Operator's Manual

Lycoming

IGO-540, IGSO-540 Series

Approved by FAA

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LYCOMING

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IGO-540, IGSO-540 Series Operator's Manual

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LYCOMING OPERATOR'S MANUAL

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 Lycoming powered aircraft. Modifications and repair procedures are contained in 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 Lycoming Service Bulletins, Instructions and Service Letters which are available from all Lycoming distributors or from the factory by subscription. Consult the latest revision of Service Letter No. L114 for subscription information.

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.

IMPORTANT SAFETY NOTICE

Proper service and repair is essential to increase the safe, reliable operation of all aircraft engines. The service procedures recommended by Lycoming are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the task. These special tools must be used when and as recommended.

It is important to note that most Lycoming publications contain various Warnings and Cautions which must be carefully read in order to minimize the risk of personal injury or the use of improper service methods that may damage the engine or render it unsafe.

It is also important to understand that these Warnings and Cautions are not all inclusive. Lycoming could not possibly know, evaluate or advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences that may be involved. Accordingly, anyone who uses a service procedure must first satisfy themselves thoroughly that neither their safety nor aircraft safety will be jeopardized by the service procedure they select.

LYCOMING OPERATOR'S MANUAL

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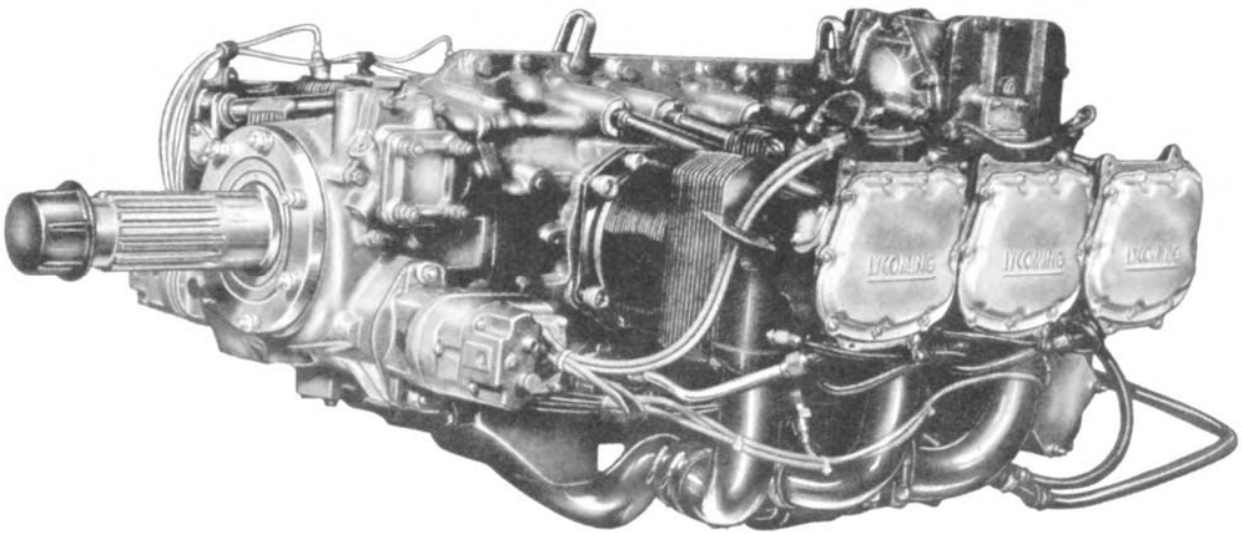
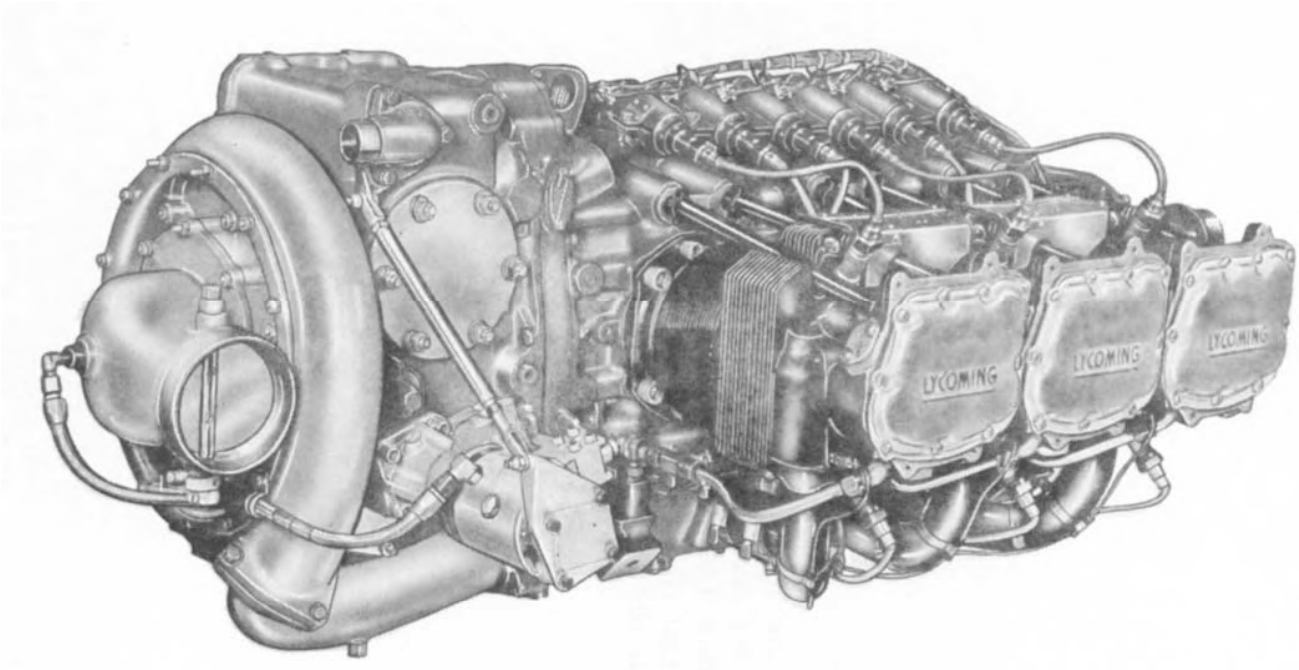


