

# OPERATOR'S MANUAL

J-540, IO-540 & HIO-540  
SERIES  
AIRCRAFT ENGINES

1st Edition

July 1976

Approved by F.A.A.

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 **AVCO** LYCOMING WILLIAMSPORT DIVISION  
AVCO CORPORATION  
WILLIAMSPORT, PENNSYLVANIA 17701

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**ATTENTION****OWNERS, OPERATORS, AND  
MAINTENANCE PERSONNEL**

This operator's manual contains a description of the engine, its specifications, and detailed information on how to operate and maintain it. Such maintenance procedures that may be required in conjunction with periodic inspections are also included. This manual is intended for use by owners, pilots and maintenance personnel responsible for care of Avco Lycoming powered aircraft. Modifications and repair procedures are contained in Avco Lycoming overhaul manuals; maintenance personnel should refer to these for such procedures.

**SAFETY WARNING**

*Neglecting to follow the operating instructions and to carry out periodic maintenance procedures can result in poor engine performance and power loss. Also, if power and speed limitations specified in this manual are exceeded, for any reason; damage to the engine and personal injury can happen. Consult your local FAA approved maintenance facility.*

**SERVICE BULLETINS, INSTRUCTIONS, AND LETTERS**

Although the information contained in this manual is up-to-date at time of publication, users are urged to keep abreast of later information through Avco Lycoming Service Bulletins, Instructions and Service Letters which are available from all Avco Lycoming distributors or from the factory by subscription. Consult the latest edition of Service Letter No. L114 for subscription information.

**SPECIAL NOTE**

*The illustrations, pictures and drawings shown in this publication are typical of the subject matter they portray; in no instance are they to be interpreted as examples of any specific engine, equipment or part thereof.*



## LIMITED STANDARD WARRANTY

Avco Lycoming Williamsport Division, AVCO Corporation (Avco Lycoming), warrants each new or remanufactured aircraft engine and each new replacement part therefor sold by it to be free from defects in material or workmanship, under normal use and service, for six calendar months from the date of first operation by the first user.

The obligation of Avco Lycoming under this warranty shall be limited to the repair or replacement at Avco Lycoming's election, of the engine or any part thereof, or of the replacement part, when a claim is made in accordance with the Avco Lycoming Warranty Application Procedure and Avco Lycoming has determined that the engine or part is not as warranted. Such repair or replacement will be made by Avco Lycoming at no charge to the holder of this warranty and Avco Lycoming will assume costs for labor in connection therewith as provided in Avco Lycoming's Removal and Installation Labor Allowance Guide Book. Any engine or part installed in the course of such repair or replacement will be warranted for the remainder of the original warranty period.

No claim shall be allowed under this warranty if in the opinion of Avco Lycoming the engine or part has been subjected to accident or used, adjusted, altered, handled, maintained or stored other than as directed in Avco Lycoming's Operator's Manual.

No agreement varying this warranty or Avco Lycoming's obligations hereunder will be binding upon Avco Lycoming unless executed by its duly authorized employee.

Avco Lycoming reserves the right to change the construction of Avco Lycoming engines at any time without incurring any obligation to incorporate such alterations in engines or parts previously sold.

ANY IMPLIED WARRANTIES APPLICABLE BY LAW TO THIS PRODUCT ARE LIMITED IN DURATION TO THE DURATION OF THE WARRANTY SET FORTH ABOVE. TO THE EXTENT PERMITTED BY LAW, ALL CONSEQUENTIAL DAMAGES ARE EXCLUDED FROM THE COMPUTATION OF DAMAGES FOR THE BREACH OF ANY EXPRESS OR IMPLIED WARRANTY.

Effective September 1, 1975 - Revision "A"

Avco Lycoming Williamsport Division  
Williamsport, Pennsylvania



LIMITED SPECIAL WARRANTY  
FOR

*\*Premium Packaged Engines and Service Parts*

Avco Lycoming Williamsport Division, AVCO Corporation (Avco Lycoming) warrants each new or remanufactured premium packaged aircraft engine and each new premium packaged replacement part therefor sold by it to be free from defects in material and workmanship under normal use and service for six calendar months from the date of first operation by the first user or six months from the date of removal of the engine or part from the original premium packaging, whichever event shall occur, provided that (1) such packaging has remained sealed and undamaged at all times, (2) the engine and/or part has been stored at all times in a weather-protected, dry area under normal humidity conditions, (3) the humidity indicators installed within the vapor barrier have not shown an unsafe condition at any time, and (4) the storage of such engine and/or part in such premium packaging has not extended beyond six months from the date of shipment from Avco Lycoming's plant in Williamsport, Pennsylvania.

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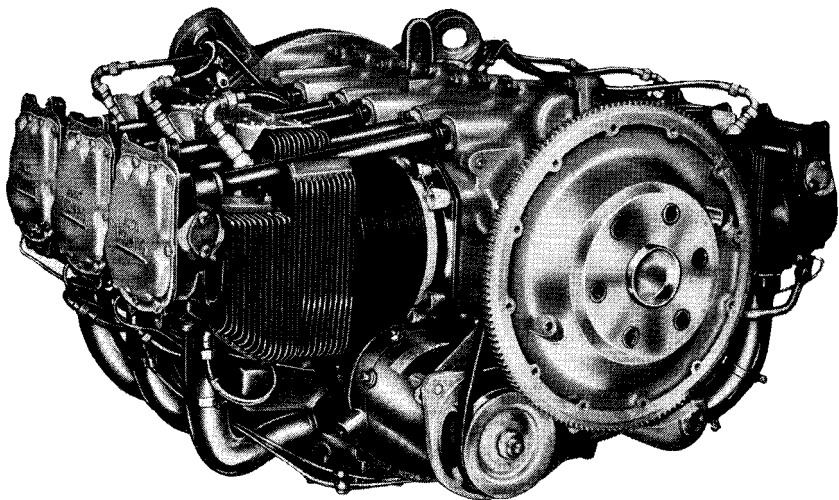
\* - The term "premium packaged" shall mean packaging in accordance with Avco Lycoming's Standard Packaging Specifications for export shipment.

Effective: September 1, 1975  
Rev. "A"

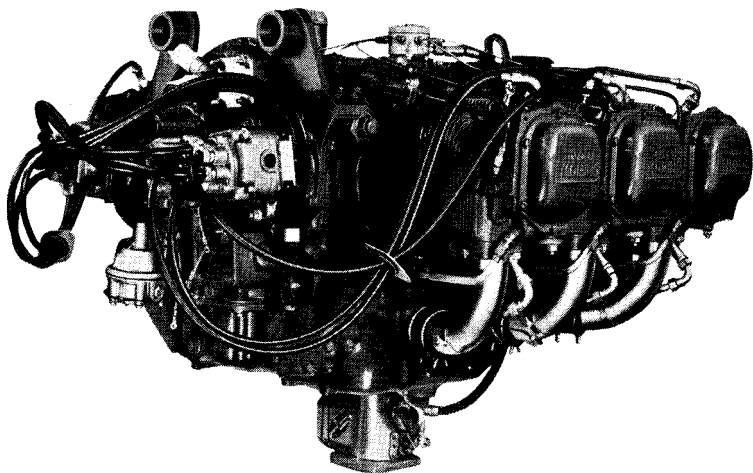
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Williamsport, Pennsylvania

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**3/4 Right Front View - Typical IO-540-B**



**3/4 Right Rear View - Typical IO-540-C**

### **WARNING**

*These engines are equipped with a dynamic counterweight system and must be operated accordingly, avoid high engine speed, low manifold pressure operation. Use a smooth, steady movement of the throttle (avoid rapid opening and closing). If this warning is not heeded, there could be severe damage to the counterweights, roller and bushings.*

**DESCRIPTION**

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**SECTION 1****DESCRIPTION**

The O-540, IO-540 and HIO-540 series are six cylinder, direct drive, horizontally opposed, air cooled engines.

In referring to the location of the various engine components, the parts are described in their relationship to the engine as installed in the airframe. Thus, the power take-off end is considered the front and the accessory drive end the rear. The sump section is considered the bottom and the opposite side of the engine where the shroud tubes are located the top. Reference to the left and right side is made with the observer facing the rear of the engine. The cylinders are numbered from front to rear, odd numbers on the right, even numbers on the left. The direction of rotation for accessory drives is determined with the observer facing the drive pad.

*Cylinders* - The cylinders are of conventional air cooled construction with the two major parts, head and barrel, screwed and shrunk together. The heads are made from an aluminum alloy casting with a fully machined combustion chamber. Rocker shaft bearing supports are cast integral with the head along with housings to form the rocker boxes for both valve rockers. The cylinder barrels, which are machined from chrome nickel molybdenum steel forgings, have deep integral cooling fins and the inside of the barrels are ground and honed to a specified finish.

*Valve Operating Mechanism* - A conventional type camshaft is located above and parallel to the crankshaft. The camshaft actuates hydraulic tappets which operate the valves through push rods and valve rockers. The valve rockers are supported on full floating steel shafts. The valve springs bear against hardened steel seats and are retained on the valve stems by means of split keys.

*Crankcase* - The crankcase assembly consists of two reinforced aluminum alloy castings, fastened together by means of studs, bolts and nuts. The mating surfaces of the two castings are joined without the use of a gasket, and the main bearing bores are machined for use of precision type main bearing inserts.

**SECTION 1****O-540, IO-540 & HIO-540 SERIES**

**Crankshaft** - The crankshaft is made from a chrome nickel molybdenum steel forging. All bearing journal surfaces are nitrided. Freedom from torsional vibration is assured by a system of pendulum type dynamic counterweights.

**Connecting Rods** - The connecting rods are made in the form of "H" sections from alloy steel forgings. They have replaceable bearing inserts in the crankshaft ends and bronze bushings in the piston ends. The bearing caps on the crankshaft ends are retained by two bolts and nuts through each cap.

**Pistons** - The pistons are machined from an aluminum alloy forging. The piston pin is a full floating type with a plug located in each end of the pin. Depending on the cylinder assembly, pistons may be machined for either three or four rings and may employ either half wedge or full wedge rings. Consult the latest revision of Service Instruction No. 1037 for proper piston and ring combinations.

**Accessory Housing** - The accessory housing is made from an aluminum casting and is fastened to the rear of the crankcase and the top rear of the sump. It forms a housing for the oil pump and the various accessory drives.

**Oil Sump (O-540, IO-540-C, -D, -J, -N, -R)** - The sump incorporates an oil drain plug, oil suction screen, mounting pad for carburetor or fuel injector, the intake riser and intake pipe connections.

**Oil Sump and Induction Assembly (Except O-540, IO-540-C, -D, -J, -N, -R)** - This assembly consists of the oil sump bolted to a mated cover containing intake pipe extensions for the induction system. When bolted together they form a mounting pad for the air inlet housing. Fuel drain plugs are provided in the cover and the sump incorporates oil drain plugs and an oil suction screen.

**Cooling System** - These engines are designed to be cooled by air pressure actuated by the forward speed of the aircraft. Baffles are provided to build up a pressure and force the air through the cylinder fins. The air is then exhausted to the atmosphere through gills or augmentor tubes usually located at the rear of the cowling.

*Induction System* - Avco Lycoming O-540 series engines are equipped with a Marvel-Schebler MA-4-5 carburetor. Particularly good distribution of the fuel-air mixture to each cylinder is obtained through the center zone induction system, which is integral with the oil sump and is submerged in oil, insuring a more uniform vaporization of fuel and aiding in cooling the oil in the sump. From the riser the fuel-air mixture is distributed to each cylinder by individual intake pipes.

Avco Lycoming IO-540, HIO-540 series engines are equipped with either a Bendix type RS or RSA fuel injector. The fuel injection system schedules fuel flow in proportion to air flow and fuel vaporization takes place at the intake ports.

A brief description of the carburetor and fuel injectors follows:

The Marvel-Schebler MA-4-5 carburetor is of the single barrel float type and is equipped with a manual mixture control and an idle cut-off.

The Bendix RS type fuel injection system operates by measuring the air flow through the throttle body of the servo valve regulator controls, and uses this measurement to operate a servo valve within the control. The regulated fuel pressure established by the servo valve is used to control the distributor valve assembly, which then schedules fuel flow in proportion to air flow.

The Bendix RSA type fuel injection system is based on the principle of measuring air flow and using the air flow signal in a stem type regulator to convert the air force into a fuel force. This fuel force (fuel pressure differential) when applied across the fuel metering section (jetting system) makes fuel flow proportional to air flow.

#### **NOTE**

*The letter "D" used as the 4th or 5th character in the model suffix means that the basic model configuration has been altered by the use of dual magnetos housed in a single housing. Example - basic model IO-540-K1A5 becomes IO-540-K1A5D.*

*Operational aspects of engines are the same and performance data and specifications for the basic model will apply.*

## SPECIFICATIONS

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**SECTION 2**

**SPECIFICATIONS**

O-540 SERIES				
	-A	-B	-E, -G, -H	-J
FAA Type Certificate	295	295	295	295
Rated horsepower	250	235	260	235
Rated speed RPM	2575	2575	2700	2400
Bore, inches	5.125	5.125	5.125	5.125
Stroke, inches	4.375	4.375	4.375	4.375
Displacement cubic inches	541.5	541.5	541.5	541.5
Compression ratio	8.5:1	7.2:1	8.5:1	8.5:1
Firing order	1-4-5-2-3-6	1-4-5-2-3-6	1-4-5-2-3-6	1-4-5-2-3-6
Spark occurs degrees BTC	25	25	25	23
Valve Rocker Clearance (hydraulic tappets collapsed)	.028-.080	.028-.080	.028-.080	.028-.080
Prop. Drive Ratio	1:1	1:1	1:1	1:1
Prop. Drive Rotation	Clockwise	Clockwise	Clockwise	Clockwise
IO-540 SERIES				
	-A, -B, -E -G, -P	-T -D, -N, -R	-C, -J	-K*, -L -M, -S*
FAA Type Certificate	1E4	1E4	1E4	1E4
Rated horsepower	290	260	250	300
Rated speed RPM	2575	2700	2575	2700
Bore, inches	5.125	5.125	5.125	5.125
Stroke, inches	4.375	4.375	4.375	4.375
Displacement cubic inches	541.5	541.5	541.5	541.5
Compression ratio	8.7:1	8.5:1	8.5:1	8.7:1
Firing order	1-4-5-2-3-6	1-4-5-2-3-6	1-4-5-2-3-6	1-4-5-2-3-6
Spark occurs degrees BTC	20	25	25	20
Valve Rocker Clearance (hydraulic tappets collapsed)	.028-.080	.028-.080	.028-.080	.028-.080
Prop. Drive Ratio	1:1	1:1	1:1	1:1
Prop. Drive Rotation	Clockwise	Clockwise	Clockwise	Clockwise

\* - NOTE: Model IO-540-K1C5, -K1F5, -K1J5 and -S1A5 has alternate rating of 290 horsepower at 2575 RPM. When operating at alternate rating, all data pertinent to the IO-540-G series is applicable.

**SECTION 2**
**O-540, IO-540 & HIO-540 SERIES**
**SPECIFICATIONS**
**HIO-540-A**

FAA Type Certificate . . . . .	1E4
Rated horsepower . . . . .	290
Rated speed RPM . . . . .	2575
Bore, inches . . . . .	5.125
Stroke, inches . . . . .	4.375
Displacement cubic inches . . . . .	541.5
Compression ratio . . . . .	8.7:1
Firing order . . . . .	1-4-5-2-3-6
Spark occurs degrees BTC . . . . .	20
Valve Rocker Clearance (hydraulic tappets collapsed) . . . . .	.028-.080
Prop. Drive Ratio . . . . .	1:1
Prop. Drive Rotation . . . . .	Clockwise

**1. STANDARD ENGINE, DRY WEIGHT**

MODEL	LBS.
O-540-J1A5D, -J2A5D, -J1B5D, -J2B5D . . . . .	387.00
O-540-B1A5, -B2A5, -B4A5 . . . . .	395.00
O-540-B1B5, -B2B5, -B4B5 . . . . .	395.00
O-540-A1A, -A1A5, -A4A5 . . . . .	396.00
O-540-A2B, -B1D5 . . . . .	396.00
O-540-A1B5, -A1C5, -A4B5 . . . . .	397.00
O-540-A4C5, -A1D5, -A4D5 . . . . .	397.00
O-540-A1D, -B2C5, -E4A5 . . . . .	397.00
O-540-E4B5 . . . . .	398.00
O-540-E4C5 . . . . .	399.00
O-540-A3D5, -H1B5D, -H2B5D . . . . .	412.00
O-540-G1A5, -G2A5 . . . . .	415.00
O-540-H1A5, -H2A5 . . . . .	416.00
IO-540-C1C5, -C4C5, -C2C . . . . .	402.00
IO-540-D4A5 . . . . .	402.00
IO-540-C1B5, -C4B5 . . . . .	404.00
IO-540-J4A5, -T4A5D . . . . .	409.00
IO-540-N1A5 . . . . .	428.00

**1. STANDARD ENGINE, DRY WEIGHT (CONT.)**

MODEL	LBS.
IO-540-R1A5 . . . . .	437.00
IO-540-B1A5, -B1C5, -E1A5 . . . . .	442.00
IO-540-A1A5, -E1B5, -G1A5 . . . . .	443.00
IO-540-G1E5, -G1F5 . . . . .	444.00
IO-540-G1B5, -P1A5, -E1C5, -G1C5 . . . . .	448.00
IO-540-M1A5 . . . . .	465.00
IO-540-K1G5D . . . . .	467.00
IO-540-K1A5, -L1A5, -K1E5, -K1F5, -K1G5 . . . . .	470.00
IO-540-K1G5, -K1C5, -K1D5, -K1J5, -S1A5 . . . . .	472.00
IO-540-K1H5 . . . . .	473.00
HIO-540-A1A . . . . .	474.00

*Accessory Drive	Drive Ratio	**Direction of Rotation
Starter	16.556:1	Counter-Clockwise
Generator	1.910:1	Clockwise
Generator (Optional)	2.500:1	Clockwise
Alternator	3.250:1	Clockwise
Alternator+	3.630:1	Clockwise
Vacuum Pump	1.300:1	Counter-Clockwise
Hydraulic Pump	1.385:1	Clockwise
Hydraulic Pump+	1.300:1	Clockwise
Tachometer	.500:1	Clockwise
Propeller Governor	.859:1	Clockwise
Propeller Governor+	.947:1	Clockwise
Magneto Drive	1.500:1	Clockwise
Fuel Pump - AN	1.000:1	Counter-Clockwise
Fuel Pump - Plunger Operated	.500:1	Counter-Clockwise

\* - When applicable.

\*\* - Viewed facing drive pad - NOTE that engines with "L" in prefix will have opposite rotation to the above.

+ - Dual magneto drive.

**OPERATING CONDITIONS**

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**SECTION 3****OPERATING CONDITIONS**

**1. GENERAL.** Close adherence to these instructions will greatly contribute to long life, economy and satisfactory operation of the engine.

**NOTE**

***YOUR ATTENTION IS DIRECTED TO THE WARRANTIES THAT APPEAR IN THE FRONT OF THIS MANUAL REGARDING ENGINE SPEED, THE USE OF SPECIFIED FUELS AND LUBRICANTS, REPAIRS AND ALTERATIONS. PERHAPS NO OTHER ITEM OF ENGINE OPERATION AND MAINTENANCE CONTRIBUTES QUITE SO MUCH TO SATISFACTORY PERFORMANCE AND LONG LIFE AS THE CONSTANT USE OF CORRECT GRADES OF FUEL AND OIL, CORRECT ENGINE TIMING, AND FLYING THE AIRCRAFT AT ALL TIMES WITHIN THE SPEED AND POWER RANGE SPECIFIED FOR THE ENGINE. DO NOT FORGET THAT VIOLATION OF THE OPERATION AND MAINTENANCE SPECIFICATIONS FOR YOUR ENGINE WILL NOT ONLY VOID YOUR WARRANTY BUT WILL SHORTEN THE LIFE OF YOUR ENGINE AFTER ITS WARRANTY PERIOD HAS PASSED.***

New engines have been carefully run-in by Avco Lycoming and therefore, no further break-in is necessary insofar as operation is concerned; however, new or newly overhauled engines should be operated using only the lubricating oils recommended in the latest edition of Service Instruction No. 1014.

