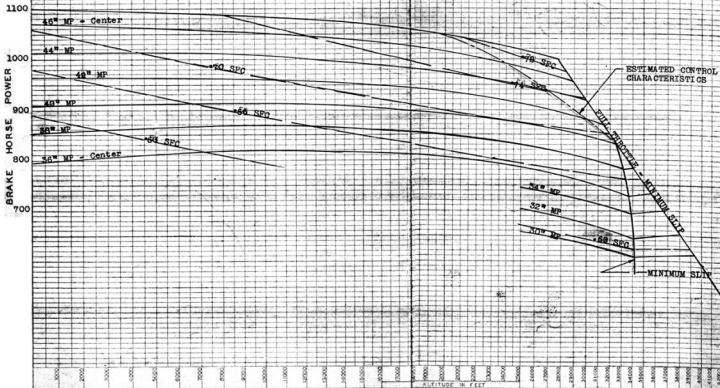
ALLISON DIVISION OF G.M.C.  
ENGINE PERFORMANCE

STANDARD CONDITIONS WITHOUT RAM

ESTIMATED ALTITUDE PERFORMANCE  
2700 RPM  
IN RUN POSITION

SPBC. NO 245-B

MODEL V-1710-145 & -145 (92R25).  
PROP. GEAR RATIO 2.36:1  
COMP. RATIO 6.0:  
BLOWER RATIO 2.06:MAX 7.48 MAIN  
IMPELLER DIAM. 12.18 IN X 10.25 IN MAIN  
FUEL METERING Speed Density Carb.  
FUEL GRADE 145 AN-P-33  
DATE 10-18-46



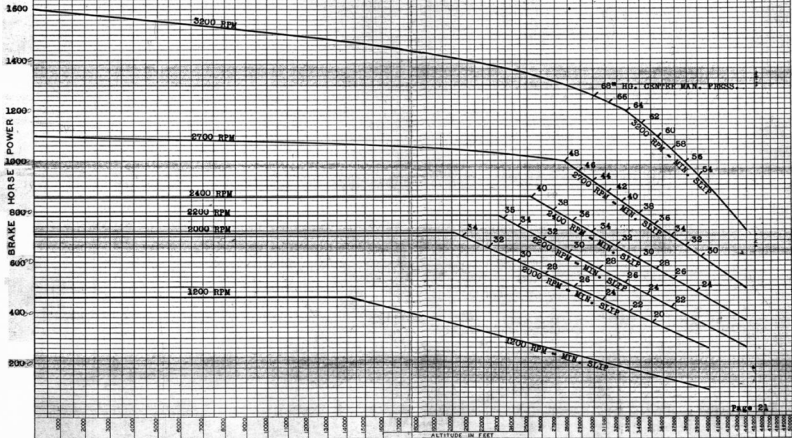
ALLISON DIVISION OF G.M.C.  
ENGINE PERFORMANCE

STANDARD CONDITIONS WITHOUT RAM

ESTIMATED FULL THROTTLE  
BHP & MANIFOLD PRESSURE

CURVE NO 245-B

MODEL V-17104143 & -145 (06RRL)  
PROP GEAR RATIO 2.36:1  
COMP. RATIO 6.0:1  
FLOWER RATIO 2.08 AUX 7.48 MAIN  
IMPELLER DIAM 12.1 AUX 10.25 MAIN  
FUEL METERING Speed Density Carb.  
FUEL GRADE 145 AN-P-35  
DATE 12-16-45  
Rev. 12-3-46





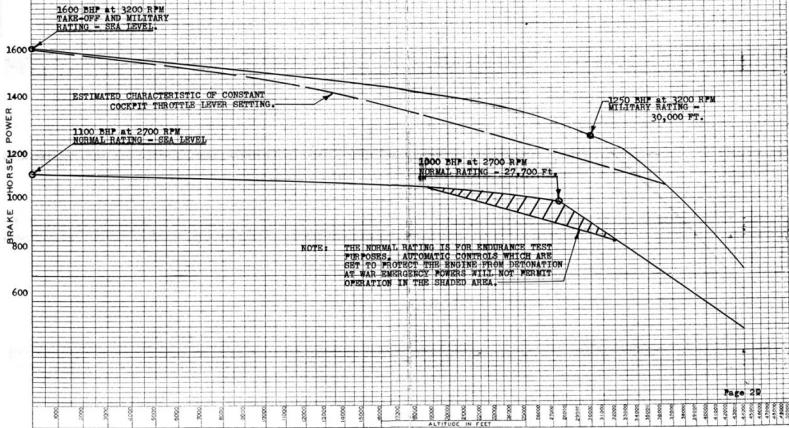
ALLISON DIVISION OF G.M.C.  
ENGINE PERFORMANCE