Typical IGO-540 Series – ¾ Left Front View



Typical IGSO-540-B Series – ¾ Right Rear View

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.

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SECTION 1
DESCRIPTION

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SECTION 1

DESCRIPTION

Subject engines are six cylinder, horizontally opposed, reduction gear driven, air-cooled models. These models have side mounted accessory drives, dry sumps and incorporate piston cooling oil jets in the crankcase. In addition, the IGSO-540 series is supercharged.

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.

Crankshaft – The crankshaft is made from a chrome 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.

Reduction Gear Unit – A planetary type reduction gear unit having a ratio of 77:120 is mounted on the forward end of the crankcase. The reduction gear unit consists of a ring gear mounted on the crankshaft flange that drives a planetary gear assembly mounted on the propeller shaft. This planetary gear assembly also meshes with a stationary gear in the reduction gear housing. Mounting pads for the magnetos and governor drive are an integral part of the reduction gear housing.

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 five rings and employ half wedge rings. Consult the latest revision of Service Instruction No. 1037 for proper piston and ring combinations.

Accessory Housing – The accessory housing, which consists of two magnesium castings securely bolted together, is fastened to the rear of the crankcase and the top of the sump. All accessory drives with the exception of the magnetos and propeller governor drives are contained within the housing. It is designed in such a manner that all accessories are mounted on the sides of the housing, thus providing improved accessibility when the engine is installed in the airframe.

Oil Sump (IGO-540 Series) – The oil sump incorporates a scavenge oil screen, oil drain plug, a mounting pad for the throttle body adapter and connections for the intake pipes.

Oil Sump (IGSO-540 Series) – The oil sump incorporates a scavenge oil screen, oil drain plug, a mounting pad for the supercharger outlet pipe and intake pipe connections.

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 usually through gills or augmenter tubes located at the rear of the cowling.

Priming System – Provision for a primer system is provided on IGSO-540 series engines.

Ignition System – Dual ignition is furnished by either a low voltage or high voltage system. See Table 1 for model application.

Both systems employ one retard breaker magneto and one conventional magneto. A source of DC power and a starting vibrator are required to complete the installation.