The minimum fuel octane rating is listed in the flight chart, Part 9 of this section. Under no circumstances should fuel of a lower octane rating or automotive fuel (regardless of octane rating) be used.

**2. PRESTARTING ITEMS OF MAINTENANCE.** Before starting the aircraft engine for the first flight of the day, there are several items of maintenance inspection that should be performed. These are described in Section 4 under Daily Pre-Flight Inspection. They must be observed before the engine is started.

**SECTION 3****O-540, IO-540 & HIO-540 SERIES****3. STARTING PROCEDURES**

The following starting procedures are recommended: However, the starting characteristics of various installations will necessitate some variation from these procedures.

**NOTE**

*Cranking periods should be limited from ten (10) to twelve (12) seconds with 5 minutes rest between cranking periods.*

**a. O-540 Series**

- (1) Perform pre-flight inspection.
- (2) Set carburetor heat control in "cold" position.
- (3) Set propeller governor (if applicable) in "Full RPM" position.
- (4) Turn fuel valve to "on" position.
- (5) Move mixture control to "Full Rich".
- (6) Turn on boost pump.
- (7) Pump throttle to full open and back to idle position for 2 to 3 strokes for a cold engine. If engine is equipped with priming system, cold engines may be primed with 1 to 3 strokes of the priming pump.
- (8) Open throttle approximately 1/4 travel.
- (9) Set magneto selector switch. Consult airframe manufacturer's handbook for correct position.
- (10) Engage starter.
- (11) When engine starts, place magneto selector switch in "Both" position.
- (12) Check oil pressure gage for indicated pressure. If oil pressure is not indicated within thirty seconds, stop engine and determine trouble.

*b. IO-540 and HIO-540 Series (Cold Engine)*

- (1) Perform pre-flight inspection.
- (2) Set propeller governor in "Full RPM".
- (3) Turn fuel valve to "on" position.
- (4) Open throttle approximately 1/4 travel.
- (5) Turn boost pump on and move mixture control to "Full Rich" position until a slight but steady flow is indicated.
- (6) Return mixture control to "Idle Cut-Off" position.
- (7) Set magneto, selector switch. Consult airframe manufacturer's handbook for correct position.
- (8) Engage starter.
- (9) When engine starts, place magneto selector switch in "Both" position.
- (10) Move mixture control slowly and smoothly to "Full Rich".
- (11) Check oil pressure gage for indicated pressure. If oil pressure is not indicated within thirty seconds, stop the engine and determine trouble.

**NOTE**

*If engine fails to achieve a normal start, assume it to be flooded and use standard clearing procedure. Then repeat above procedure.*

*Hot Engine* - Because of the fact that the fuel percolates and the system must be cleared of vapor, it is recommended that the same procedure, as outlined above, be used for starting a hot engine.

**4. COLD WEATHER STARTING.** During extreme cold weather, it may be necessary to preheat the engine and oil before starting.

**5. GROUND RUNNING AND WARM-UP.** Subject engines are air pressure cooled and depend on the forward movement of the aircraft to maintain proper cooling. Particular care is necessary, therefore, when operating these engines on the ground. To prevent overheating, it is recommended that the following precautions be observed.

**SECTION 3****O-540, IO-540 & HIO-540 SERIES****NOTE**

*Any ground check that requires full throttle operation must be limited to three minutes, or less if indicated cylinder head temperature should exceed the maximum stated in this manual.*

- a. Head the aircraft into the wind.
- b. Leave mixture in "Full Rich".
- c. Operate the engine on the ground only with the propeller in minimum blade angle setting.
- d. Warm up at approximately 1000-1200 RPM. Avoid prolonged idling and do not exceed 2200 RPM on the ground.
- e. Engine is warm enough for take-off when the throttle can be opened without the engine faltering.

**6. GROUND CHECK.**

- a. Warm up as directed above.
- b. Check both oil pressure and oil temperature.
- c. Leave mixture in "Full Rich".
- d. (Where applicable) Move the propeller control through its complete range to check operation and return to full low pitch position. Full feathering check (twin engine) on the ground is not recommended but the feathering action can be checked by running the engine between 1000-1500 RPM; then momentarily pulling the propeller control into the feathering position. Do not allow the RPM to drop more than 500 RPM.
- e. A proper magneto check is important. Additional factors, other than the ignition system, affect magneto drop-off. They are load-power output, propeller pitch and mixture strength. The important thing is that the engine runs smoothly because magneto drop-off is affected by the variables listed above. Make the magneto check in accordance with the following procedures.

(1) (Controllable Pitch Propeller) With propeller in minimum pitch angle, set the engine to produce 50 - 65% power as indicated by the manifold pressure gage. Mixture control should be in the full rich position. At these settings, the ignition system and spark plugs must work harder because of the greater pressure within the cylinders. Under these conditions ignition problems, if they exist, will occur. Mag checks at low power settings will only indicate fuel - air distribution quality.

**NOTE**

*Aircraft that are equipped with fixed pitch propellers, or not equipped with manifold pressure gage, may check magneto drop-off with engine operating at approximately 2100-2200 RPM.*

(2) Switch from both magnetos to one and note drop-off, return to both until engine regains speed and switch to the other magneto and note drop-off, then return to both. Drop-off should not exceed 175 RPM and should not exceed 50 RPM between magnetos. A smooth drop-off past normal is usually a sign of a too lean or too rich mixture.

f. Do not operate on a single magneto for too long a period, a few seconds is usually sufficient to check drop-off and will minimize plug fouling.

**7. OPERATING IN FLIGHT.**

a. Subject engines are equipped with a dynamic counterweight system and must be operated accordingly. Use a smooth, steady movement (avoid rapid opening and closing) of the throttle.

b. See airframe manufacturer's instructions for recommended power settings.

c. Fuel Mixture Leaning Procedure.

Improper fuel/air mixture during flight is responsible for many engine problems, particularly during take-off and climb power settings. The procedures described in this manual provide proper fuel/air mixture when leaning Avco Lycoming engines; they have proven to be both economical and practical by eliminating excessive fuel consumption and reducing damaged parts replacement. It is therefore recommended that operators, of all Avco Lycoming aircraft power-plants, utilize the instructions in this publication any time the fuel/air mixture is adjusted during flight.

## SECTION 3

## O-540, IO-540 &amp; HIO-540 SERIES

Manual leaning may be monitored by exhaust gas temperature indication, fuel flow indication, and by observation of engine speed and/or airspeed. However, whatever instruments are used in leaning the mixture, the following general rules should be observed by the operator of Avco Lycoming aircraft engines.

**GENERAL RULES**

*Never exceed the maximum red line cylinder head temperature limit.*

*For maximum service life, cylinder head temperatures should be maintained below 435<sup>o</sup>F. (224<sup>o</sup>C.) during high performance cruise operation and below 400<sup>o</sup>F. (205<sup>o</sup>C.) for economy cruise powers.*

*On engines with manual mixture control, maintain mixture control in "Full Rich" position for rated take-off, climb and maximum cruise powers (above approximately 75%). However, during take-off from high elevation airport or during climb, roughness or loss of power may result from over-richness. In such a case adjust mixture control only enough to obtain smooth operation - not for economy. Observe instruments for temperature rise. Rough operation due to over-rich fuel/air mixture is most likely to be encountered in carbureted engines at altitude above 5,000 feet.*

*Always return the mixture to full rich before increasing power settings.*

*Operate the engine at maximum power mixture for performance cruise powers and at best economy mixture for economy cruise power; unless otherwise specified in the airplane owners manual.*

*During let-down flight operations it may be necessary to manually lean uncompensated carbureted or fuel injected engines to obtain smooth operation.*

**1. LEANING TO EXHAUST GAS TEMPERATURE GAGE.**

a. Normally aspirated engines with fuel injectors or uncompensated carburetors.

*(1) Maximum Power Cruise (approximately 75% power) - Never lean beyond 150<sup>o</sup>F. on rich side of peak EGT unless aircraft operator's manual shows otherwise. Monitor cylinder head temperatures.*

*(2) Best Economy Cruise (approximately 75% power and below) - Operate at peak EGT.*

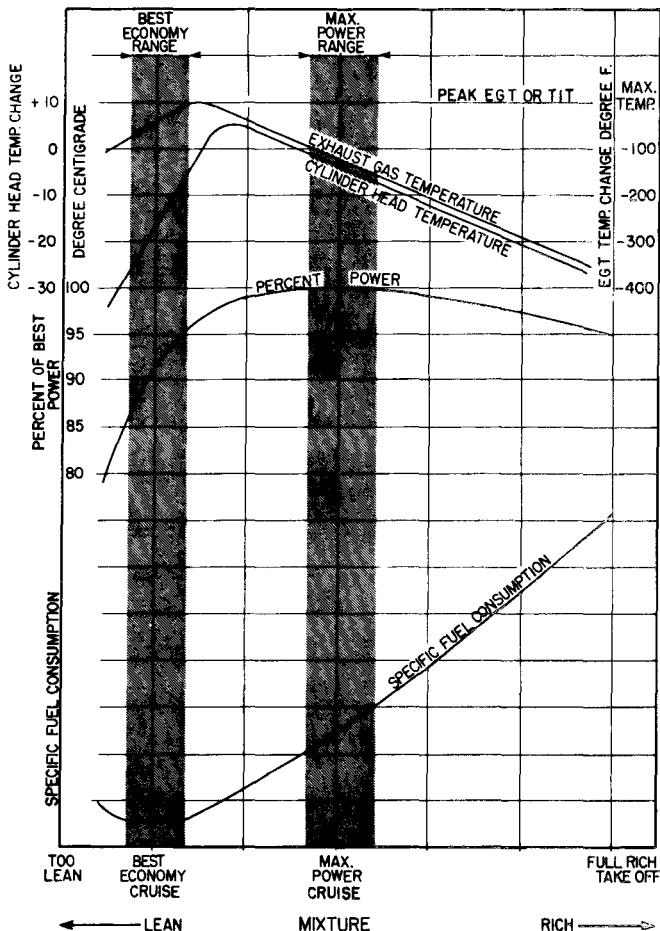


Figure 3-1. Representative Effect of Leaning on Cylinder Head Temperature, EGT (Exhaust Gas Temperature), Engine Power and Specific Fuel Consumption at Constant Engine RPM and Manifold Pressure

**SECTION 3****O-540, IO-540 & HIO-540 SERIES****2. LEANING TO FLOWMETER.**

Lean to applicable fuel-flow tables or lean to indicator marked for correct fuel-flow for each power setting.

**3. LEANING WITH MANUAL MIXTURE CONTROL (Without flowmeter or EGT gage).***a. Carbureted Engines.*

- (1) Slowly move mixture control from "Full Rich" position toward lean position.
- (2) Continue leaning until engine roughness is noted.
- (3) Enrich until engine runs smoothly and power is regained.

**8. USE OF CARBURETOR HEAT CONTROL** - Under certain moist atmospheric conditions at temperature of 20<sup>0</sup> to 90<sup>0</sup>, it is possible for ice to form in the induction system, even in summer weather. This is due to the high air velocity through the carburetor venturi and the absorption of heat from this air by vaporization of the fuel. The temperature in the mixture chamber may drop as much as 70<sup>0</sup>F. below the temperature of the incoming air. If this air contains a large amount of moisture, the cooling process can cause precipitation in the form of ice. Ice formation generally begins in the vicinity of the butterfly and may build up to such an extent that a drop in power output could result. A loss of power is reflected by a drop in manifold pressure in installations equipped with constant speed propellers and a drop in manifold pressure and RPM in installations equipped with fixed pitch propellers. If not corrected, this condition may cause complete engine stoppage.

To avoid this condition, all installations are equipped with a system for preheating the incoming air supply to the carburetor. In this way, sufficient heat is added to replace the heat loss due to vaporization of fuel; and the mixing chamber's temperature cannot drop to the freezing point of water. This air preheater is essentially a tube or jacket through which the exhaust pipe from one or more cylinders is passed, and the air flowing over these surfaces is raised to the required temperature before entering the carburetor. Consistently high temperatures are to be avoided because of a loss in power and a decided variation of the mixture. High charge temperatures also favor detonation and preignition, both of which are to be avoided if normal service life is to be expected from the engine. The following outline is the proper method of utilizing the carburetor heat control.



(1) *Take-off* - Take-off should be made with carburetor heat in full cold position. The possibility of icing at wide throttle opening is very remote.

(2) *Flight Operation* - The carburetor air heat control should be left in the cold position during normal flight operations. On damp, cloudy, foggy or hazy days, regardless of outside temperature, keep a sharp lookout for loss of power. This loss of power will be shown by unaccountable loss in manifold pressure or RPM or both, depending on whether a constant speed or fixed pitch propeller is installed on the aircraft. When this situation arises, apply full carburetor air heat and open the throttle to limiting manifold pressure. This will result in an additional drop in manifold pressure which is normal, and this drop will be regained as the ice is melted out of the induction system. When the ice has been melted from the induction system the carburetor heat control should be returned to the cold position. Only in aircraft equipped with a carburetor air temperature gage may partial heat be used to keep the mixture temperature above the freezing point (32°F.).

#### **WARNING**

*Caution must be exercised when operating with partial heat on aircraft that do not have a carburetor air temperature gage. Moisture in crystal form that would ordinarily pass through the induction system, can be raised in temperature by use of partial heat to the point where the crystals are melted into liquid form. This moisture can form carburetor ice due to the temperature drop as it passes through the venturi of the carburetor. It is advisable, therefore, to use either full heat or no heat in aircraft that are not equipped with a carburetor air temperature gage.*

(3) *Landing Approach* - In making an approach for a landing, carburetor air heat should generally be in the "Full Cold" position. However, if icing conditions are suspected, the "Full Heat" should be applied. In the event that full power need be applied under these conditions, as for an aborted landing, the carburetor heat should be returned to "Full Cold" after full power application. See the aircraft flight manual for specific instructions.

**SECTION 3**
**O-540, IO-540 & HIO-540 SERIES**
**9. ENGINE FLIGHT CHART.**

Fuel and Oil -

Model	*Aviation Grade Fuel
O-540-B Series	80/87 octane, minimum
O-540-A, -E, -G, -H, IO-540-C, -D, -N	91/96 octane, minimum
IO-540 Series (Except -C, -D, -N)	100/130 octane, minimum
HIO-540 Series	100/130 octane, minimum

\* - Refer to the latest edition of Service Instruction No. 1070.

**NOTE**

*Aviation grade 100LL fuels in which the lead content is limited to 2 c. c. per gal. are approved for continuous use in the above listed engines.*

**ALL MODELS**

\*Recommended Grade Oil

Average Ambient Air	MIL-L-6082 Grades	MIL-L-22851 Ashless Dispersant Grades
Above 60°F.	SAE 50	SAE 40 or SAE 50
30° to 90°F.	SAE 40	SAE 40
0° to 70°F.	SAE 30	SAE 40 or SAE 30
Below 10°F.	SAE 20	SAE 30

\* - Refer to the latest edition of Service Instruction No. 1014.

Oil Sump Capacity (all models)	.12 U. S. Quarts
Minimum Safe Quantity in Sump	2-3/4 U. S. Quarts

**OPERATING CONDITIONS**

Average Ambient Air	*Oil Inlet Temperature	
	Desired	Maximum
Above 60°F.	180°F. (82°C.)	245°F. (118°C.)
30° to 90°F.	180°F. (82°C.)	245°F. (118°C.)
0° to 70°F.	170°F. (77°C.)	225°F. (107°C.)
Below 10°F.	160°F. (71°C.)	210°F. (99°C.)

\* - Engine oil temperature should not be below 140°F. (60°C.) during continuous operation.

Oil Pressure, psi	Maximum	Minimum	Idling
Normal Operating			
All Models (except -F, -J, -N)	90	60	25
-F, -J, -N	90	55	25
Start and Warm Up	100		

**OPERATING CONDITIONS (CONT.)**

Fuel Pressure, psi	MIN.	MAX.	IDLE MIN.
<b>O-540 SERIES</b>	0.5	8.0	
*IO-540-A, -B Series			
*IO-540-E1A5, -E1B5, -K1C5, -K1E5			
*IO-540-G1A5, -G1E5, -G1F5			
Inlet to fuel injector	20	26	
*IO-540-C, -D, -N, -T Series			
Inlet to fuel pump	-2	35	
Inlet to fuel injector	14	45	12
*IO-540-E1C5, -G1B5, -G1C5, -G1D5			
-L1A5, -M1A5, -P1A5, -S1A5			
*HIO-540-A1A			
Inlet to fuel pump	-4	40	
Inlet to fuel injector	18	40	12
*IO-540-K1A5, -K1B5, -K1F5, -K1G5			
-K1G5D, -K1J5			
Inlet to fuel pump	-2	40	
Inlet to fuel injector	18	40	12
*IO-540-J4A5, -R1A5			
Inlet to fuel pump	-4	45	
Inlet to fuel injector	14	45	12

\* - 55 psi maximum to fuel pump inlet with the fuel injector in idle cut-off.

**SECTION 3 O-540, IO-540 & HIO-540 SERIES  
OPERATING CONDITIONS (CONT.)**
**O-540-A Series**

Operation	RPM	HP	Fuel Cons. Gal./Hr.	Max. Oil Cons. Qts./Hr.	*Max. Cyl.Head Temp.
Normal Rated	2575	250	-----	1.11	500°F.
Performance Cruise (75% Rated)	2350	190	16.3	0.63	500°F.
Economy Cruise (60% Rated)	2200	150	12.5	0.50	500°F.

**O-540-B Series**

Normal Rated	2575	235	-----	1.05	500°F.
Performance Cruise (75% Rated)	2350	175	15.5	0.58	500°F.
Economy Cruise (60% Rated)	2200	140	12.2	0.47	500°F.

**O-540-E, -G, -H; IO-540-D, -N, -R**

Normal Rated	2700	260	-----	1.16	500°F.
Performance Cruise (75% Rated)	2450	195	19.0	0.65	500°F.
Economy Cruise (60% Rated)	2350	155	15.0	0.52	500°F.

**O-540-J Series**

Normal Rated	2400	235	-----	1.05	500°F.
Performance Cruise (75% Rated)	2200	175	12.8	0.58	500°F.
Economy Cruise (60% Rated)	2000	140	10.2	0.47	500°F.

\* - At Bayonet Location - For maximum service life of the engine, maintain cylinder head temperatures between 150°F. and 435°F. during continuous operation.

**OPERATING CONDITIONS (CONT.)**

**IO-540-C, -J Series\*\***

Operation	RPM	HP	Fuel Cons. Gal./Hr.	Max. Oil Cons. Qts./Hr.	*Max. Cyl.Head Temp.
Normal Rated	2575	250	-----	1.11	500°F.
Performance Cruise (75% Rated)	2350	190	16.5	0.63	500°F.
Economy Cruise (60% Rated)	2200	150	12.5	0.50	500°F.

**IO-540-A, -G, -P Series**

Normal Rated	2575	290	-----	1.29	500°F.
Performance Cruise (75% Rated)	2350	220	16.5	0.73	500°F.
Economy Cruise (60% Rated)	2200	175	12.0	0.59	500°F.

**IO-540-B, -E Series**

Normal Rated	2575	290	-----	1.29	475°F.
Performance Cruise (75% Rated)	2350	220	16.5	0.73	475°F.
Economy Cruise (60% Rated)	2200	175	12.0	0.59	475°F.

**IO-540-K, -L, -M, -S Series**

Normal Rated	2700	300	-----	1.34	475°F.
Performance Cruise (75% Rated)	2450	225	18.0	0.75	475°F.
Economy Cruise (60% Rated)	2350	180	12.8	0.60	475°F.

\* - At Bayonet Location - For maximum service life of the engine, maintain cylinder head temperatures between 150°F. and 435°F. during continuous operation.