STANDARD CONDITIONS WITHOUT RAM

GUARANTEED PERFORMANCE

SPEC. NO. 245-B

MODEL V-1710 -143 & -145 06RAL  
PROP GEAR RATIO 2.36:1  
COMP. RATIO 6.0:1  
BLOWER RADIOS 08 AUX 7.48 MAIN  
MPELLER DIAM 12.1 AU 10.25 MAIN  
FUEL METERING Speed Density Carb.  
FUEL GRADE 145 AN-P-33  
DATE 12-18-45  
REV. 12-3-46



ALLISON DIVISION OF G.M.C.  
ENGINE PERFORMANCE

STANDARD CONDITIONS WITHOUT RAM

ESTIMATED ALTITUDE PERFORMANCE  
2000 RPM  
LONG RANGE CRUISE

SPEC. NO. 245-B

MODEL V-1710-145 & -145 (D55&L)  
PROP GEAR RATIO 2.56:1  
COMP. RATIO 8.0:1  
BLOWER RATIO 8.0:1 AUX 7.45 MAIN  
IMPELLER DIAM. 12.18 AUX 10.25 MAIN  
FUEL METERING Speed Density Carb.  
FUEL GRADE 145 A-1-E-55  
DATE 10-6-45

BRAKE HORSE POWER

700  
600  
500  
400  
300  
200

MAXIMUM PERMISSIBLE BHP AT 2000 RPM

ESTIMATED CONTROL CHARACTERISTICS

PILE PROTRUDE - MINIMUM SLIP

MINIMUM SLIP

ALTITUDE IN FEET

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000 16000 17000 18000 19000 20000 21000 22000 23000 24000 25000 26000 27000 28000 29000 30000 31000 32000 33000 34000 35000 36000 37000 38000 39000 40000 41000 42000 43000 44000 45000 46000 47000 48000 49000 50000

PROPOSED SETTING OF SPEED DENSITY CARBURETOR  
FOR G6R&G6L ENGINES

FUEL/AIR

RUN POSITION

LONG RANGE CRUISE

AIR FLOW

ALLISON DIVISION  
GENERAL MOTORS CORPORATION

Spec. No. 245-B

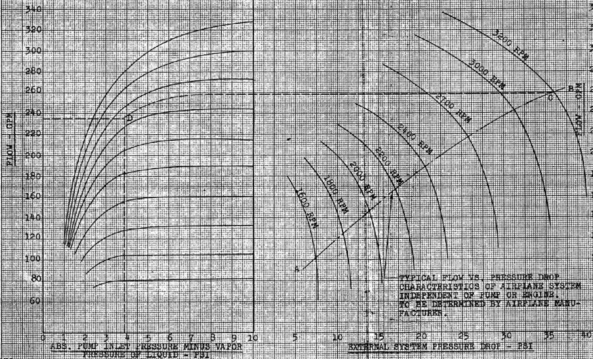
ESTIMATED V-TIC COOLANT PUMP CHARACTERISTICS  
30% SPEC. AB-8-2 STYRENE GLYCOL -- 70% WATER -- BY VOLUME  
SHOWING RELATION BETWEEN ENGINE RPM, EXTERNAL  
PRESSURE DROP AND PUMP INLET CONDITIONS

EXAMPLE I

CURVES SHOWING EFFECT OF PUMP  
INLET PRESSURE MINUS VAPOR PRES-  
SURE AT PUMP INLET ON FLOW.

FLOW VS. PRESSURE DROP IN THE EXTERNAL  
SYSTEM (ENGINE OUTLET TO PUMP INLET) AT  
10 PSI PUMP INLET PRESSURE MINUS VAPOR  
PRESSURE AT PUMP INLET FOR VARIOUS  
ENGINE SPEEDS.