The magnetos are mounted on opposite sides of the reduction gear housing and are driven by bevel gears that engage a common idler gear. All of the subject magnetos incorporate an integral feed-thru capacitor and require no external noise filter in the ground lead.

Lubrication System – Lubrication is of the full pressure, dry sump type. The accessory drive bearings, connecting rod bearings, crankshaft front bushing, reduction gear pinion shafts, camshaft bearings, valve tappets, push rods, valve rocker arm bushings, governor drive, propeller shaft thrust bearing and reduction gear teeth are lubricated by positive pressure. The piston, piston pins, cams, cylinder walls, valve rockers, valve stems and other parts are lubricated by spray and run-off from moving parts.

The lubrication system is actuated by an impeller type oil pump mounted on the accessory housing. The pump assembly incorporates a pressure pump and a scavenge pump driven by a common drive shaft. The pressure pump draws oil from a tank mounted separately from the engine and forces the oil through a drilled passage to the oil filter. The pressure oil from the full flow filter is then directed through an oil check valve to the oil pressure relief valve. (The oil check valve acts as a shut-off valve for gravity-fed oil when the engine is not operating, thereby preventing the oil from draining into the crankcase.) In the case of an obstruction within the oil filter, the oil flows directly from the pump to the relief valve by means of a bypass valve, built into the filter assembly.

The oil pressure relief valve, which is adjustable, controls the engine pressure by discharging excess oil back to the inlet side of the pump. The remainder, or normal pressure oil then flows through two separately drilled passages; one passage distributing pressure oil to the accessory drive section and the other being the main oil supply passage extending the full length of the crankcase, with auxiliary passages drilled to each main bearing. These passages align with holes in the main bearing journals and deliver oil to the interior of the crankshaft. Each connecting rod bearing receives pressure oil through passages drilled in the crankshaft. Pressure oil is delivered to the reduction gear from the front main bearing oil chamber in the crankshaft.

The main oil gallery in the left crankcase half registers with a drilled hole in the reduction gear housing and supplies oil to the propeller governor drive. High pressure oil from the propeller governor is delivered to the interior of the propeller shaft by indexing holes suitably sealed to prevent leakage and consequent pressure drop.

Oil from the main supply passage flows to the two valve passages running the length of each half of the crankcase, and is then conducted through branches to the hydraulic tappets and to the camshaft bearings. Oil enters the tappet through indexing holes and travels out to the valve mechanism through hollow push rods, lubricating the valve rocker bearings and valve stems. Oil drains from the rocker boxes through external drain tubes connecting the rocker boxes with the oil sump.

Scavenge oil is collected in the oil sump, from which point drilled passages conduct the oil back to the scavenge pump in the accessory housing, where the oil is then discharged to the external oil tank. Pressure build-up within the crankcase is held to a minimum by means of a breather mounted on the accessory housing. In addition, six spring loaded oil jets in the crankcase furnish an oil spray to provide internal cooling for the pistons.

Induction System (IGO-540 Series) – All models are equipped with a Bendix RS-10ED fuel injector. This fuel injector meters fuel in proportion to air flow to air bled nozzles at individual intake ports. A manual mixture control and idle cut-off are provided.

IGSO-540-A Series – This series is equipped with a Bendix RS-10FB1 fuel injector. This fuel injector has single point injection, altitude compensation and meters fuel in proportion to air flow. The fuel line to the injector nozzle (on all models except –A1F) includes a variable venturi fuel flow modulator.

IGSO-540-B Series – This series is equipped with either a Simmonds Type 580 or 582 multi-plunger, variable stroke fuel injection pump. This pump includes automatic mixture compensation for manifold pressure and altitude, auto-lean and auto-rich mixture control settings and an integral fuel supply pump.

IGSO-540 Series – This series engines is equipped with a gear driven mechanical supercharger of the single stage centrifugal type. The supercharger is located on the accessory housing at the rear of the engine and incorporates a 6.75 inch diameter impeller which is gear driven at 11.27 times the crankshaft speed. As the fuel/air mixture leaves the supercharger, it is carried through the supercharger outlet pipe into the distribution center of the sump where the mixture is distributed to the individual cylinders by separate intake pipes.