\*\* - Limiting manifold pressure for continuous operation of IO-540-C4B5, -C4C5, -J4A5 with Hartzell propeller HCE2Y type hub and 8465-7R blades. Do not exceed 27 inches manifold pressure below 2300 RPM.

**SECTION 3**
**O-540, IO-540 & HIO-540 SERIES**
**OPERATING CONDITIONS (CONT.)**
**IO-540-T Series**

Operation	RPM	HP	Fuel Cons. Gal./Hr.	Max. Oil Cons. Qts./Hr.	*Max. Cyl.Head Temp.
Normal Rated	2700	260	-----	1.16	500°F.
Performance Cruise (75% Rated)	2450	195	15.0	0.65	500°F.
Economy Cruise (60% Rated)	2350	155	12.0	0.52	500°F.

**HIO-540-A Series**

Normal Rated	2575	290	-----	1.29	475°F.
Performance Cruise (75% Rated)	2350	220	16.5	0.73	475°F.
Economy Cruise (60% Rated)	2200	175	12.0	0.58	475°F.

\* - At Bayonet Location - For maximum service life of the engine, maintain cylinder head temperatures between 150°F. and 435°F. during continuous operation.

***e. Engine Shut-Down -***

- (1) Set propeller at minimum blade angle.
- (2) Idle until there is a decided decrease in cylinder head temperature.
- (3) Move mixture control to "Idle Cut-Off".
- (4) When engine stops, turn ignition switch off.

CURVE NO. 11800

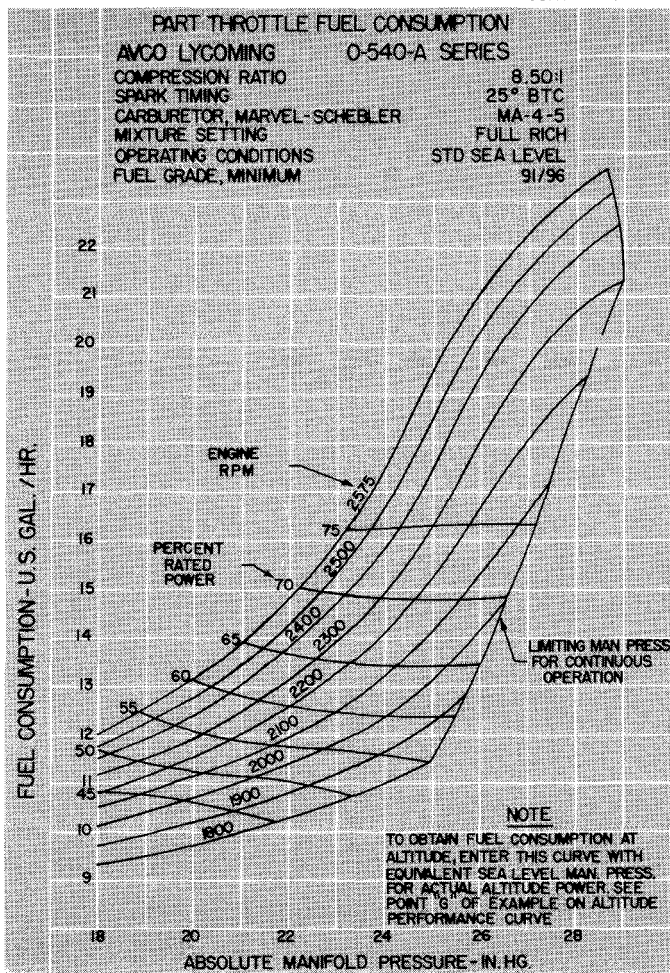


Figure 3-2. Part Throttle Fuel Consumption Curve - O-540-A

CURVE NO. 11799

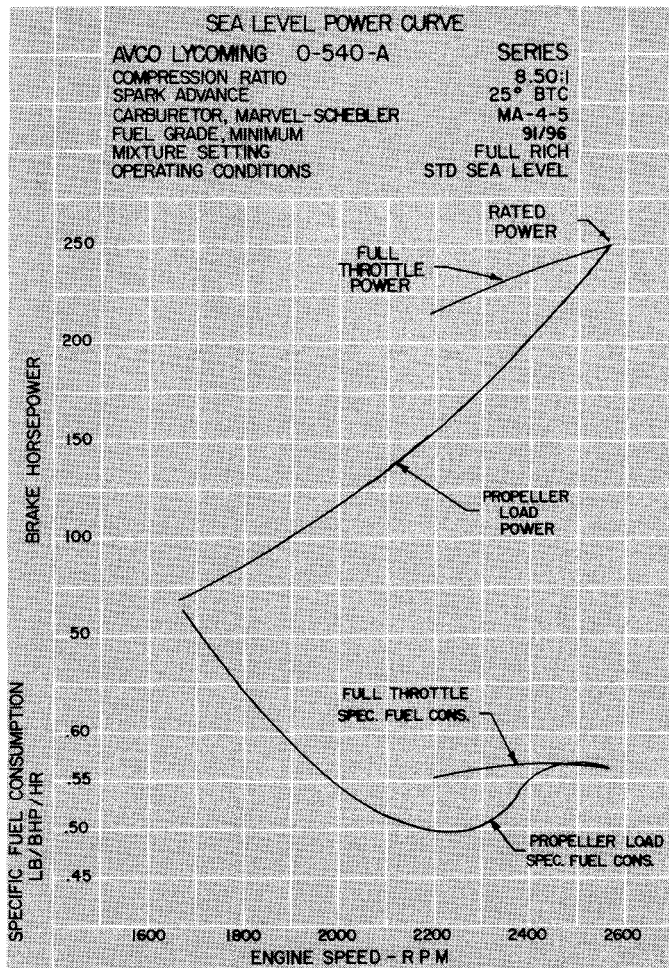


Figure 3-3. Sea Level Power Curve - O-540-A





CURVE NO. 10822-B

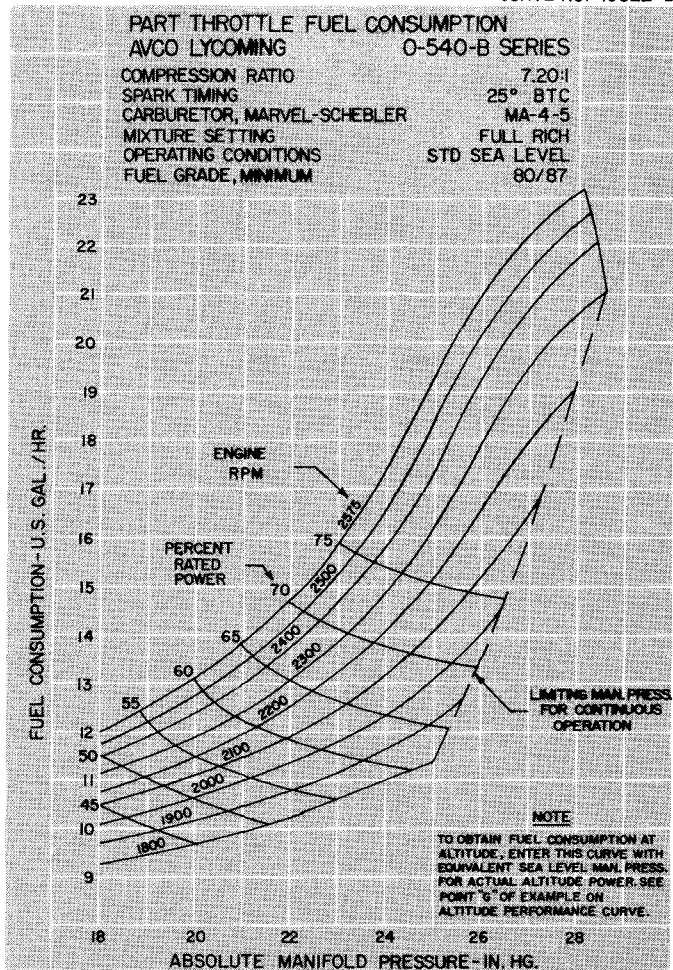


Figure 3-5. Part Throttle Fuel Consumption Curve - O-540-B

CURVE NO. 10821-B

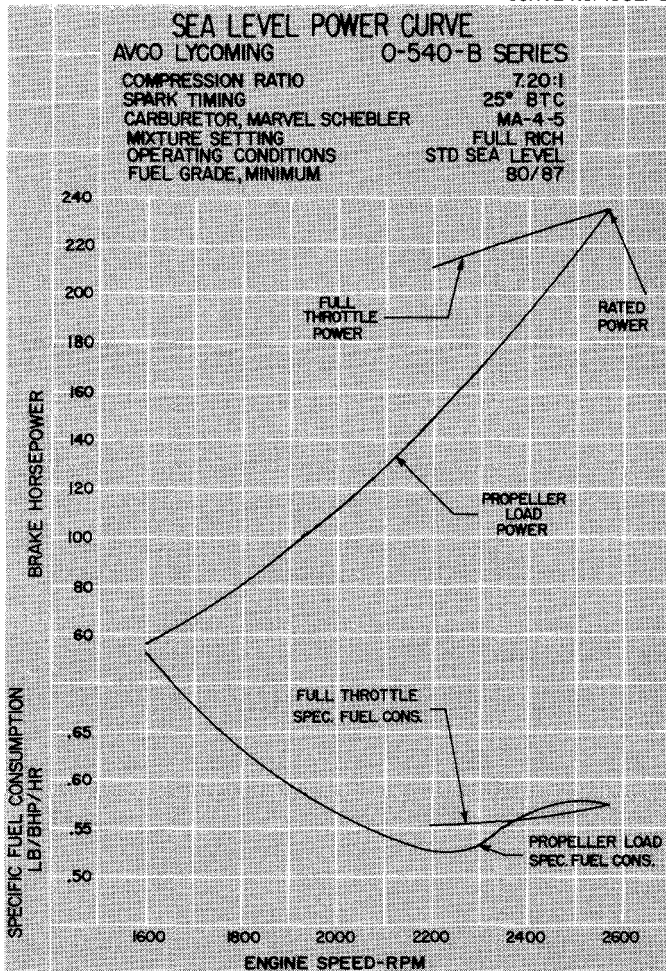


Figure 3-6. Sea Level Power Curve - O-540-B

## SECTION 3

## O-540, IO-540 &amp; HIO-540 SERIES

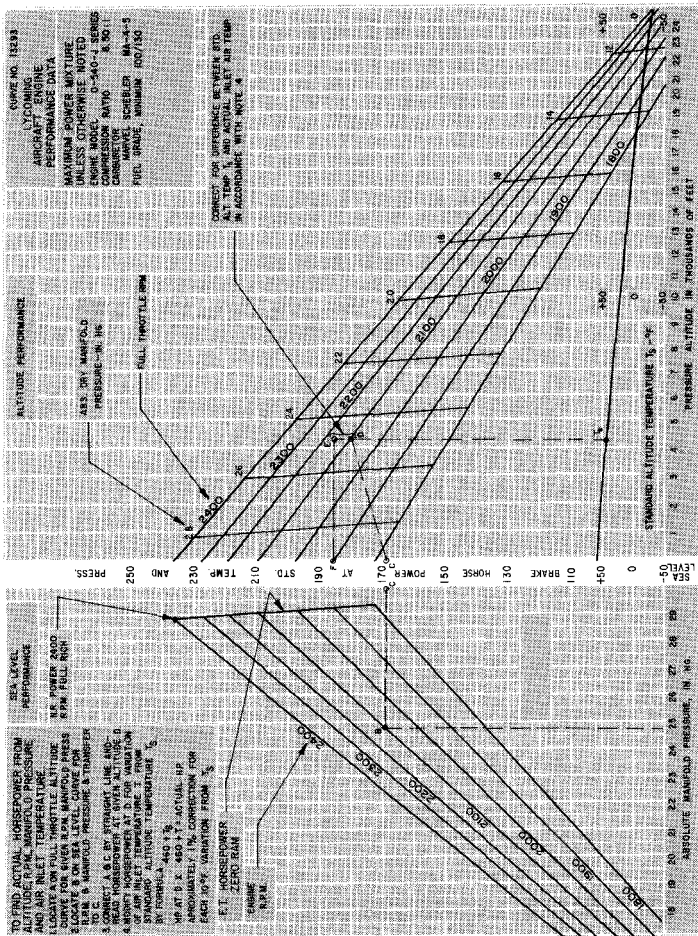


Figure 3-7. Sea Level and Altitude Performance - O-540-J

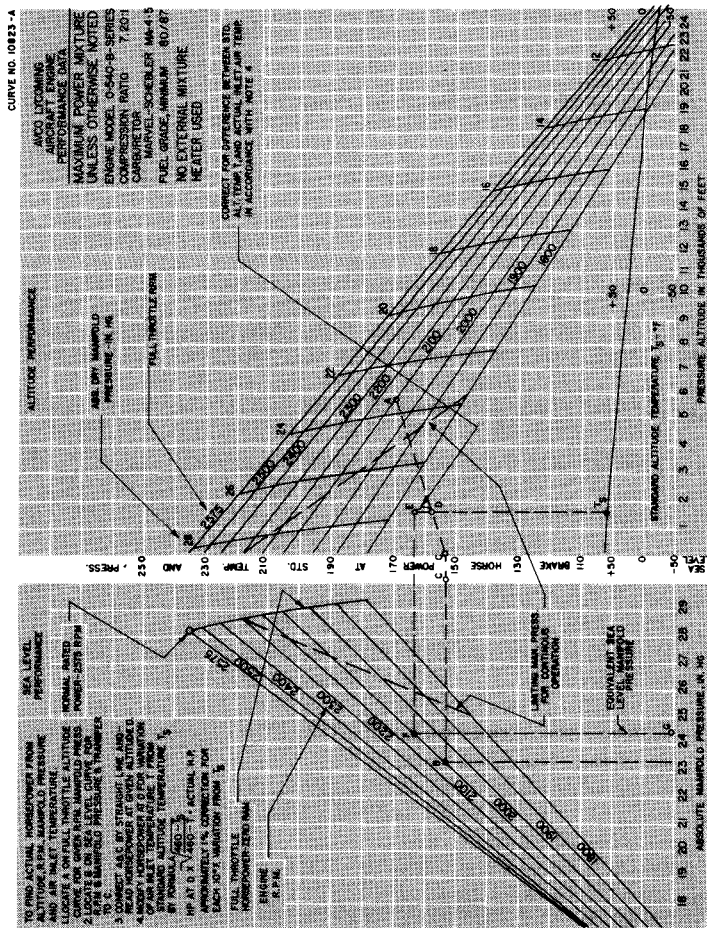
**USING CURVE TO FIND ACTUAL HORSEPOWER -**

The following is an example of how to use the Sea Level and Altitude Performance curves for normally aspirated engines, printed on these pages, to determine actual horsepower being delivered by the engine for given altitude, RPM, manifold pressure and oil inlet temperature. This example (figure 3-8) is for illustration purposes only.

1. Determine equivalent full throttle horsepower on altitude performance curve for observed manifold pressure and RPM. Example: At 2100 RPM and 23.2 inches manifold pressure, locate Point "A".
2. Repeat above procedure on sea level performance curve. Example: Point "B".
3. Transfer value obtained in step 2 to altitude performance curve. Example: Point "C".
4. Connect point "A" and point "C" with a straight line.
5. Read horsepower on line "CA" for given altitude (Example: At 1500 feet with a power setting of 2100 RPM and 23.2 in. Hg., horsepower is 157. Point "D".)
6. Correct power approximately 1% for each 10<sup>0</sup> variation in intake air temperatures from the standard altitude temperature shown below. Add correction for temperatures below standard, subtract correction for temperatures above standard. (Example: With an air inlet temperature of 14<sup>0</sup>F. at an altitude of 1500 feet, 54<sup>0</sup>F. - 14<sup>0</sup>F. = 40<sup>0</sup> variation. 1% for each 10<sup>0</sup> variation is 4%. 4% of 157 horsepower is approximately 6 horsepower. Since temperature is below standard, add correction: 157 + 6 = 163 horsepower - Point "E".)

**STANDARD ALTITUDE TEMPERATURES IN DEGREES F.**

Pressure Altitude (Thousands)	SL	2	3	6	8	10	12	14	16	18	20	22	24	
Standard Altitude Temperature (°F.)	59	52	45	38	31	23	16	9	+	2	-5	-12	-19	-27