Assume that with a coolant flow  
of 235 GPM, the best selection  
data and preliminary estimate on  
tank temperature drop and tank to  
pump line pressure drop results  
in a pump inlet pressure minus  
vapor pressure of 3.9 psi. Fol-  
low this intersection at B along  
the dotted example line to the  
required RPM Curve (say 3200 RPM).  
This intersection defines the  
external system is not to exceed  
36 psi pressure drop at 238 GPM  
flow. If Curve A-B, which  
approximates the external system  
is drawn, the actual pressure  
drop at 235 GPM is determined as  
29.5 #/sq.in.



TYPICAL FLOW VS. PRESSURE DROP  
CHARACTERISTICS OF AIRPLANE SYSTEM  
INDEPENDENT OF PUMP OR ENGINE,  
TO BE DETERMINED BY AIRPLANE MANU-  
FACTURER.

EXAMPLE II

Assume that in a given installa-  
tion the pressure drop vs. flow  
curve of the system external to the  
engine (block outlet to pump in-  
let) is as shown by Curve A-B.  
This curve crosses the 3200 RPM  
line at C and indicates that at  
10 psi pump inlet pressure minus  
vapor pressure the coolant flow  
will be 258 GPM. Following the  
dotted example back to the left  
side of the page, interpolating  
between curves and assuming that  
a flow of 235 GPM is required, it  
will be necessary to maintain  
conditions at the pump inlet to  
give a pump inlet pressure minus  
vapor pressure of 3.9 psi.

NP&H Division is Dept. Vapor Pressure & Liquid.

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-C-53		(2)	12/21/43	Compound - Anti-seize
AN-E-11	(c)		7/7/45	Preps. for Storage
AN-I-32			1/17/45	Magnetic Inspection
AN-N-1			9/21/44	Noses - Engine
AN-VV-O-446	(a)		1/5/43	Oil-Lubricating
AN-GGG-P-363		(2)	5/9/42	Pipe threads
AN-P-61			8/1/44	Cadmium Plating
AN-P-4		(4)	11/16/44	Spark Plugs
AN-GGG-S-126	(a)		1/30/43	Screw threads
AN-VV-C-566		(3)	12/21/43	Compound - Anti-seize (Mica base)
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-C-130	(a)		8/24/45	Ignition Cable
AN-F-28		(2)	11/15/43	Fuel - Grade 91
AN-F-33		(1)	2/23/45	Fuel - Grade 115/145
AN-I-27			10/27/45	Radio Interference limits
AN-O-5			4/27/43	Oil - Low pour lubricating
AN-E-2	(b)	(1)	3/8/45	Ethylene glycol

ARMY-NAVY SPECS.

AN-9500	(c)		10/26/44	Engines - General Spec.
AN-9501	(c)		10/26/44	Engines - Model Spec.
AN-9502	(c)		10/26/44	Engines - Qualification Test
AN-9503	(c)		10/26/44	Engines - Acceptance Test
AN-9504	(a)		2/12/45	Engines - Torsional Vibration

AAF Specs.

39417		(2)	1/28/45	Cable, High Speed Ignition
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FEDERAL SPECS.

VV-O-611			2/5/35	Oil; Lub., steam cylinder
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<u>ANA STD. DWGS. REV.</u>	<u>DATED</u>	<u>TITLE (IN BRIEF)</u>
AN 4037	6/10/40	Oil Flange - 3 bolt
AN 4048	1/6/42	Oil Flange - 4 bolt
AN 5531-1 1	5/25/44	Tachometer Generator
AN 4055 1	8/11/42	Adapter - Vac. Pump Pad
AN 6111-1 2	8/28/45	Vacuum Pump - Type I Pad
 <u>ANA DESIGN STD.</u>		
AND10001 2	12/27/44	Hyd. & Vac. Pump Pad - Type II
AND10002 1	12/27/44	Generator Pad
AND10003 2	12/27/44	Fuel Pump Pad
AND10004 3	12/27/44	Starter Pad
AND10005 2	12/27/44	Tachometer Pad
AND10010 2	1/5/45	Prop. Governor Pad
AND10202	10/21/43	Engine Data Plate
AND10207	9/28/42	Control lever connection
AND10304	9/2/41	Starter Clearance (Type I)
AND10305	2/28/42	Generator Clearance

ANA BULLETINS

Bulletin 152 (b)	11/4/44	Engine Serial Numbers
Bulletin 182 (b)	10/16/45	Material Substitutions