TABLE 1

MODEL APPLICATION			
	Magneto		
Model	Left	Right	Fuel Injector
IGO-540			Bendix
-A1A	S6RN-200	S6RN-204	RS-10ED1
-A1B	S6RN-600	S6RN-604	RS-10ED1
-A1C	S6RN-1208	S6RN-1209	RSA-10DB1
-B1A	S6RN-200	S6RN-204	RS-10ED2
-B1B	S6RN-600	S6RN-604	RS-10ED2
-B1C	S6RN-200	S6RN-204	RS-10ED2
IGSO-540			
-A1A	S6RN-600	S6RN-604	RS-10FB1
-A1C	S6RN-600	S6RN-604	RS-10FB1
-A1D	S6RN-1208	S6RN-1209	RS-10FB1
-A1E	S6RN-1208	S6RN-1209	RS-10FB1
-A1F	S6RN-1208	S6RN-1209	RS-10FB1
-A1H	S6RN-1208	S6RN-1209	RS-10FB1
-B1A	S6RN-600	S6RN-604	Simmonds 580-582
-B1C	S6RN-1208	S6RN-1209	Simmonds 580-582

SECTION 2
SPECIFICATIONS

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SECTION 2

SPECIFICATIONS

IGO-540-A, -B SERIES

FAA Type Certificate	1E11
Take-off RPM	
Engine	3400
Propeller	2180
Take-off horsepower	350
Rated RPM	
Engine	3000
Propeller	1925
Rated horsepower	325
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
Valve rocker clearance (hydraulic tappets collapsed)	.028-.080
Propeller drive ratio	77:120
Propeller drive rotation (viewed from rear)	Clockwise

IGSO-540-A SERIES

FAA Type Certificate	1E7
Take-off RPM	
Engine	3400
Propeller	2180
Take-off horsepower and manifold pressure	
Sea level	380 at 47 in. Hg.
Critical altitude	380 at 43.5 in. Hg.
Rated RPM	
Engine	3200
Propeller	2050
Rated horsepower and manifold pressure	
Sea level	360 at 45 in. Hg.
Critical altitude	360 at 41.7 in. Hg.
Bore, inches	5.125
Stroke, inches	4.375
Displacement cubic inches	541.5
Compression ratio	7.30:1
Firing order	1-4-5-2-3-6
Spark occurs, degree BTC	25
Valve rocker clearance (hydraulic tappets collapsed)	.028-.080
Propeller drive ratio	77:120
Propeller drive rotation (viewed from rear)	Clockwise
Supercharger gear ratio	11.27:1

SPECIFICATIONS (CONT.)

IGSO-540-B SERIES

FAA Type Certificate 1E7
Take-off RPM
  Engine 3400
  Propeller 2180
Take-off horsepower and manifold pressure
  Sea level ..... 380 at 47. in. Hg.
  Critical altitude ..... 380 at 43.5 in. Hg.
Rated RPM
  Engine 3200
  Propeller 2050
Rated horsepower and manifold pressure
  Sea level ..... 360 at 45 in. Hg.
  Critical altitude ..... 360 at 40.5 in. Hg.
Bore, inches 5.125
Stroke, inches 4.375
Displacement, cubic inches 541.5
Compression ratio 7.30:1
Firing order 1-4-5-2-3-6
Spark occurs, degrees BTC 25
Valve rocker clearance (hydraulic tappets collapsed) ..... .028-.080
Propeller drive ratio 77:120
Propeller drive rotation (viewed from rear) ..... Clockwise
Supercharger gear ratio 11.27:1

DETAIL WEIGHTS

ENGINE, standard dry weight (includes fuel injector, magnetos, spark plugs, ignition system and inter-cylinder baffles).

MODEL	LBS.
IGO-540-A1A	506.00
IGO-540-A1B	517.00
IGO-540-B1A, -B1C	500.00
IGO-540-B1B	511.00
IGSO-540-A1A	549.00
IGSO-540-A1C, -A1D, -A1F	539.00
IGSO-540-A1E, -A1H	541.00
IGSO-540-B1A	532.00
IGSO-540-B1C	522.00

DETAIL WEIGHTS (CONT.)

ENGINE, standard dry weight (includes fuel injector, magnetos, spark plugs, ignition harness, inter-cylinder baffles and a Prestolite 24V., 100 Amp alternator with adapter and coupling).