**SECTION 3**
**O-540, IO-540 & HIO-540 SERIES**

**Figure 3-8. Sea Level and Altitude Performance Curve - O-540-B**

CURVE NO. I2954

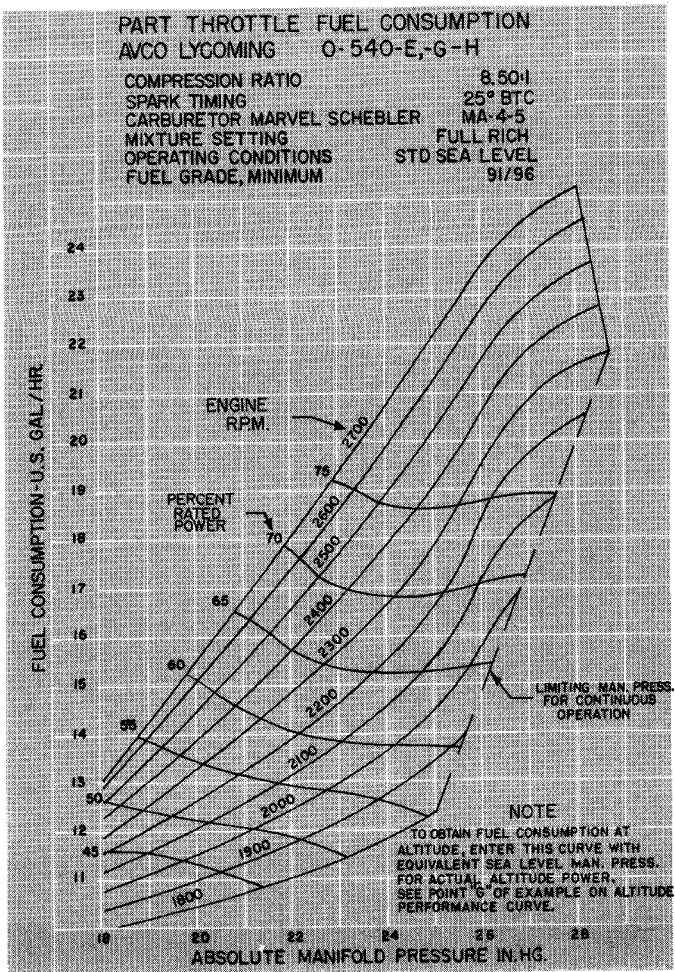


Figure 3-9. Part Throttle Fuel Consumption Curve - O-540-E, -G, -H



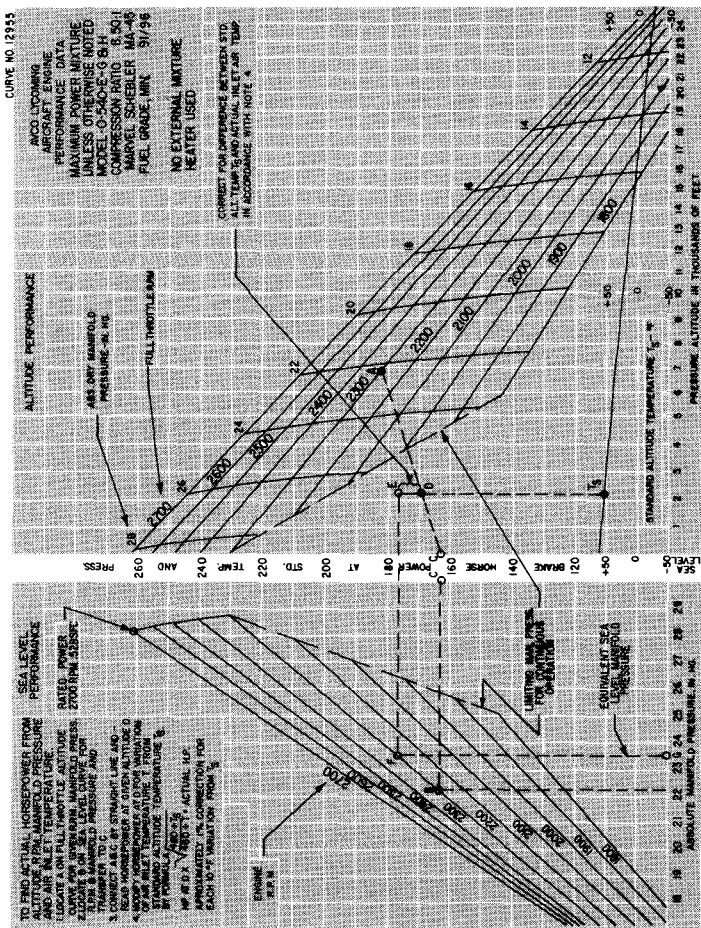


Figure 3-10. Sea Level and Altitude Performance Curve - O-540-E, -G, -H



CURVE NO. 12742-A

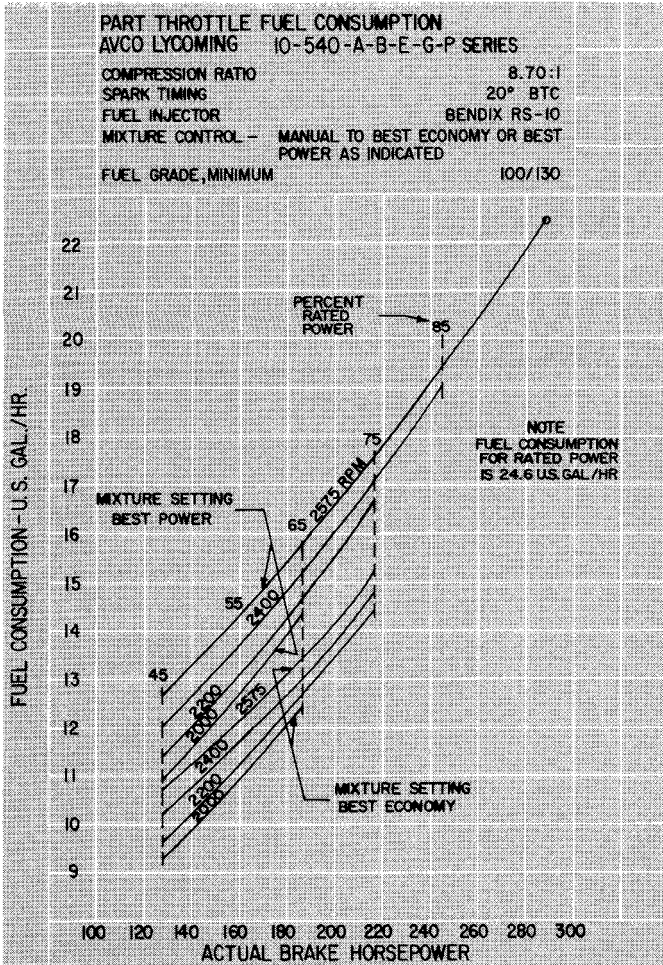


Figure 3-11. Part Throttle Fuel Consumption - IO-540-A, -B, -E, -G, -P

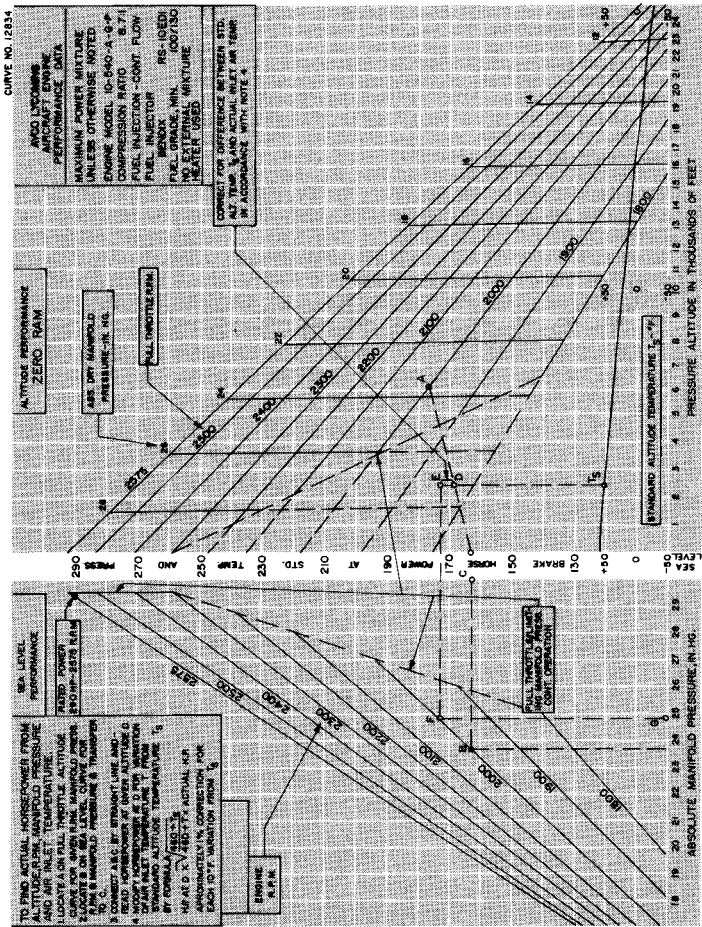


Figure 3-12. Sea Level and Altitude Performance Curve - IO-540-A, -G, -P



CURVE NO. 12838

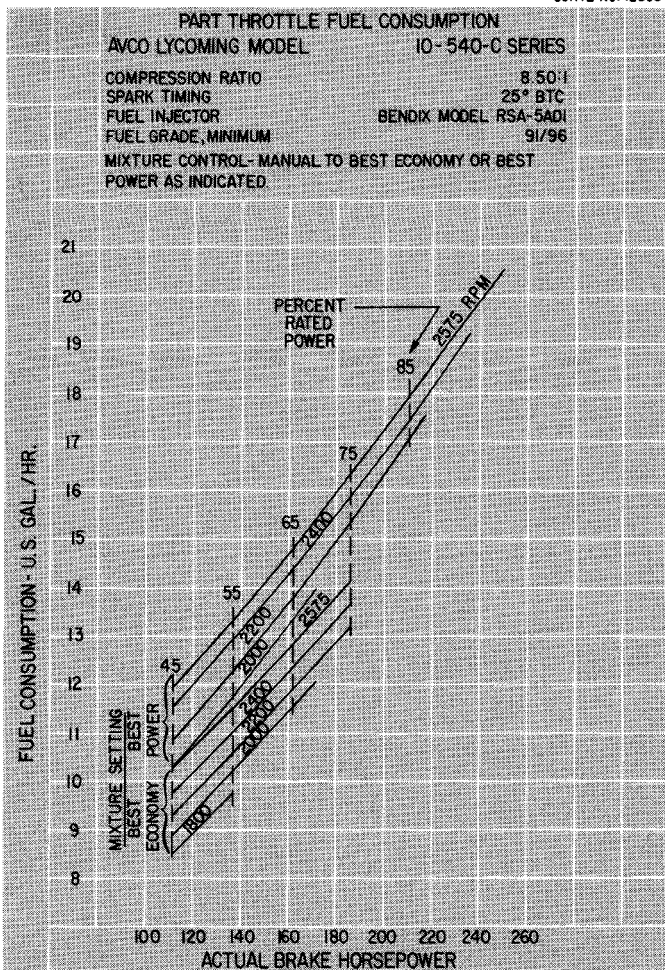


Figure 3-14. Part Throttle Fuel Consumption Curve - IO-540-C

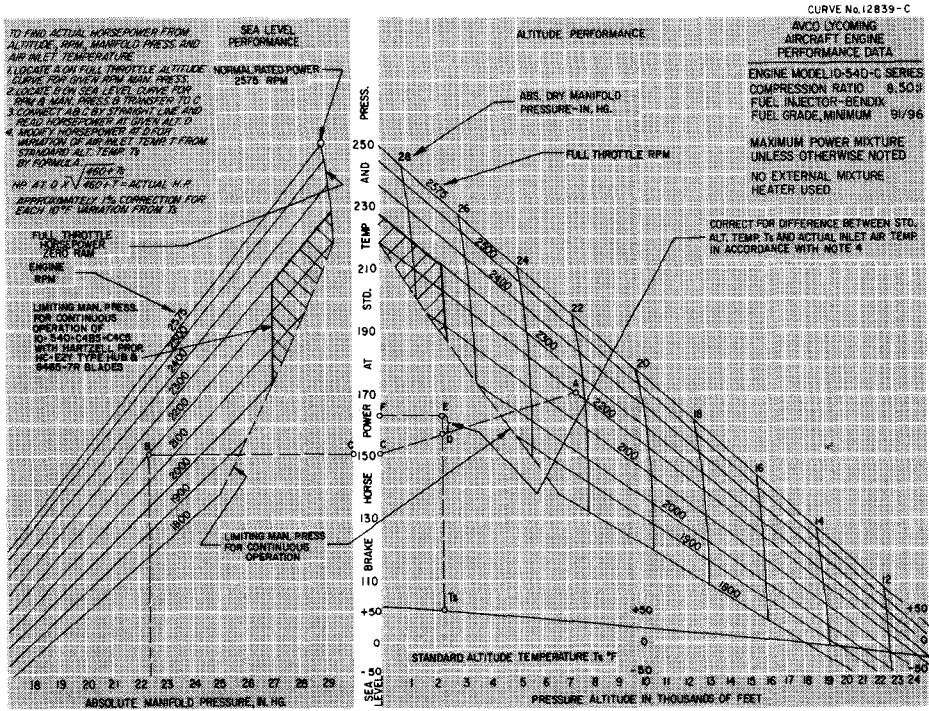


Figure 3-15. Sea Level and Altitude Performance Curve - IO-540-C

CURVE NO. 12957

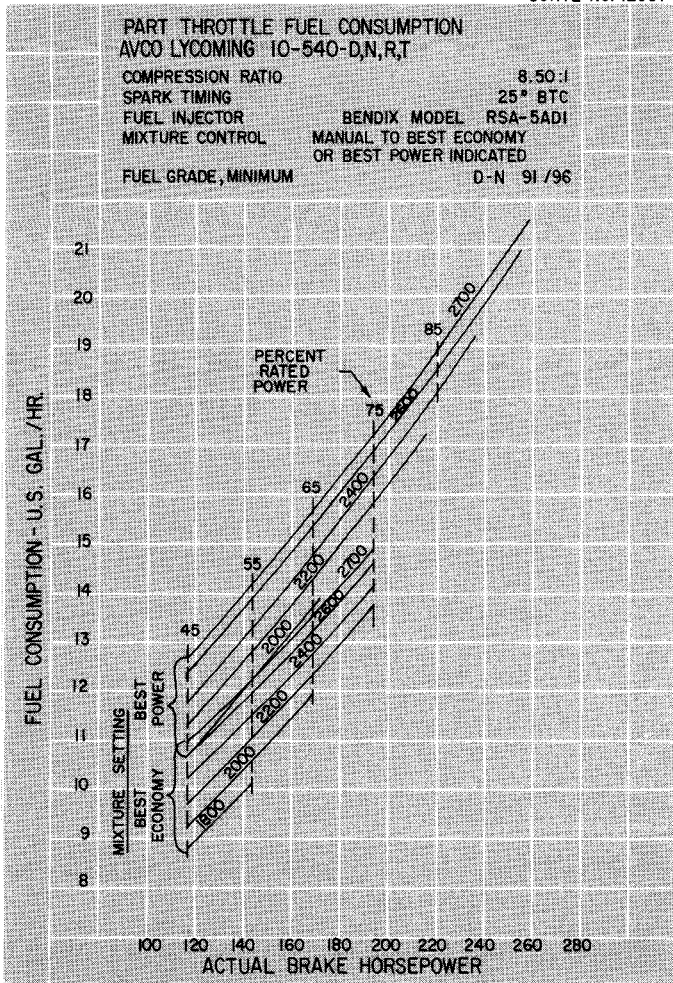


Figure 3-16. Part Throttle Fuel Consumption Curve - IO-540-D, -N, -R, -T



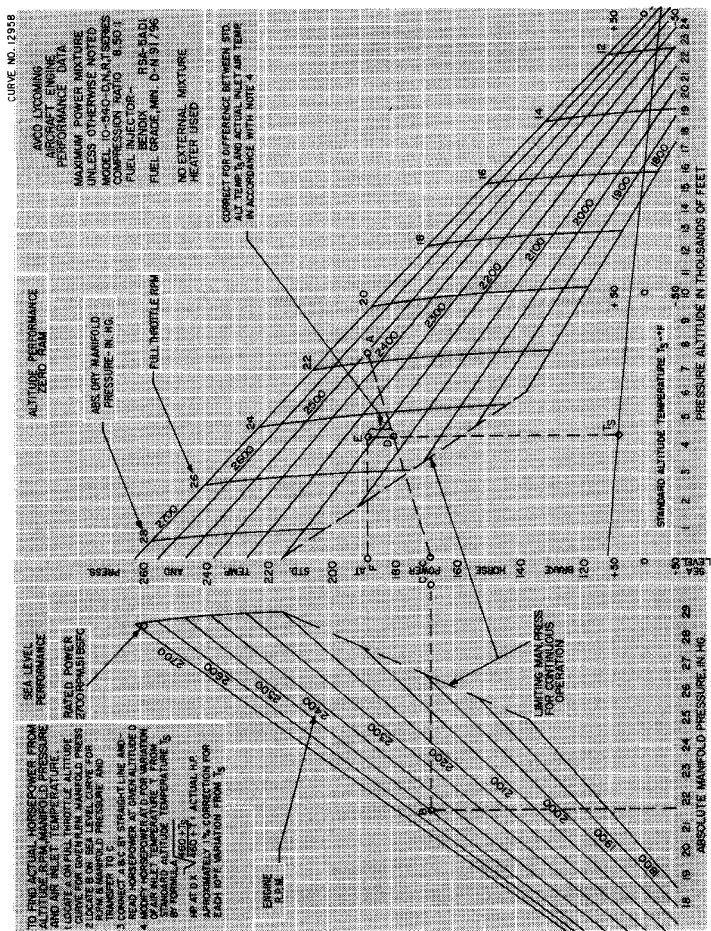


Figure 3-17. Sea Level and Altitude Performance Curve - IO-540-D, -N, -R, -T

CURVE NO. 13002

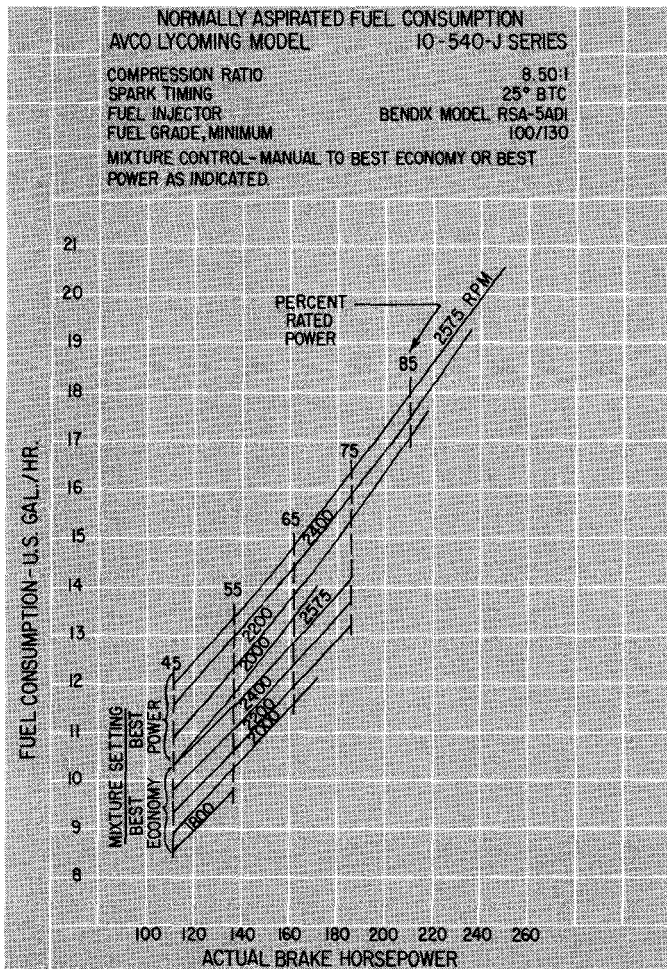


Figure 3-18. Normally Aspirated Fuel Consumption Curve - IO-540-J



CURVE NO. 13005-A

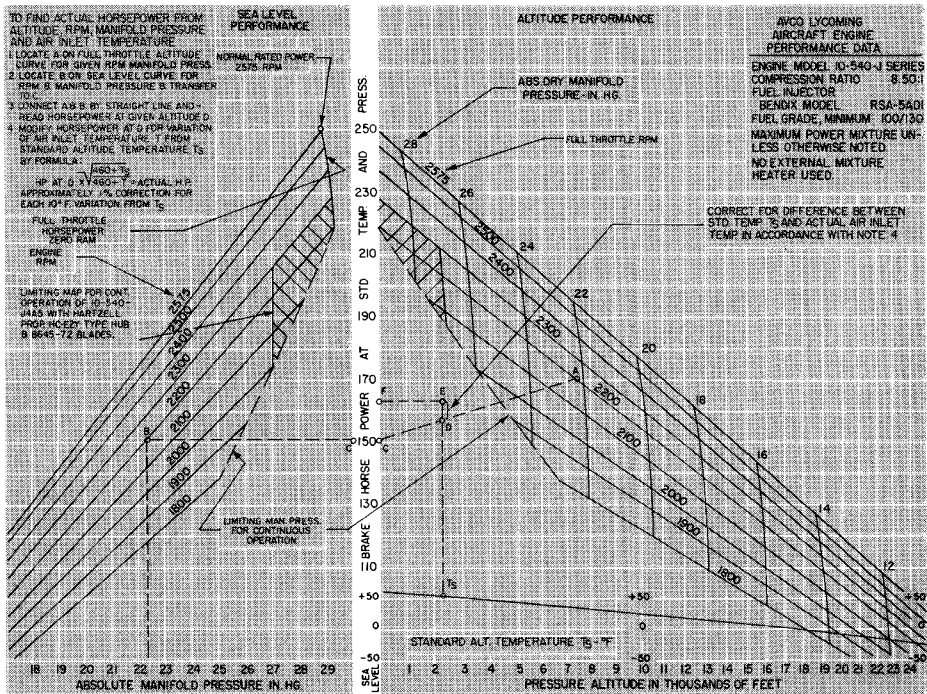


Figure 3-19. Sea Level and Altitude Performance Curve - 10-540-J

CURVE NO. 13012

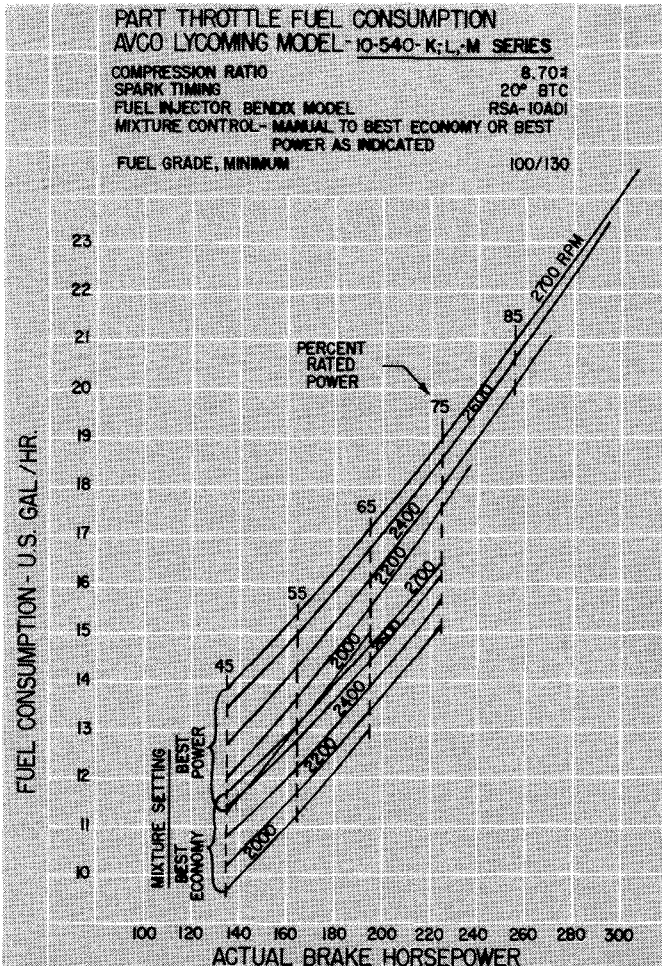


Figure 3-20. Part Throttle Fuel Consumption Curve - IO-540-K, -L, -M, -S

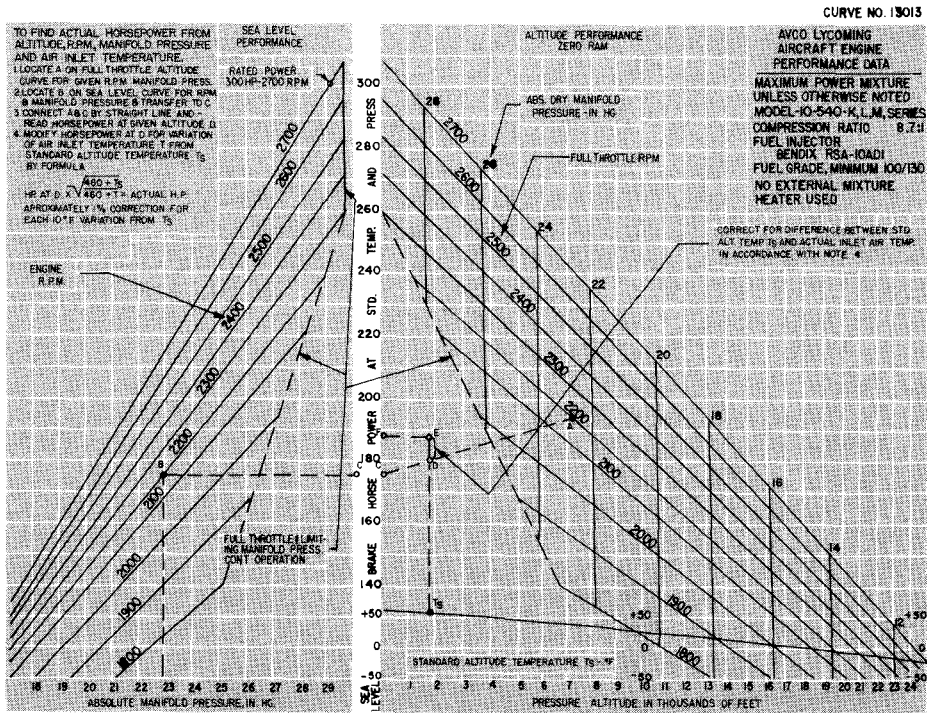


Figure 3-21. Sea Level and Altitude Performance Curve - IO-540-K, -L, -M, -S

CURVE NO. 13253

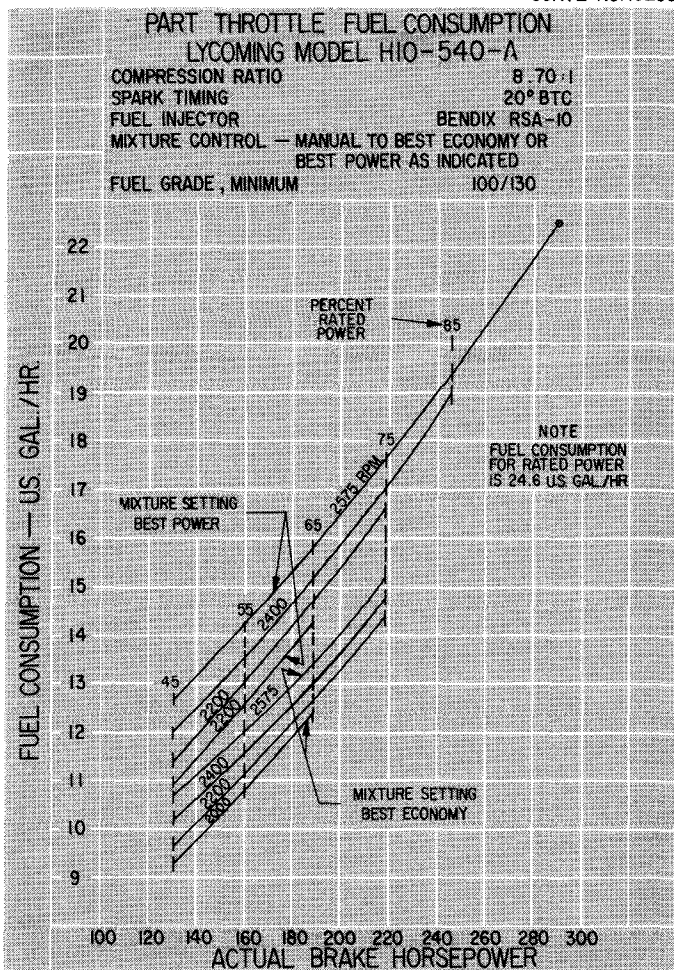


Figure 3-22. Part Throttle Fuel Consumption Curve - HIO-540-A1A

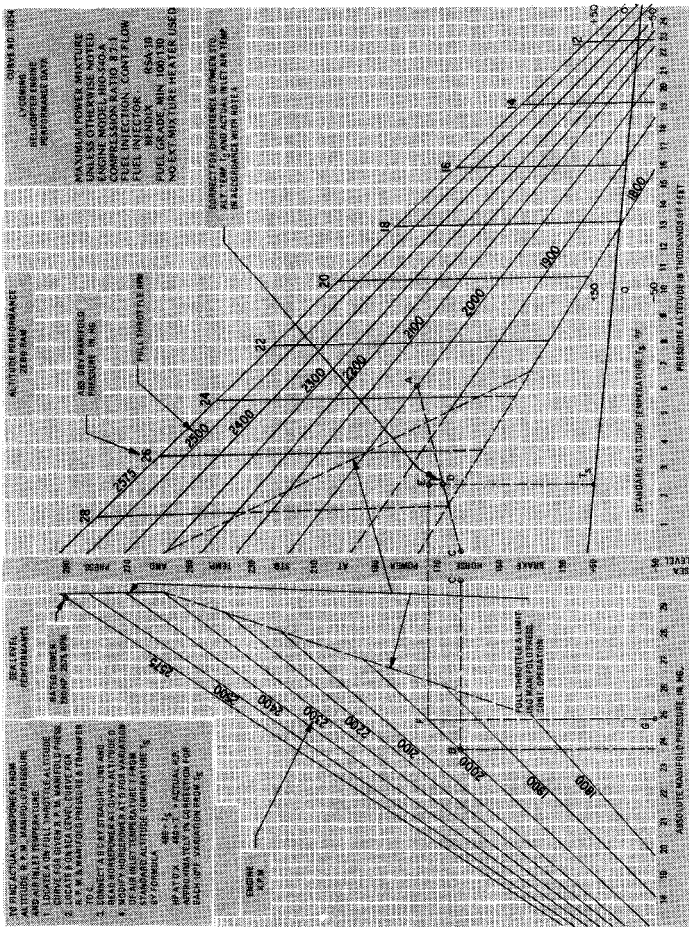


Figure 3-23. Sea Level and Altitude Performance Curve - HIO-540-A1A

## PERIODIC INSPECTION

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## SECTION 4

### PERIODIC INSPECTIONS

#### NOTE

*Perhaps no other factor is quite so important to safety and durability of the aircraft and its components as faithful and diligent attention to regular checks for minor troubles and prompt repair when they are found.*

The operator should bear in mind that the items listed in the following pages do not constitute a complete aircraft inspection, but are meant for the engine only. Consult the airframe manufacturer's handbook for additional instructions.

*Pre-Starting Inspection* - The daily pre-flight inspection is a check of the aircraft prior to the first flight of the day. This inspection is to determine the general condition of the aircraft and engine.

The importance of proper pre-flight inspection cannot be over emphasized. Statistics prove several hundred accidents occur yearly directly responsible to poor pre-flight.

Among the major causes of poor pre-flight inspection are lack of concentration, reluctance to acknowledge the need for a check list, carelessness bred by familiarity and haste.

**1. DAILY PRE-FLIGHT (ENGINE).**

- a. Be sure all switches are in the "Off" position.
- b. Be sure magneto ground wires are connected.
- c. Check oil level.
- d. See that fuel tanks are full.
- e. Check fuel and oil line connections, note minor indications for repair at 50 hour inspection. Repair any leaks before aircraft is flown.
- f. Open the fuel drain to remove any accumulation of water and sediment.
- g. Make sure all shields and cowling are in place and secure. If any are missing or damaged, repair or replacement should be made before the aircraft is flown.
- h. Check controls for general condition, travel and freedom of operation.
- i. Induction system air filter should be inspected and serviced in accordance with the airframe manufacturer's recommendations.

**2. 25 HOUR INSPECTION (ENGINE).** After the first twenty-five hours operation time; new, remanufactured or newly overhauled engines should undergo a 50 hour inspection including draining and renewing lubricating oil.

**3. 50 HOUR INSPECTION (ENGINE).** In addition to the items listed for daily pre-flight inspection, the following maintenance checks should be made after every 50 hours of operation.

**a. Ignition System -**

- (1) If fouling of spark plugs has been apparent, rotate bottom plugs to upper position.



## O-540, IO-540 &amp; HIO-540 SERIES

## SECTION 4

(2) Examine spark plug leads of cable and ceramics for corrosion and deposits. This condition is evidence of either leaking spark plugs, improper cleaning of the spark plug walls or connector ends. Where this condition is found, clean the cable ends, spark plug walls and ceramics with a dry, clean cloth or a clean cloth moistened with methyl-ethyl ketone. All parts should be clean and dry before reassembly.

(3) Check ignition harness for security of mounting clamps and be sure connections are tight at spark plug and magneto terminals.

*b. Fuel and Induction System* - Check the primer lines for leaks and security of the clamps. Remove and clean the fuel inlet strainers. Check the mixture control and throttle linkage for travel, freedom of movement, security of the clamps and lubricate if necessary. Check the air intake ducts for leaks, security, filter damage; evidence of dust or other solid material in the ducts is indicative of inadequate filter care or damaged filter. Check vent lines for evidence of fuel or oil seepage; if present, fuel pump may require replacement.

*c. Lubrication System* -

(1) Check oil lines for leaks, particularly at connections; for security of anchorage and for wear due to rubbing or vibration, for dents and cracks.

(2) Replace elements on external full flow oil filters. Before disposing of used element check interior folds for traces of metal particles that might be evidence of internal engine damage. Drain and renew lubricating oil on installations not employing replaceable full flow filters.

*d. Exhaust System* - Check attaching flanges at exhaust ports on cylinders for evidence of leakage. If they are loose, they must be removed and machined flat before they are reassembled and tightened. Examine exhaust manifolds for general condition.

*e. Cooling System* - Check cowling and baffles for damage and secure anchorage. Any damaged or missing part of the cooling system must be repaired or replaced before the aircraft resumes operation.

*f. Cylinders* - Check rocker box covers for evidence of oil leaks. If found, replace gasket and tighten screws to specified torque (50 inch lbs.).

## SECTION 4

## O-540, IO-540 &amp; HIO-540 SERIES

Check cylinders for evidence of excessive heat which is indicated by burned paint on the cylinder. This condition is indicative of internal damage to the cylinder and, if found, its cause must be determined and corrected before the aircraft resumes operation.

Heavy discoloration and appearance of seepage at cylinder head and barrel attachment area is usually due to emission of thread lubricant used during assembly of the barrel at the factory, or by slight gas leakage which stops after the cylinder has been in service for awhile. This condition is neither harmful nor detrimental to engine performance and operation. If it can be proven that leakage exceeds these conditions, the cylinder should be replaced.

**4. 100 HOUR INSPECTION.** In addition to the items listed for daily pre-flight and 50 hour inspection, the following maintenance checks should be made after every one hundred hours of operation.

*a. Electrical System -*

(1) Check all wiring connected to the engine or accessories. Any shielded cables that are damaged should be replaced. Replace clamps or loose wires and check terminals for security and cleanliness.

(2) Remove spark plugs; test, clean and regap. Replace if necessary.

*b. Lubrication System - Drain and renew lubricating oil.*

*c. Magnetos -* Check breaker points for pitting and minimum gap. Check for excessive oil in the breaker compartment, if found, wipe dry with a clean lintless cloth. The felt located at the breaker points should be lubricated in accordance with the magneto manufacturer's instructions. Check magneto to engine timing. Timing procedure 5, 1, b of this manual.

*d. Engine Accessories -* Engine mounted accessories such as pumps, temperature and pressure sensing units should be checked for secure mounting, tight connections.

*e. Cylinders -* Check cylinders visually for cracked or broken fins.

*f. Engine Mounts -* Check engine mounting bolts and bushings for security and excessive wear. Replace any bushings that are excessively worn.

*g. Primer Nozzles* - If primer system is used for thermal shocking, disconnect primer nozzles and ascertain that fuel flow is nearly equal to all nozzles.

*b. Fuel Injector Nozzles and Lines* - Check fuel injector nozzles for looseness. Tighten to 60 in. lbs. torque. Check fuel line for dye stains at connections (indicating leakage) and security of lines. Repair or replacement must be accomplished before aircraft resumes operation.

*i. Carburetor* - Check throttle body attaching screws for tightness, the correct torque for these screws is 40 to 50 inch pounds.

**5. 400 HOUR INSPECTION.** In addition to the items listed for daily pre-flight, 50 hour and 100 hour inspections, the following maintenance check should be made after every 400 hours of operation.

*Valve Inspection* - Remove rocker box covers and check for freedom of valve rockers when valves are closed. Look for evidence of abnormal wear or broken parts in the area of the valve tips, valve keeper, springs and spring seats. If any indications are found, the cylinder and all of its components should be removed (including the piston and connecting rod assembly) and inspected for further damage. Replace any parts that do not conform with limits shown in the latest revision for Special Service Publication No. SSP2070.

**6. NON-SCHEDULED INSPECTIONS.** Occasionally, service bulletins or service instructions are issued by Avco Lycoming Division that require inspection procedures that are not listed in this manual. Such publications, usually are limited to specified engine models and become obsolete after corrective modification has been accomplished. All such publications are available from Avco Lycoming distributors, or from the factory by subscription. Consult the latest edition of Service Letter No. L114 for subscription information. Maintenance facilities should have an up-to-date file of these publications available at all times.

**MAINTENANCE PROCEDURES**

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**SECTION 5****MAINTENANCE PROCEDURES**

The procedures described in this section are provided to guide and instruct personnel in performing such maintenance operations that may be required in conjunction with the periodic inspections listed in the preceding section. No attempt is made to include repair and replacement operations that will be found in the applicable Avco Lycoming Overhaul Manual.

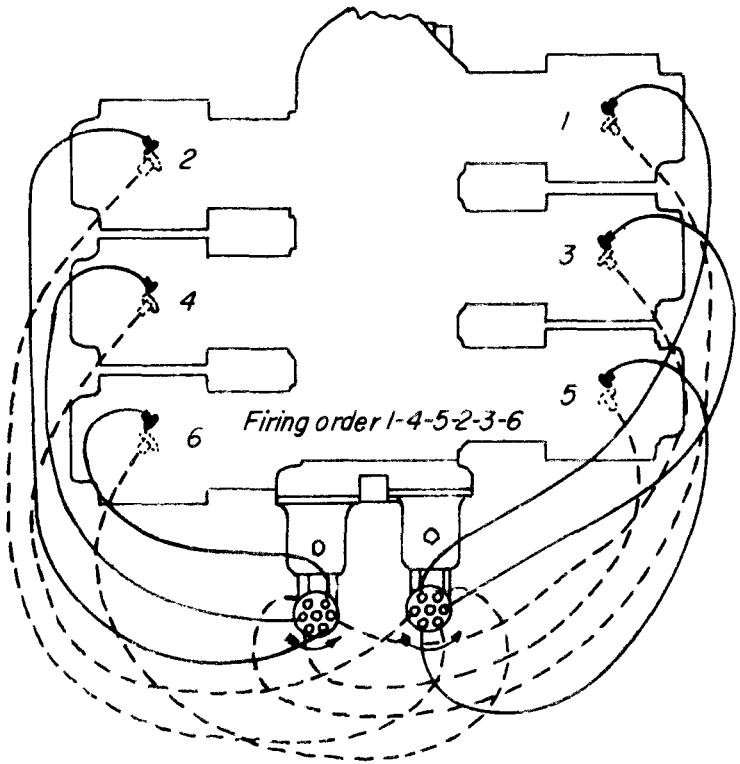
**1. IGNITION AND ELECTRICAL SYSTEM.**

*a. Ignition Harness and Wire Replacement* - In the event that an ignition harness or an individual lead is to be replaced, consult the wiring diagram to be sure harness is correctly installed. Mark location of clamps and clips to be certain the replacement is clamped at correct locations.

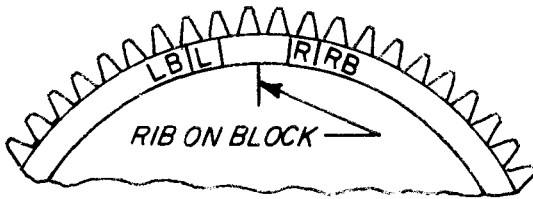
*b. Timing Magneto to Engine* -

(1) Remove a spark plug from No. 1 cylinder and place a thumb over the spark plug hole. Rotate the crankshaft in direction of normal rotation until the compression stroke is reached, this is indicated by a positive pressure inside the cylinder tending to push the thumb off the spark plug hole. Continue rotating the crankshaft until the advance timing mark on the front face of the starter ring gear is in alignment with the small hole located at the two o'clock position on the front face of the starter housing. (Ring gear may be marked at 20° and 25°. Consult specifications for correct timing mark for your installation.) At this point, the engine is ready for assembly of the magnetos.

(2) *Single magneto* - Remove the inspection plugs from both magnetos and turn the drive shaft in direction of normal rotation until (-20 and -200 series) the first painted chamfered tooth on the distributor gear is aligned in the center of the inspection window (-1200 series) the applicable timing mark on the distributor gear is approximately aligned with the mark on the distributor block. See figure 5-2. Being sure the gear does not move from this position, install gaskets and magnetos on the engine. Note that an adapter is used with all magnetos. Secure with (clamps on -1200 series) washers and nuts; tighten only finger tight.



*Figure 5-1 Ignition Wiring Diagram*



*Figure 5-2 Timing Marks - 6 cyl. 1200 Series*

(3) Using a battery powered timing light, attach the positive lead to a suitable terminal connected to the switch terminal of the magneto and the negative lead to any unpainted portion of the engine. Rotate the magneto in its mounting flange to a point where the light comes on, then slowly turn it in the opposite direction until the light goes out. Bring the magneto back slowly until the light just comes on. Repeat this with the second magneto.

(4) Back off the crankshaft a few degrees, the timing lights should go out. Bring the crankshaft slowly back in direction of normal rotation until the timing mark and the hole in the starter housing are in alignment. At this point, both lights should go on simultaneously. Tighten nuts to specified torque.

(5) *Dual Magnetos* - Place the engine in the No. 1 advance firing position as directed in paragraph 1b(1).

(6) Install the magneto-to-engine gasket on the magneto flange.

**WARNING**

*Do not attach harness spark plug ends to the spark plugs until all magneto-to-engine timing procedures and magneto-to-switch connections are entirely completed.*

(7) To remove engine-to-magneto drive gear train backlash by turning engine magneto drive as far as possible in direction opposite to normal rotation and then return in the direction of normal rotation to timing mark on starter support.

(8) Remove the timing window plug from the most convenient side of the magneto housing and the plug from the rotor viewing location in the center of the housing.

(9) Turn the rotating magnet drive shaft in the normal direction of magneto rotation until the painted tooth of the large distributor gear is centered in the timing hole.