MODEL	LBS.
IGO-540-A1C	534.00

DIMENSIONS, INCHES

MODEL	HEIGHT	WIDTH	LENGTH
IGO-540-A1A, -A1B, -A1C	21.72	34.25	46.38
IGO-540-B1A, -B1B, -B1C	21.66	34.25	46.38
IGSO-540-A1A, -A1D, -A1F	28.44	34.25	48.15
IGSO-540-A1C, -A1E, -A1H	20.30	34.25	56.74
IGSO-540-B1A, -B1C	20.30	34.25	48.63

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SECTION 3
OPERATING INSTRUCTIONS

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SECTION 3

OPERATING INSTRUCTIONS

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 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 revision of Service Instruction No. 1014.

The minimum fuel octane rating is listed in the flight chart, Part 8 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.

3. STARTING PROCEDURES.

a. IGO-540 Series.

(1) Perform pre-flight inspection.

(2) Set propeller governor in "Full RPM".

(3) Turn fuel valve to "on" position.

(4) Open throttle approximately ¼ 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 gauge 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.

b. 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.

c. IGSO-540 Series.

(1) Perform pre-flight inspection.

(2) Set propeller governor in "Full RPM".

(3) Turn fuel valve on.

(4) Move mixture control to "Idle Cut-Off" ("A" Series). Move mixture control to "Full Rich" ("B" Series).

(5) Turn boost pump on.

(6) Open throttle approximately ¼ travel.

(7) Set magneto selector switch. Consult airframe manufacturer's handbook for correct position.

(8) Engage starter.

(9) While engaging the starter, operate the primer switch approximately three seconds.

(10) When engine fires, move ignition switch to "Both".

(11) ("A" Series) – move mixture control to "Full Rich". ("B" Series) – leave mixture control in "Full Rich".

(12) Check oil pressure gauge for indicated pressure. If oil pressure is not indicated within thirty seconds, stop the engine and determine trouble.

NOTE

Prime sufficiently but not excessively, depending on engine temperatures. This will vary from no prime for a hot engine to holding the primer switch four to ten seconds for a cold 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.

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. Engine is warm enough for take-off when engine runs smoothly.

6. GROUND CHECK.

a. Check both oil pressure and oil temperature; oil temperature should be in minimum range before take-off.

b. Leave mixture in "Full Rich".

c. Move the propeller control through its complete range to check operation and return to full low pitch position. Full feathering check 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.

d. 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) With the propeller in minimum pitch angle, set the engine to produce 50 – 65% power as indicated by the manifold pressure gauge. 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.

   (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. Normal drop-off is 100 RPM. 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 a too rich mixture.

(3) Do not operate on a single magneto for too long a period, 2 to 3 seconds is usually sufficient to check drop-off and will minimize plug fouling.

7. OPERATION IN FLIGHT.

a. Subject engines are equipped with a dynamic counterweight system and must be operated accordingly. Avoid rapid opening and closing of the throttle.

b. See airframe manufacturer's instructions for correct manifold pressures for power settings.

c. *Manual Mixture Control Leaning Procedure* – Opinion varies among operators regarding leaning procedures to obtain most economical fuel-air-ratios with a certain margin of safety. Improper fuel and air mixtures take their toll in high replacement parts in the form of cracked cylinder head, burned pistons, warped piston ring lands and warped and failed valves. The procedures set forth in the following paragraphs for "leaning out" a Lycoming engine have proven to be the most economical, both in low fuel consumption and low parts replacement rates, and it is recommended that all Lycoming engine operators adhere to these procedures.

CAUTION

NEVER OPERATE AN ENGINE IN EXCESS OF THE MAXIMUM CYLINDER HEAD TEMPERATURE SPECIFIED.

THE MIXTURE CONTROL SHOULD REMAIN IN THE "FULL RICH" POSITION FOR TAKE-OFF, NORMAL RATED OEPRATION AND CLIMB POWER SETTINGS. DURING CLIMB, IF ROUGHNESS OR LOSS OF POWER IS NOTED DUE TO OVER RICHNESS, IT IS PERMISSIBLE TO LEAN ONLY UNTIL ENGINE OPERATED SMOOTHLY.