(10) Observe that at this time the built in pointer just ahead of the rotor viewing window aligns with the R or L mark on the rotor depending on whether the magneto is of right or left hand rotation as specified on the magneto nameplate.

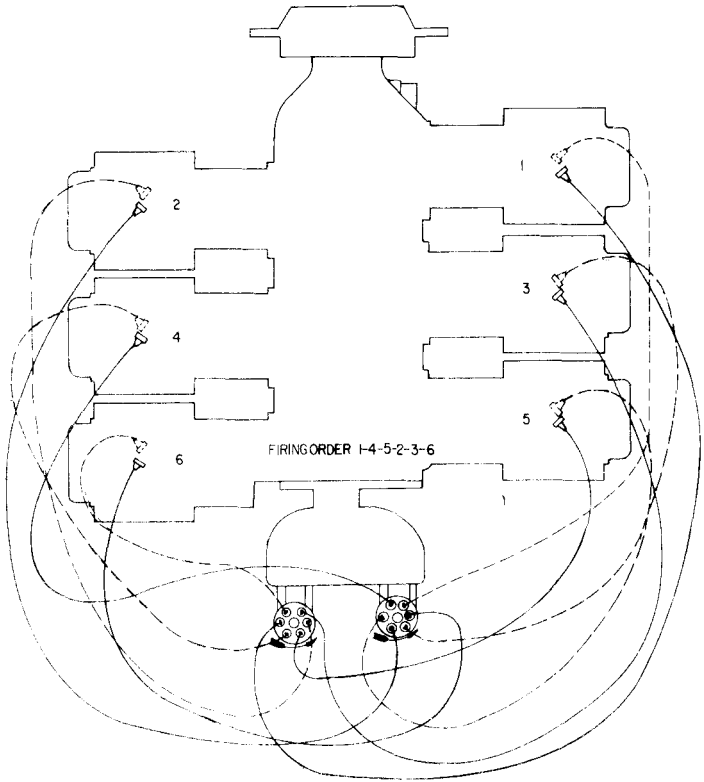


Figure 5-3. Ignition Wiring Diagram - Dual Magneto



(11) Hold the magneto in its No. 1 firing position (tooth in window center and pointer over R or L mark on rotor) and install magneto to the engine and loosely clamp in position.

(12) Attach red lead from the timing light to left switch adapter lead, green lead of timing light to right switch adapter lead and the black lead of the light to magneto housing.

(13) Turn the entire magneto in direction of rotor rotation until the red timing light comes on.

(14) Rotate the magneto in the opposite direction until the red light just goes off indicating left main breaker has opened. Then evenly tighten the magneto mounting clamps.

(15) Back the engine up approximately 10° and then carefully "bump" the engine forward at the same time observing the timing lights.

(16) At the No. 1 firing position of the engine, the red light should go off indicating left main breaker opening. The right main breaker, monitored by the green light, must open within  $\pm 2$  engine degrees of the No. 1 firing position.

(17) Repeat steps (13) thru (15) until the condition described in paragraph (16) is obtained.

(18) Complete tightening of the magneto securing clamps by torquing to 150 inch pounds.

(19) Recheck timing once more and if satisfactory disconnect timing light. Remove adapter leads.

(20) Reinstall plugs in timing inspection holes and torque to 12 - 15 in. lbs.

#### **NOTE**

*Some timing lights operate in the reverse manner as described. The light comes on when the breaker points open. Check your timing light instructions.*

*c. Internal Timing - Dual Magneto - Check the magneto terminal timing and breaker synchronization in the following manner.*

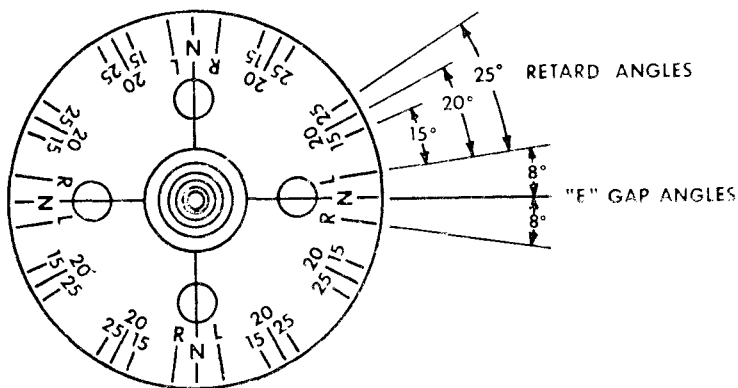


Figure 5-4. Timing Marks on Rotating Magnet

(1) *Main Breakers* - Connect the timing light negative lead to any unpainted surface of the magneto. Connect one positive lead to the left main breaker terminal and the second positive lead to the right main breaker terminal.

(2) Back the engine up a few degrees and again bump forward toward number one cylinder firing position while observing timing lights. Both lights should go out to indicate opening of the main breakers when the timing pointer is indicating within the width of the "L" or "R" mark. If breaker timing is incorrect, loosen breaker screws and correct. Retorque breaker screws to 20 to 25 in. lbs.

(3) *Retard Breaker* - Remove timing light leads from the main breaker terminals. Attach one positive lead to retard breaker terminal, and second positive lead to the tachometer breaker terminal, if used.

(4) Back the engine up a few degrees and again bump forward toward number one cylinder firing position until pointer is aligned with 15° retard timing mark. See figure 5-4. Retard breaker should just open at this point.

(5) If retard timing is not correct, loosen cam securing screw and turn the retard breaker cam as required to make retard breaker open per paragraph c(4). Retorque cam screw to 16 to 20 in. lbs.

(6) Observe that tachometer breaker is opened by the cam lobe. No synchronization of this breaker is required.

(7) Check action of impulse coupling (D-2000 series only). With the ignition switch off observe breaker cam end of rotor while manually cranking engine through a firing sequence. Rotor should alternately stop and then (with an audible snap) be rotated rapidly through a retard firing position.

*d. Generator or Alternator Output* - The generator or alternator (whichever is applicable) should be checked to determine that the specified voltage and current are being obtained.

## **2. FUEL SYSTEM.**

*a. Repair of Fuel Leaks* - In the event a line or fitting in the fuel system is replaced, only a fuel soluble lubricant, such as clean engine oil or Loctite Hydraulic Sealant may be used. Do not use any other form of thread compound.

*b. Carburetor or Fuel Injector Inlet Screen Assembly* - Remove the assembly and check the screen for distortion or openings in the strainer. Replace for either of these conditions. Clean screen assembly in solvent and dry with compressed air. To install the screen assembly, place the gasket on the screen assembly and install the assembly in the throttle body and tighten to 35-40 inch pounds torque for carburetor or 60-70 inch pounds torque for fuel injector.

*c. Fuel Grades and Limitations* - See recommended fuel grades on page 3-10.

In the event that the specified fuel is not available at some locations, it is permissible to use higher octane fuel. Fuel of a lower octane than specified is not to be used. Under no circumstances should automotive fuel be used (regardless of octane rating).

### **NOTE**

*It is recommended that personnel be familiar with Service Instruction No. 1070 regarding specified fuel for Avco Lycoming engines.*

*d. Air Intake Ducts and Filter* - Check all air intake ducts for dirt or restrictions. Inspect and service air filters as instructed in the airframe manufacturer's handbook.

*e. Idle Speed and Mixture Adjustment* -

(1) Start the engine and warm up in the usual manner until oil and cylinder head temperatures are normal.

(2) Check magnetos. If the "mag-drop" is normal, proceed with idle adjustment.

(3) Set throttle stop screw so that the engine idles at the airframe manufacturer's recommended idling RPM. If the RPM changes appreciably after making idle mixture adjustment during the succeeding steps, readjust the idle speed to the desired RPM.

(4) When the idling speed has been stabilized, move the cockpit mixture control lever with a smooth, steady pull toward the "Idle Cut-Off" position and observe the tachometer for any change during the leaning process. Caution must be exercised to return the mixture control to the "Full Rich" position before the RPM can drop to a point where the engine cuts out. An increase of more than 50 RPM while "leaning out" indicates an excessively rich idle mixture. An immediate decrease in RPM (if not preceded by a momentary increase) indicates the idle mixture is too lean.

If the above indicates that the idle adjustment is too rich or too lean, turn the idle mixture adjustment in the direction required for correction, and check this new position by repeating the above procedure. Make additional adjustments as necessary until a check results in a momentary pick-up of approximately 50 RPM. Each time the adjustment is changed, the engine should be run up to 2000 RPM to clear the engine before proceeding with the RPM check. Make final adjustment of the idle speed adjustment to obtain the desired idling RPM with closed throttle. The above method aims at a setting that will obtain maximum RPM with minimum manifold pressure. In case the setting does not remain stable, check the idle linkage; any looseness in this linkage would cause erratic idling. In all cases, allowance should be made for the effect of weather conditions and field altitude upon idling adjustment.

**3. LUBRICATION SYSTEM.**

*a. Oil Grades and Limitations* - Service the engine in accordance with the recommendations shown in Section 3, Page 3-10.

*b. Oil Suction and Oil Pressure Screens* - At each fifty hours inspection remove, inspect for metal particles, clean and reinstall.

**NOTE**

*On installations employing external oil filters, the above step is not practical at this time. But should be observed at the 100 hour inspection.*

*c. Oil Relief Valve (Non-Adjustable)* - The function of the oil pressure relief valve is to maintain engine oil pressure within specified limits. The valve, although not adjustable, may be controlled by the addition of a maximum of nine STD-425 washers under the cap to increase pressure or the use of a spacer (Avco Lycoming P/N 73629 or 73630) to decrease pressure. A modification on later models has eliminated the need for the spacers. Particles of metal or other foreign matter lodged between the ball and seat will result in faulty readings. It is advisable, therefore, to disassemble, inspect and clean the valve if excessive pressure fluctuations are noted.

*d. Oil Relief Valve (Adjustable)* - The adjustable oil relief valve enables the operator to maintain engine oil pressure within the specified limits. If the pressure under normal operating conditions should consistently exceed the maximum or minimum specified limits, adjust the valve as follows:

With the engine warmed up and running at approximately 2000 RPM, observe the reading on the oil pressure gage. If the pressure is above maximum or below minimum specified limits, stop engine and screw the adjusting screw out to decrease pressure and in to increase pressure. Depending on installation, the adjusting screw may have only a screw driver slot and is turned with a screw driver; or may have the screw driver slot plus a pinned .375-24 castellated nut and may be turned with either a screw driver or a box wrench.

**SECTION 5****O-540, IO-540 & HIO-540 SERIES**

**4. CYLINDERS.** It is recommended that as a field operation, cylinder maintenance be confined to replacement of the entire assembly. For valve replacement, consult the proper overhaul manual. This should be undertaken only as an emergency measure.

*a. Removal of Cylinder Assembly -*

(1) Remove exhaust manifold.

(2) Remove rocker box drain tube, intake pipe, baffle and any clips that might interfere with the removal of the cylinder.

(3) Disconnect ignition cables and remove the bottom spark plug.

(4) Remove rocker box cover and rotate crankshaft until piston is approximately at top center of the compression stroke. This is indicated by a positive pressure inside of cylinder tending to push thumb off of bottom spark plug hole.

(5) Slide valve rocker shafts from cylinder head and remove the valve rockers. Valve rocker shafts can be removed after the cylinder is removed from the engine. Remove rotator cap from exhaust valve stem.

(6) Remove push rods by grasping ball end and pulling rod out of shroud tube. Detach shroud tube spring and lock plate and pull shroud tubes through holes in cylinder head.

**NOTE**

*The hydraulic tappets, push rods, rocker arms and valves must be assembled in the same location from which they were removed.*

(7) Remove cylinder base nuts and hold down plates (where employed) then remove cylinder by pulling directly away from crankcase. Be careful not to allow the piston to drop against the crankcase, as the piston leaves the cylinder.

*b. Removal of Piston from Connecting Rod -* Remove the piston pin plugs. Insert piston pin puller through piston pin, assemble puller nut; then proceed to remove piston pin. Do not allow connecting rod to rest on the cylinder bore of the crankcase. Support the connecting rod with heavy rubber band, discarded cylinder base oil ring seal, or any other non-marring method.

*c. Removal of Hydraulic Tappet Sockets and Plunger Assemblies* - It will be necessary to remove and bleed the hydraulic tappet plunger assembly so that dry tappet clearance can be checked when the cylinder assembly is reinstalled. This is accomplished in the following manner:

(1) Remove the hydraulic tappet push rod socket by inserting the forefinger into the concave end of the socket and withdrawing. If the socket cannot be removed in this manner, it may be removed by grasping the edge of the socket with a pair of needle nose pliers. However, care must be exercised to avoid scratching the socket.

(2) To remove the hydraulic tappet plunger assembly, use the special Avco Lycoming service tool. In the event that the tool is not available, the hydraulic tappet plunger assembly may be removed by a hook in the end of a short piece of lockwire, inserting the wire so that the hook engages the spring of the plunger assembly. Draw the plunger assembly out of the tappet body by gently pulling the wire.

#### **CAUTION**

*Never use a magnet to remove hydraulic plunger assemblies from the crankcase. This can cause the check ball to remain off its seat, rendering the unit inoperative.*

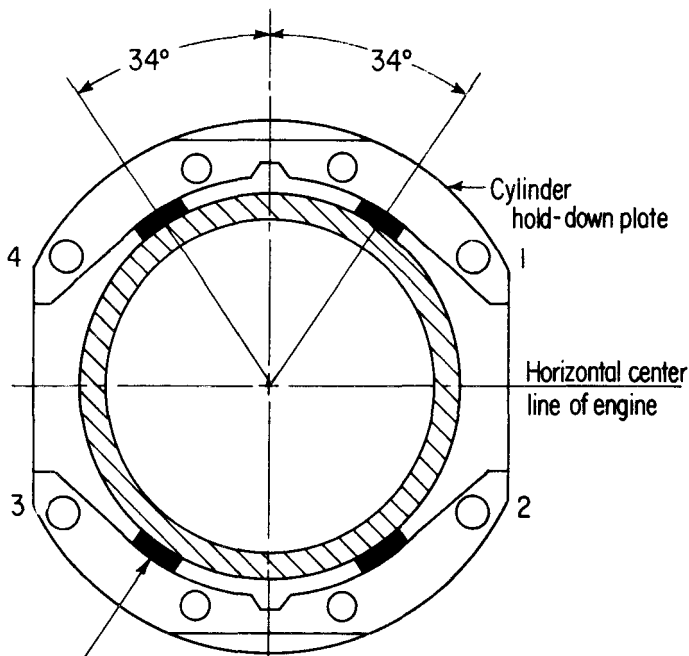
*d. Assembly of Hydraulic Tappet Plunger Assemblies* - To assemble the unit, unseat the ball by inserting a thin clean wire through the oil inlet hole. With the ball off its seat, insert the plunger and twist clockwise so that the spring catches. All oil must be removed before the plunger is inserted.

*e. Assembly of Cylinder and Related Parts* - Rotate the crankshaft so that the connecting rod of the cylinder being assembled is at the top center of compression stroke. This can be checked by placing two fingers on the intake and exhaust tappet bodies. Rock crankshaft back and forth over top center. If the tappet bodies do not move the crankshaft is on the compression stroke.

(1) Place each plunger assembly in its respective tappet body and assemble the socket on top of plunger assembly.

(2) Assemble piston with rings so that the number stamped on the piston pin boss is toward the front of the engine. The piston pin should be a handpush fit. If difficulty is experienced in inserting the piston pin, it is probably caused by carbon or burrs in the piston pin hole. During assembly, always use a generous quantity of oil, both in the piston pin hole and on the piston pin.

(3) Assemble one piston pin plug at each end of the piston pin and place a new rubber oil seal ring around the cylinder skirt. Coat piston and rings and the inside of the cylinder generously with oil.



Shim- 4 req'd per cylinder  
 (.010 IN. thick X .50/.70 IN. wide  
 During initial tightening, use two shims  
 between each plate and the barrel,  
 located as shown. Remove shims be-  
 fore final tightening.

**Figure 5-5. Location of Shims Between Cylinder Barrel and Hold-Down Plates (where applicable) and Sequence of Tightening Cylinder Base Hold-Down Nuts**



(4) Using a piston ring compressor, assemble the cylinder over the piston so that the intake port is at the bottom of the engine. Push the cylinder all of the way on, catching the ring compressor as it is pushed off.

**NOTE**

*Before installing cylinder hold-down nuts, lubricate crankcase through stud threads with any one of the following lubricants, or combinations of lubricants.*

1. 90% SAE 50W engine oil and 10% STP.
2. Parker Thread Lube.
3. 60% SAE 30 engine oil and 40% Parker Thread Lube.

(5) Assemble hold-down plates (where applicable) and cylinder base hold-down nuts and tighten as directed in the following steps.

**NOTE**

*At any time a cylinder is replaced, it is necessary to retorque the thru-studs on the cylinder on the opposite side of the engine.*

(a) (*Engines using hold-down plates*) - Install shims between cylinder base hold-down plates and cylinder barrel, as directed in figure 5-5, and tighten 1/2 inch hold-down nuts to 300 inch lbs. (25 foot lbs.) torque, using the sequence shown in figure 5-5.

(b) Remove shims, and using the same sequence, tighten the 1/2 inch cylinder base nuts, to 600 in. lbs. (50 foot lbs.) torque.

**NOTE**

*Cylinder assemblies not using hold-down plate are tightened in the same manner as above omitting the shims.*

(c) Tighten the 3/8 inch hold-down nuts to 300 inch lbs. (25 foot lbs.) torque. Sequence of tightening is optional.

(d) As a final check, hold the torque wrench on each nut for about five seconds. If the nut does not turn, it may be presumed to be tightened to correct torque.

**CAUTION**

*After all cylinder base nuts have been tightened, remove any nicks in the cylinder fins by filing or burring.*

(6) Install new shroud tube oil seals on both ends of shroud tube. Install shroud tube and lock in place as required for type of cylinder.

(7) Assemble each push rod in its respective shroud tube, and assemble each rocker in its respective position by placing rocker between bosses and sliding valve rocker shaft in place to retain rocker. Before installing exhaust valve rocker, place rotator cap over end of exhaust valve stem.

(8) Be sure that the piston is at top center of compression stroke and that both valves are closed. Check clearance between the valve stem tip and the valve rocker. In order to check this clearance, place the thumb of one hand on the valve rocker directly over the end of the push rod and push down so as to compress the hydraulic tappet spring. While holding the spring compressed, the valve clearance should be between .028 and .080 inch. If clearance does not come within these limits, remove the push rod and insert a longer or shorter push rod, as required to correct clearance.

**NOTE**

*Inserting a longer push rod will decrease the valve clearance.*

(9) Install intercylinder baffles, rocker box covers, intake pipes, rocker box drain tubes and exhaust manifold.

**5. GENERATOR OR ALTERNATOR DRIVE BELT TENSION.**

Check the tension of a new belt 25 hours after installation. Refer to Service Instruction No. 1129 for methods of checking generator or alternator drive belt tensions.

**TROUBLE--SHOOTING**

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**SECTION 6****TROUBLE—SHOOTING**

Experience has proven that the best method of trouble-shooting is to decide on the various causes of a given trouble and then to eliminate causes one by one, beginning with the most probable. The following charts list some of the more common troubles, which may be encountered in maintaining engines; their probable causes and remedies.

**1. TROUBLE-SHOOTING—ENGINE.**

<b>TROUBLE</b>	<b>PROBABLE CAUSE</b>	<b>REMEDY</b>
Failure of Engine to Start	Lack of fuel	Check fuel system for leaks. Fill fuel tank. Clean dirty lines, strainers or fuel valves.
	Overpriming	Leave ignition "off" and mixture control in "Idle Cut-Off", open throttle and "unload" engine by cranking for a few seconds. Turn ignition switch on and proceed to start in a normal manner.
	Defective spark plugs	Clean and adjust or replace spark plugs.
	Defective ignition wire	Check with electric tester, and replace any defective wires.
	Defective battery	Replace with charged battery.