(1) *IGO-540 Series – Manual Leaning Procedures.*

(a) Not Equipped with Exhaust Gas Temperature Gauge or Fuel Flowmeter – 75% Cruise Power or Less.

(i) With mixture in full rich, slowly move the control toward the lean position and continue to lean until a slight loss in power is noted.

(ii) Enrich mixture rather abruptly until power is regained which will be accompanied by a slight propeller surge.

(b) Equipped with a Fuel Flowmeter.

(i) Lean in accordance with the power/fuel flow curve.

(c) Equipped with Exhaust Gas Temperature (EGT) Gauge.

(i) Above 75% power – Never lean beyond 150°F on rich side of peak EGT unless aircraft operator's manual shows otherwise. Monitor cylinder head temperatures.

(ii) 75% power and below – Operate at peak EGT.

NOTE

Operation on the lean side of peak will result in slightly better fuel economy but may cause unstable engine operation.

(2) *IGSO-540 Series – Manual Leaning Procedures.*

(a) Not Equipped with a Fuel Flowmeter or Exhaust Gas Temperature Gauge.

(i) Supercharged engines should not be manually leaned without the aid of an approved flowmeter or exhaust gas temperature gauge.

(b) Equipped with an Approved Fuel Flowmeter.

(i) Lean in accordance with the power/fuel flow curve.

(c) Equipped with an Exhaust Gas Temperature Gauge (EGT).

(i) 75% cruise power – Never lean beyond 150°F on rich side of peak EGT. Monitor cylinder head temperatures.

(ii) 65% cruise power and below – Operate at peak EGT.

NOTE

Operation on the lean side of peak will result in slightly better fuel economy but may cause unstable engine operation.

d. When increasing power, first increase the RPM with propeller governor, then increase the manifold pressure with the throttle. For decreasing power always throttle back to desired manifold pressure and then change propeller governor to desired RPM.

CAUTION

ON IGSO-540 SERIES – NEVER EXCEED 47 IN. HG. AT SEA LEVEL OR 43.5 IN. HG. AT CRITICAL ALTITUDE AT TAKE-OFF SPEED OF 3400. NEVER EXCEED 45 IN. HG. AT SEA LEVEL AT NORMAL RATED SPEED. NEVER EXCEED 41.7 IN. HG. ON –A SERIES OR 40.5 IN. HG. ON –B SERIES AT CRITICAL ALTITUDE AT NORMAL RATED SPEED.

e. Limit take-off and climb to 5 minutes at 3400 RPM.

NOTE

Although take-off power may be used for a maximum of 5 minutes, it is advisable to throttle back to rated power as soon as take-off obstructions have been cleared.