**SECTION 6**
**O-540, IO-540 & HIO-540 SERIES**

TROUBLE	PROBABLE CAUSE	REMEDY
Failure of Engine to Start (Cont.)	Improper operation of magneto breaker	Clean points. Check internal timing of magnetos.
	Lack of sufficient fuel flow	Disconnect fuel line and check fuel flow.
	Water in fuel injector or carb.	Drain fuel injector or carburetor and fuel lines.
	Internal failure	Check oil screens for metal particles. If found, complete overhaul of the engine may be indicated.
Failure of Engine to Idle Properly	Incorrect idle mixture	Adjust mixture.
	Leak in induction system	Tighten all connections in the induction system. Replace any parts that are defective.
	Incorrect idle adjustment	Adjust throttle stop to obtain correct idle.
	Uneven cylinder compression	Check condition of piston rings and valve seats.
	Faulty ignition system	Check entire ignition system.
	Insufficient fuel pressure	Adjust fuel pressure.
	Leak in air bleed nozzle balance line	Check connection and replace if necessary.
	Plugged fuel injector nozzle	Clean or replace nozzle.
	Flow divider fitting plugged	Clean fitting.

**O-540, IO-540 & HIO-540 SERIES**

**SECTION 6**

TROUBLE	PROBABLE CAUSE	REMEDY
Low Power and Uneven Running	Mixture too rich; indicated by sluggish engine operation, red exhaust flame at night. Extreme cases indicated by black smoke from exhaust	Readjustment of fuel injector or carburetors by authorized personnel is indicated.
	Mixture too lean; indicated by overheating or back-firing	Check fuel lines for dirt or other restrictions. Readjustment of fuel injector or carburetor by authorized personnel is indicated.
	Leaks in induction system	Tighten all connections. Replace defective parts.
	Defective spark plugs	Clean and gap or replace spark plugs.
	Improper fuel	Fill tank with fuel of recommended grade.
	Magneto breaker points not working properly	Clean points. Check internal timing of magnetos.
	Defective ignition wire	Check wire with electric tester. Replace defective wire.
	Defective spark plug terminal connectors	Replace connectors on spark plug wire.
	Plugged fuel injector nozzle	Clean or replace nozzle.
Failure of Engine to Develop Full Power	Leak in induction system	Tighten all connections and replace defective parts.

**SECTION 6**
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TROUBLE	PROBABLE CAUSE	REMEDY
Failure of Engine to Develop Full Power (Cont.)	Plugged fuel injector nozzle	Clean or replace nozzle.
	Throttle lever out of adjustment	Adjust throttle lever.
	Improper fuel flow	Check strainer, gage and flow at the fuel line.
	Restriction in air scoop	Examine air scoop and remove restrictions.
	Improper fuel	Drain and refill tank with recommended fuel.
Rough Engine	Faulty ignition	Tighten all connections. Check system with tester. Check ignition timing.
	Cracked engine mount	Replace or repair mounting.
	Defective mounting bushings	Install new mounting bushings.
	Uneven compression	Check compression.
	Plugged fuel injector nozzle	Clean or replace nozzle.
Low Oil Pressure	Insufficient oil	Fill sump to proper level with recommended oil.
	Air lock or dirt in relief valve	Remove and clean oil pressure relief valve.
	Leak in suction line or pressure line	Check gasket between accessory housing and crankcase.
	High oil temperature	See "High Oil Temperature" in "Trouble" column.
	Defective pressure gage	Replace.

**O-540, IO-540 & HIO-540 SERIES**

**SECTION 6**

<b>TROUBLE</b>	<b>PROBABLE CAUSE</b>	<b>REMEDY</b>
Low Oil Pressure (Cont.)	Stoppage in oil pump intake passage	Check line for obstruction. Clean suction strainer.
High Oil Temperature	Insufficient air cooling	Check air inlet and outlet for deformation or obstruction.
	Insufficient oil supply	Fill oil sump to proper level with specified oil.
	Low grade of oil	Replace with oil conforming to specifications.
	Clogged oil lines or strainers	Remove and clean oil strainers.
	Excessive blow-by	Usually caused by worn or stuck rings.
Excessive Oil	Failing or failed bearing	Examine sump for metal particles. If found, overhaul of engine is indicated.
	Defective temperature gage	Replace gage.
	Low grade of oil	Fill tank with oil conforming to specification.
	Failing or failed bearings	Check sump for metal particles.
	Worn piston rings	Install new rings.
	Incorrect installation of piston rings	Install new rings.



**SECTION 6****O-540, IO-540 & HIO-540 SERIES**

<b>TROUBLE</b>	<b>PROBABLE CAUSE</b>	<b>REMEDY</b>
Excessive Oil Consumption (Cont.)	Failure of rings to seat (new nitrided cylinders)	Use mineral base oil. Climb to cruise altitude at full power and operate at 75% cruise power setting until oil consumption stabilizes.
High Fuel Flow Indicated on Fuel Gage	Plugged fuel injector nozzle	Clean or replace nozzle.

**INSTALLATION AND STORAGE**

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**SECTION 7****INSTALLATION AND STORAGE**

**1. PREPARATION OF ENGINE FOR INSTALLATION.** Before installing an engine that has been prepared for storage, remove all dehydrator plugs, bags of dessicant and preservative oil from the engine. Preservation oil can be removed by removing the bottom spark plugs and turning the crankshaft three or four revolutions by hand. The preservative oil will then drain through the spark plug holes. Draining will be facilitated if the engine is tilted from side to side during the above operation. Preservative oil which has accumulated in the sump can be drained by removing the oil sump plug. Engines that have been stored in a cold place should be removed to an environment of at least 70°F. (21°C.) for a period of 24 hours before preservative oil is drained from the cylinders. If this is not possible, heat the cylinders with heat lamps before attempting to drain the engine.

After the oil sump has been drained, the plug should be replaced, safety-wired, and the sump refilled with lubricating oil. The crankshaft should again be turned several revolutions to saturate the interior of the engine with the clean oil. When installing spark plugs, make sure that they are clean, if not, wash them in clean petroleum solvent. Of course, there will be a small amount of preservative oil remaining in the engine, but this can cause no harm. However, after twenty-five hours of operation, the lubricating oil should be drained while the engine is hot. This will remove any residual preservative oil that may have been present.

**CAUTION**

*Do not rotate the crankshaft of an engine containing preservative oil before removing the spark plugs, because if the cylinders contain any appreciable amount of the mixture, the resulting action, known as hydraulic, will cause damage to the engine. Also, any contact of the preservative oil with painted surfaces should be avoided.*

*General* - Should any of the dehydrator plugs, containing crystals of silica-gel or similar material, be broken during their term of storage or upon their removal from the engine, and if any of the contents should fall into the engine, that portion of the engine must be disassembled and thoroughly cleaned before using the engine. The oil strainers should be removed and cleaned in gasoline or some other hydrocarbon solvent. The fuel drain screen located in the fuel inlet of the carburetor or fuel injector should also be removed and cleaned in a hydrocarbon solvent. The operator should also note if any valves are sticking. If they are, this condition can be eliminated by coating the valve stem generously with a mixture of gasoline and lubrication oil.

*Inspection of Engine Mounting* - If the aircraft is one from which an engine has been removed, make sure that the engine mount is not bent or damaged by distortion or misalignment as this can produce abnormal stresses within the engine.

*Attaching Engine to Mounts* - See airframe manufacturer's recommendations for method of mounting the engine.

*Oil and Fuel Line Connections* - The oil and fuel line connections are called out on the accompanying installation drawings.

*Propeller Installation* - Consult the airframe manufacturer for information relative to propeller installation.

## **2. PREPARATION OF CARBURETORS AND FUEL INJECTORS FOR INSTALLATION.**

Carburetors and fuel injectors that have been prepared for storage should undergo the following procedures before being placed in service.

*Carburetor (MA-4-5)* - Remove the fuel drain plug and drain preservative oil. Remove the fuel inlet strainer assembly and clean in a hydrocarbon solvent. Reinstall the fuel drain plug and fuel inlet strainer assembly.

*Fuel Injector (Bendix)* - Remove and clean the fuel inlet strainer assembly and reinstall. Inject clean fuel into the fuel inlet connection with the fuel outlets uncapped until clean fuel flows from the outlets. Do not exceed 15 psi inlet pressure.

***CORROSION PREVENTION IN ENGINES INSTALLED  
IN INACTIVE AIRCRAFT***

Corrosion can occur, especially in new or overhauled engines, on cylinder walls of engines that will be inoperative for periods as brief as two days. Therefore, the following preservation procedure is recommended for inactive engines and will be effective in minimizing the corrosion condition for a period up to thirty days.

***NOTE***

*Ground running the engine for brief periods of time is not a substitute for the following procedure; in fact, the practice of ground running will tend to aggravate rather than minimize this corrosion condition.*

- a. As soon as possible after the engine is stopped, move the aircraft into the hangar, or other shelter where the preservation process is to be performed.
- b. Remove sufficient cowling to gain access to the spark plugs and remove both spark plugs from each cylinder.
- c. Spray the interior of each cylinder with approximately (2) ounces of corrosion preventive oil while cranking the engine about five (5) revolutions with the starter. The spray gun nozzle may be placed in either of the spark plug holes.

***NOTE***

*Spraying should be accomplished using an airless spray gun (Spraying Systems Co., "Gunjet" Model 24A-8395 or equivalent). In the event an airless spray gun is not available, personnel should install a moisture trap in the air line of a conventional spray gun and be certain oil is hot at the nozzle before spraying cylinders.*

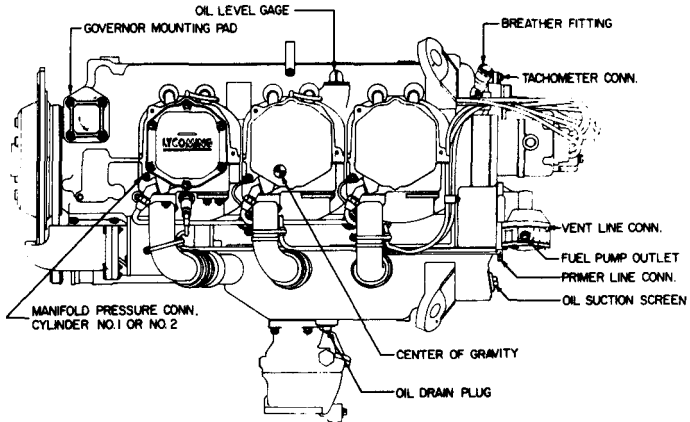
- d. With the crankshaft stationary, again spray each cylinder through the spark plug holes with approximately two ounces of corrosion preventive oil. Assemble spark plugs and do not turn crankshaft after cylinders have been sprayed.

**SECTION 7****O-540, IO-540 & HIO-540 SERIES**

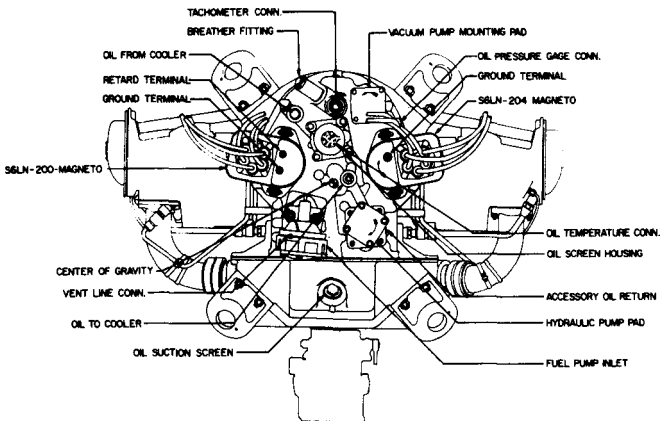
The corrosion preventive oil to be used in the foregoing procedure should conform to specification MIL-L-6529, Type 1 heated to 200°F./220°F. (93°C./104°C.) spray nozzle temperature. It is not necessary to flush preservative oil from the cylinder prior to flying the aircraft. The small quantity of oil coating the cylinders will be expelled from the engine during the first few minutes of operation.

**NOTE**

*Oils of the type mentioned are to be used in Avco Lycoming aircraft engines for corrosion prevention only, and not for lubrication. See the latest edition of Avco Lycoming Service Instruction No. 1014 and Service Bulletin No. 318 for recommended lubricating oil.*



**Figure 7-1. Installation Drawing - Left Side View - O-540 Series**



**Figure 7-2. Installation Drawing - Rear View - O-540 Series**

## SECTION 7

## O-540, IO-540 & HIO-540 SERIES

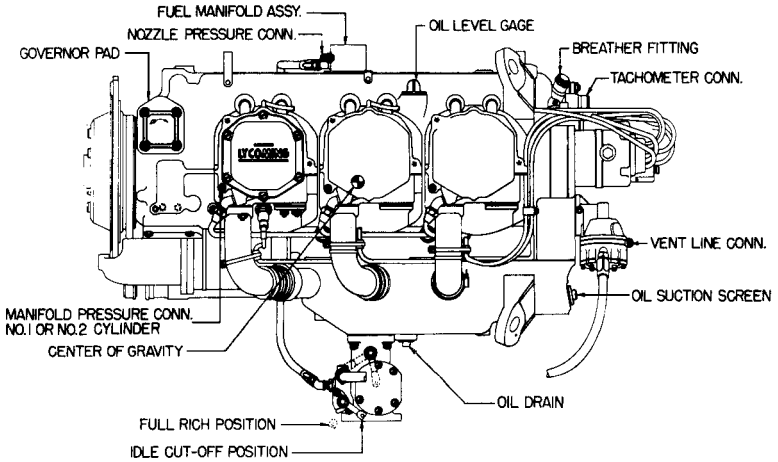


Figure 7-3. Installation Drawing - Left Side View - IO-540-C, -D, -J, -N

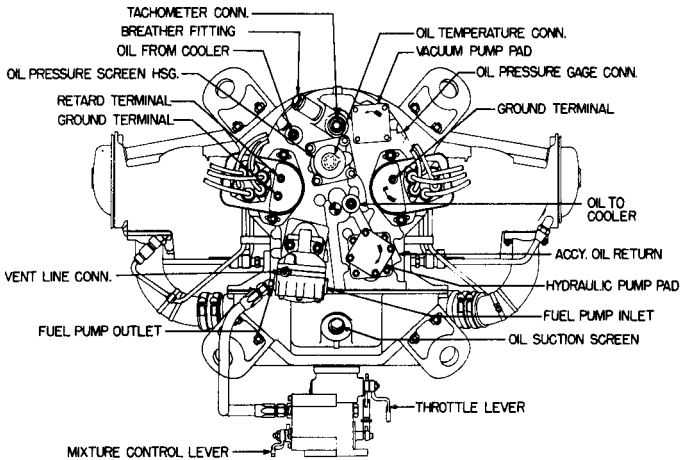
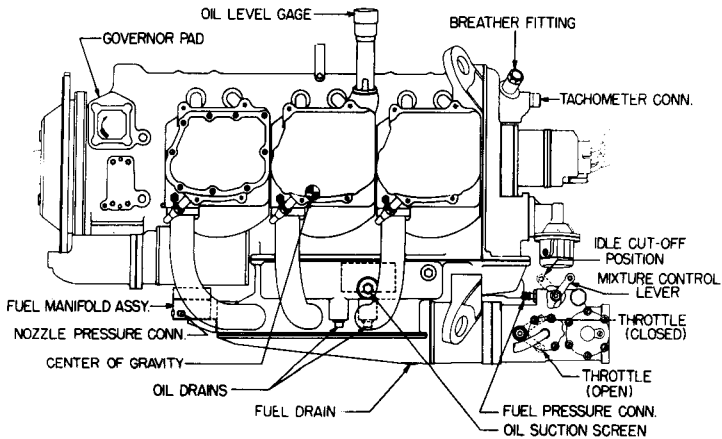
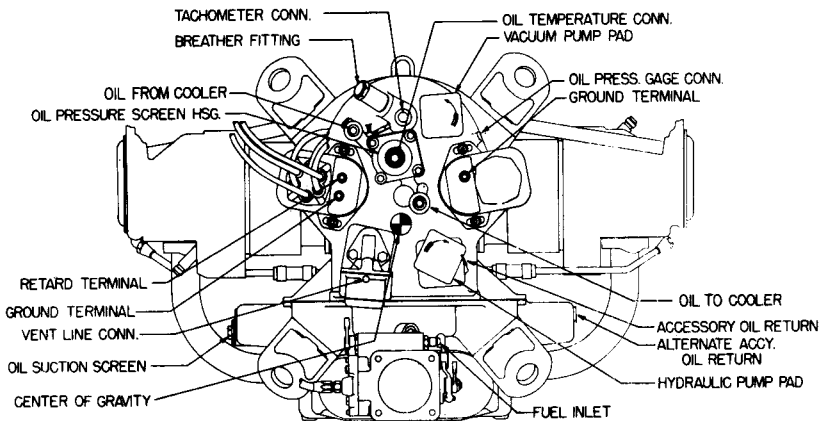


Figure 7-4. Installation Drawing - Rear View - IO-540-C, -D, -J, -N





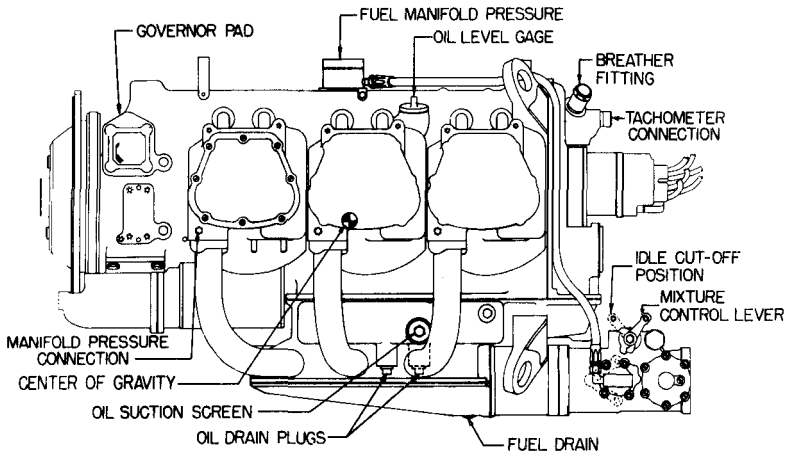
**Figure 7-5. Installation Drawing - Left Side View - IO-540-B, -E**



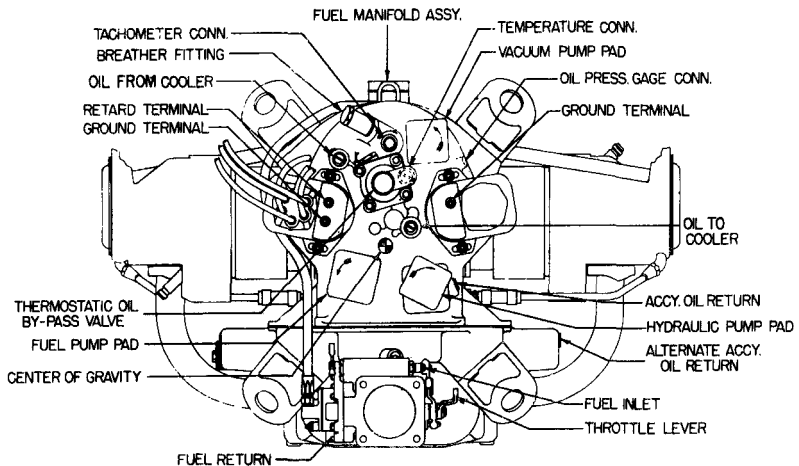
**Figure 7-6. Installation Drawing - Rear View - IO-540-B, -E**

**SECTION 7**

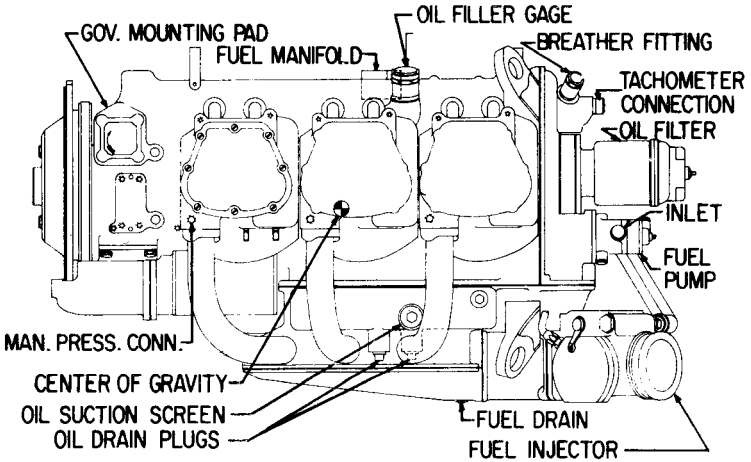
**O-540, IO-540 & HIO-540 SERIES**



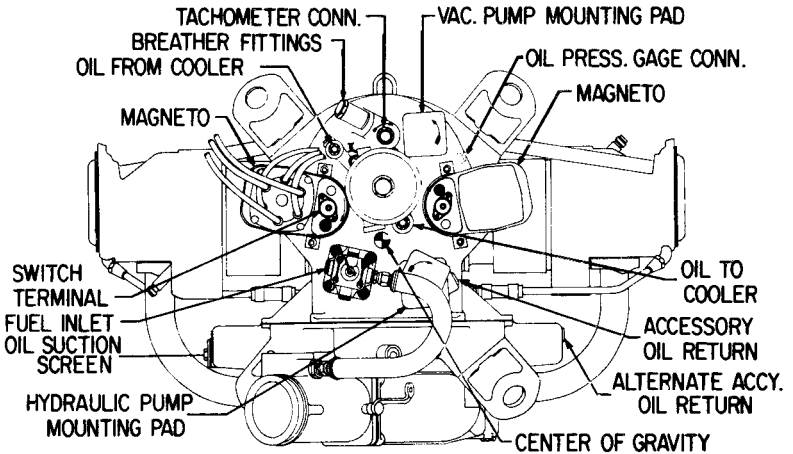
**Figure 7-7. Installation Drawing - Left Side View - IO-540-A, -G, -P, -S**



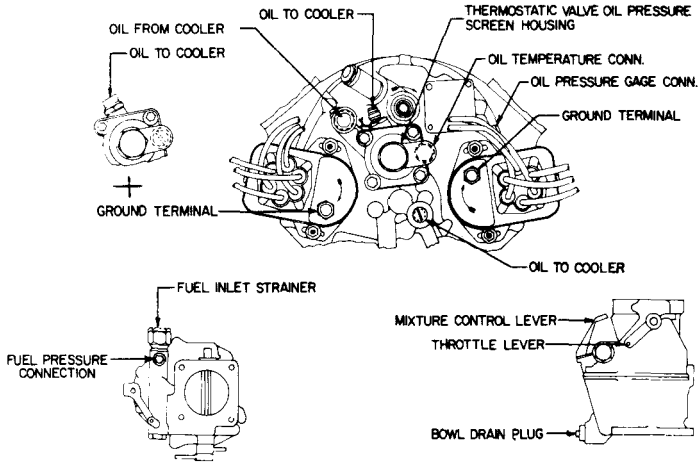
**Figure 7-8. Installation Drawing - Rear View - IO-540-A, -G, -P, -S**



**Figure 7-9. Installation Drawing - Left Side View - IO-540-K**



**Figure 7-10. Installation Drawing - Rear View - IO-540-K**

**SECTION 7**
**O-540, IO-540 & HIO-540 SERIES**


**Figure 7-11. Installation Drawing - Alternate Oil Line Connections, Magnetos and Views of Carburetor - O-540 Series**

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**SECTION 8**

**TABLES**

FOR TIGHTENING TORQUE RECOMMENDATIONS AND INFORMATION CONCERNING TOLERANCES AND DIMENSIONS THAT MUST BE MAINTAINED IN AVCO LYCOMING AIRCRAFT ENGINES, CONSULT THE LATEST EDITION OF SPECIAL SERVICE PUBLICATION NO. SSP2070.

CONSULT LATEST EDITION OF SERVICE INSTRUCTION NO. 1029 AND NO. 1150 FOR INFORMATION PERTINENT TO CORRECTLY INSTALLING CYLINDER ASSEMBLY.

## FIXED WING ONLY

**GROUND RUN AFTER TOP OVERHAUL  
OR CYLINDER CHANGE WITH NEW RINGS**

(DO NOT USE AFTER MAJOR OVERHAUL)

1. Avoid dusty location and loose stones.
2. Head aircraft into wind.
3. All cowling should be in place, cowl flaps open.
4. Accomplish ground run in full flat pitch.
5. Never exceed 200°F. oil temperature.
6. If cylinder head temperatures reach 400°F., shut down and allow engine to cool before continuing.

Type Aircraft \_\_\_\_\_

Registration No. \_\_\_\_\_

Aircraft No. \_\_\_\_\_

Owner \_\_\_\_\_

Engine Model \_\_\_\_\_ S/N \_\_\_\_\_

Date \_\_\_\_\_

Run-Up By \_\_\_\_\_

### GROUND RUN

Time	RPM	MAP	Temperature				Pressure				Temperature			Fuel Flow	
			L.oil	R.oil	L.cyl	R.cyl	L.oil	R.oil	L.fuel	R.fuel	L.carb	R.carb	Amb.Air	Left	Right
5 min	1000														
10 min	1200														
10 min	1300														
5 min	1500														
5 min	1600														
5 min	1700														
5 min	1800														

Mag. Check

Adjustment Required

After Completion of Ground Run

Power Check

1. Visually inspect engine(s)

2. Check oil level(s)

Idle Check

## FLIGHT TEST AFTER TOP OVERHAUL OR CYLINDER CHANGE WITH NEW RINGS

1. Test fly aircraft one hour.
2. Use standard power for climb, and at least 75% power for cruise.
3. Make climb shallow and at good airspeed for cooling.
4. Record engine instrument readings during climb and cruise.

Tested by \_\_\_\_\_

### FLIGHT TEST RECORD

Time	RPM	MAP	Temperature				Pressure				Temperature			Fuel Flow			
			L.oil	R.oil	L.cyl	R.cyl	L.oil	R.oil	L.fuel	R.fuel	L.carb	R.carb	Amb.Air	Left	Right		
(Climb)																	
Cruise																	

**Adjustments Required After Flight**

**After Test Flight**

1. Make careful visual inspection of engine(s).
2. Check oil level(s).
3. If oil consumption is excessive, (see operator's manual for limits), remove spark plugs and check cylinder barrels for scoring.



**FULL THROTTLE HP AT ALTITUDE  
(Normally Aspirated Engines)**

Altitude Ft.	% S. L. H. P.	Altitude Ft.	% S. L. H. P.	Altitude Ft.	% S. L. H. P.
0	100	10,000	70.8	19,500	49.1
500	98.5	11,000	68.3	20,000	48.0
1,000	96.8	12,000	65.8	20,500	47.6
2,000	93.6	13,000	63.4	21,000	46.0
2,500	92.0	14,000	61.0	21,500	45.2
3,000	90.5	15,000	58.7	22,000	44.0
4,000	87.5	16,000	56.5	22,500	43.3
5,000	84.6	17,000	54.3	23,000	42.2
6,000	81.7	17,500	53.1	23,500	41.4
7,000	78.9	18,000	52.1	24,000	40.3
8,000	76.2	18,500	51.4	24,500	39.5
9,000	73.5	19,000	50.0	25,000	38.5

**TABLE OF SPEED EQUIVALENTS**

Sec./Mi.	M. P. H.	Sec./Mi.	M. P. H.	Sec./Mi.	M. P. H.
72.0	50	24.0	150	14.4	250
60.0	60	22.5	160	13.8	260
51.4	70	21.2	170	13.3	270
45.0	80	20.0	180	12.8	280
40.0	90	18.9	190	12.4	290
36.0	100	18.0	200	12.0	300
32.7	110	17.1	210	11.6	310
30.0	120	16.4	220	11.2	320
27.7	130	15.6	230	10.9	330
25.7	140	15.0	240	10.6	340

**CENTIGRADE—FAHRENHEIT CONVERSION TABLE**

Example: To convert 20°C. to Fahrenheit, find 20 in the center column headed (F—C); then read 68.0°F. in the column (F) to the right. To convert 20°F. to Centigrade; find 20 in the center column and read -6.67°C. in the (C) column to the left.

<u>C</u>	<u>F—C</u>	<u>F</u>	<u>C</u>	<u>F—C</u>	<u>F</u>
-56.7	-70	-94.0	104.44	220	428.0
-51.1	-60	-76.0	110.00	230	446.0
-45.6	-50	-58.0	115.56	240	464.0
-40.0	-40	-40.0	121.11	250	482.0
-34.0	-30	-22.0	126.67	260	500.0
-38.9	-20	-4.0	132.22	270	518.0
-23.3	-10	14.0	137.78	280	536.0
-17.8	0	32.0	143.33	290	554.0
-12.22	10	50.0	148.89	300	572.0
-6.67	20	68.0	154.44	310	590.0
-1.11	30	86.0	160.00	320	608.0
4.44	40	104.0	165.56	330	626.0
10.00	50	122.0	171.11	340	644.0
15.56	60	140.0	176.67	350	662.0
21.11	70	158.0	182.22	360	680.0
26.67	80	176.0	187.78	370	698.0
32.22	90	194.0	193.33	380	716.0
27.78	100	212.0	198.89	390	734.0
43.33	110	230.0	204.44	400	752.0
38.89	120	248.0	210.00	410	770.0
54.44	130	266.0	215.56	420	788.0
60.00	140	284.0	221.11	430	806.0
65.56	150	302.0	226.67	440	824.0
71.00	160	320.0	232.22	450	842.0
76.67	170	338.0	257.78	460	860.0
82.22	180	356.0	243.33	470	878.0
87.78	190	374.0	248.89	480	896.0
93.33	200	392.0	254.44	490	914.0
98.89	210	410.0	260.00	500	932.0

**INCH FRACTIONS CONVERSIONS**  
**Decimals, Area of Circles and Millimeters**

Inch Fraction	Decimal Equiv.	Area Sq. In.	MM. Equiv.	Inch Fraction	Decimal Equiv.	Area Sq. In.	MM. Equiv.
1/64	.0156	.0002	.397	1/2	.5	.1964	12.700
1/32	.0312	.0008	.794	17/32	.5312	.2217	13.494
3/64	.0469	.0017	1.191	35/64	.5469	.2349	13.891
1/16	.0625	.0031	1.587	9/16	.5625	.2485	14.288
3/32	.0937	.0069	2.381	19/32	.5937	.2769	15.081
7/64	.1094	.0094	2.778	39/64	.6094	.2916	15.478
1/8	.125	.0123	3.175	5/8	.625	.3068	15.875
5/32	.1562	.0192	3.969	21/32	.6562	.3382	16.669
11/64	.1719	.0232	4.366	43/64	.6719	.3545	17.065
3/16	.1875	.0276	4.762	11/16	.6875	.3712	17.462
7/32	.2187	.0376	5.556	23/32	.7187	.4057	18.256
15/64	.2344	.0431	5.593	47/64	.7344	.4235	18.653
1/4	.25	.0491	6.350	3/4	.75	.4418	19.050
9/32	.2812	.0621	7.144	25/32	.7812	.4794	19.844
19/64	.2969	.0692	7.540	51/64	.7969	.4987	20.241
5/16	.3125	.0767	7.937	13/16	.8125	.5185	20.637
11/32	.3437	.0928	8.731	27/32	.8437	.5591	21.431
23/64	.3594	.1014	9.128	55/64	.8594	.5800	21.828
3/8	.375	.1105	9.525	7/8	.875	.6013	22.225
13/32	.4062	.1296	10.319	29/32	.9062	.6450	23.019
27/64	.4219	.1398	10.716	59/64	.9219	.6675	23.416
7/16	.4375	.1503	11.112	15/16	.9375	.6903	23.812
15/32	.4687	.1725	11.906	31/32	.9687	.7371	24.606
31/64	.4844	.1842	12.303	63/64	.9844	.7610	25.003



# OPERATOR'S MANUAL

## REVISION

REVISION No.	PUBLICATION	PUBLICATION No.	PUBLICATION DATE
60297-10-1	O-540, IO-540 & HIO-540 Operator's Manual	60297-10	July, 1976

The page(s) furnished herewith are intended either to replace, add to, or delete pages in the basic manual.

Previous revisions to this publication	This revision consists of:-
	February, 1977 2-2 3-1

**SECTION 2**  
**SPECIFICATIONS**

O-540 SERIES				
	-A	-B	-E, -G, -H	-J
FAA Type Certificate	295	295	295	295
Rated horsepower	250	235	260	235
Rated speed RPM	2575	2575	2700	2400
Bore, inches	5.125	5.125	5.125	5.125
Stroke, inches	4.375	4.375	4.375	4.375
Displacement cubic inches	541.5	541.5	541.5	541.5
Compression ratio	8.5:1	7.2:1	8.5:1	8.5:1
Firing order	1-4-5-2-3-6	1-4-5-2-3-6	1-4-5-2-3-6	1-4-5-2-3-6
Spark occurs degrees BTC	25	25	25	23
Valve Rocker Clearance (hydraulic tappets collapsed)	.028-.080	.028-.080	.028-.080	.028-.080
Prop. Drive Ratio	1:1	1:1	1:1	1:1
Prop. Drive Rotation	Clockwise	Clockwise	Clockwise	Clockwise
IO-540 SERIES				
	-A, -B, -E -G, -P	-T -D, -N, -R	-C, -J	-K*, -L -M, -S*
FAA Type Certificate	1E4	1E4	1E4	1E4
Rated horsepower	290	260	250	300
Rated speed RPM	2575	2700	2575	2700
Bore, inches	5.125	5.125	5.125	5.125
Stroke, inches	4.375	4.375	4.375	4.375
Displacement cubic inches	541.5	541.5	541.5	541.5
Compression ratio	8.7:1	8.5:1	8.5:1	8.7:1
Firing order	1-4-5-2-3-6	1-4-5-2-3-6	1-4-5-2-3-6	1-4-5-2-3-6
Spark occurs degrees BTC	20	25	25	20
Valve Rocker Clearance (hydraulic tappets collapsed)	.028-.080	.028-.080	.028-.080	.028-.080
Prop. Drive Ratio	1:1	1:1	1:1	1:1
Prop. Drive Rotation	Clockwise	Clockwise	Clockwise	Clockwise

\* - NOTE: Model IO-540-K1C5, -K1F5, -K1J5 and -S1A5 has alternate rating of 290 horsepower at 2575 RPM. When operating at alternate rating, all data pertinent to the IO-540-G series is applicable.

**SECTION 2**
**O-540, IO-540 & HIO-540 SERIES**
**SPECIFICATIONS**
**HIO-540-A**

FAA Type Certificate . . . . .	1E4
Rated horsepower . . . . .	290
Rated speed RPM . . . . .	2575
Bore, inches . . . . .	5.125
Stroke, inches . . . . .	4.375
Displacement cubic inches . . . . .	541.5
Compression ratio . . . . .	8.7:1
Firing order . . . . .	1-4-5-2-3-6
Spark occurs degrees BTC . . . . .	20
Valve Rocker Clearance (hydraulic tappets collapsed) . . . . .	.028-.080
Prop. Drive Ratio . . . . .	1:1
Prop. Drive Rotation . . . . .	Clockwise

**1. STANDARD ENGINE, DRY WEIGHT**

MODEL	LBS.
O-540-J1A5D, -J2A5D, -J1B5D, -J2B5D . . . . .	387.00
O-540-B1A5, -B2A5, -B4A5 . . . . .	395.00
O-540-B1B5, -B2B5, -B4B5 . . . . .	395.00
O-540-A1A, -A1A5, -A4A5 . . . . .	396.00
O-540-A2B, -B1D5 . . . . .	396.00
O-540-A1B5, -A1C5, -A4B5 . . . . .	397.00
O-540-A4C5, -A1D5, -A4D5 . . . . .	397.00
O-540-A1D, -B2C5, -E4A5 . . . . .	397.00
O-540-E4B5 . . . . .	398.00
O-540-E4C5 . . . . .	399.00
O-540-A3D5, -H1B5D, -H2B5D . . . . .	412.00
O-540-G1A5, -G2A5 . . . . .	415.00
O-540-H1A5, -H2A5 . . . . .	416.00
IO-540-C1C5, -C4C5, -C2C . . . . .	402.00
IO-540-D4A5 . . . . .	402.00
IO-540-C1B5, -C4B5 . . . . .	404.00
IO-540-J4A5, -T4A5D, -T4B5D . . . . .	409.00
IO-540-N1A5 . . . . .	428.00

**SECTION 3****OPERATING CONDITIONS**

**1. GENERAL.** Close adherence to these instructions will greatly contribute to long life, economy and satisfactory operation of the engine.

**NOTE**

***YOUR ATTENTION IS DIRECTED TO THE WARRANTIES THAT APPEAR IN THE FRONT OF THIS MANUAL REGARDING ENGINE SPEED, THE USE OF SPECIFIED FUELS AND LUBRICANTS, REPAIRS AND ALTERATIONS. PERHAPS NO OTHER ITEM OF ENGINE OPERATION AND MAINTENANCE CONTRIBUTES QUITE SO MUCH TO SATISFACTORY PERFORMANCE AND LONG LIFE AS THE CONSTANT USE OF CORRECT GRADES OF FUEL AND OIL, CORRECT ENGINE TIMING, AND FLYING THE AIRCRAFT AT ALL TIMES WITHIN THE SPEED AND POWER RANGE SPECIFIED FOR THE ENGINE. DO NOT FORGET THAT VIOLATION OF THE OPERATION AND MAINTENANCE SPECIFICATIONS FOR YOUR ENGINE WILL NOT ONLY VOID YOUR WARRANTY BUT WILL SHORTEN THE LIFE OF YOUR ENGINE AFTER ITS WARRANTY PERIOD HAS PASSED.***

New engines have been carefully run-in by Avco Lycoming and therefore, no further break-in is necessary insofar as operation is concerned; however, new or newly overhauled engines should be operated using only the lubricating oils recommended in the latest edition of Service Instruction No. 1014.

**NOTE**

***Cruising should be done at 65% to 75% power until a total of 50 hours has accumulated or oil consumption has stabilized. This is to insure proper seating of the rings and is applicable to new engines, and engines in service following cylinder replacement or top overhaul of one or more cylinders.***

The minimum fuel octane rating is listed in the flight chart, Part 9 of this section. Under no circumstances should fuel of a lower octane rating or automotive fuel (regardless of octane rating) be used.

**2. PRESTARTING ITEMS OF MAINTENANCE.** Before starting the aircraft engine for the first flight of the day, there are several items of maintenance inspection that should be performed. These are described in Section 4 under Daily Pre-Flight Inspection. They must be observed before the engine is started.

## SECTION 3

## O-540, IO-540 &amp; HIO-540 SERIES

## 3. STARTING PROCEDURES

The following starting procedures are recommended: However, the starting characteristics of various installations will necessitate some variation from these procedures.

*NOTE*

*Cranking periods should be limited from ten (10) to twelve (12) seconds with 5 minutes rest between cranking periods.*

*a. O-540 Series*

- (1) Perform pre-flight inspection.
- (2) Set carburetor heat control in "cold" position.
- (3) Set propeller governor (if applicable) in "Full RPM" position.
- (4) Turn fuel valve to "on" position.
- (5) Move mixture control to "Full Rich".
- (6) Turn on boost pump.
- (7) Pump throttle to full open and back to idle position for 2 to 3 strokes for a cold engine. If engine is equipped with priming system, cold engines may be primed with 1 to 3 strokes of the priming pump.
- (8) Open throttle approximately 1/4 travel.
- (9) Set magneto selector switch. Consult airframe manufacturer's handbook for correct position.
- (10) Engage starter.
- (11) When engine starts, place magneto selector switch in "Both" position.
- (12) Check oil pressure gage for indicated pressure. If oil pressure is not indicated within thirty seconds, stop engine and determine trouble.