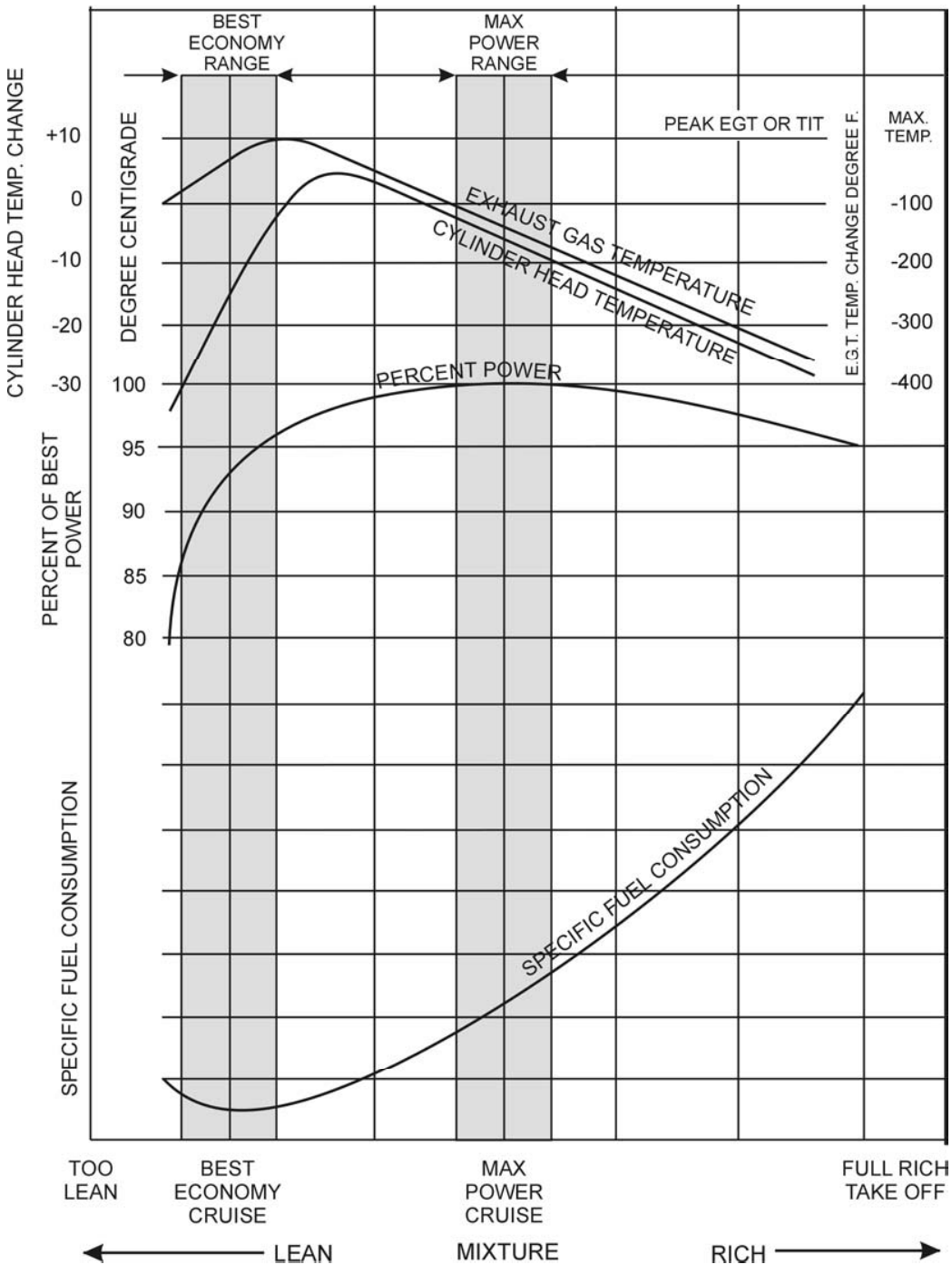

Figure 3-1. Representative Effect of Fuel/Air Ratio on Cylinder Head Temperature, Power and Specific Fuel Consumption at Constant RPM Cruise Range Operation

8. ENGINE FLIGHT CHART.

Fuel and Oil –

ALL MODELS

Aviation Grade Fuel..... 100/130 octane, minimum

Average Ambient Air	*Recommended Grade Oil MIL-L-6092B 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 revision of Service Instruction No. 1014.

OPERATING CONDITIONS

Average Ambient Air	* Oil Inlet Temperature Desired	Maximum
Above 60°F	180°F (82°C)	235°F (118°C)
30° to 90°F	180°F (82°C)	235°F (118°C)
0° to 70°F	180°F (82°C)	235°F (118°C)
Below 10°F	170°F (71°C)	210°F (99°C)

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

Oil Pressure, psi	Max.	Min.	Idling
All models except			
IGSO-540-B1A, -B1C	85	55	25
IGSO-540-B1A, -B1C	85	55	35

Fuel Pressure, psi	Maximum	Minimum	Idle
IGO-540 Series, except –A1C	26	20	
IGO-540-A1C			
Inlet to fuel pump	40	-4	
Inlet to fuel injector	40	25	12
IGSO-540-A Series	35	17	

OPERATING CONDITION (CONT.)

Fuel Pressure, psi (Cont.)

IGSO-540-B Series

Fuel injector model	580		582	
	Max.	Min.	Max.	Min.
Inlet to integral supply pump	15.0	-2.0	24.0	-2.5
Integral supply pump outlet	35.0	9.0	35.0	9.0
Emergency to integral supply pump	15.0	9.0	35.0	9.0

IGO-540 SERIES

Operation	RPM	HP	Fuel Cons. Gal./Hr.	Max. Oil Cons. Qts./Hr.	*Max. Cyl. Head Temp.
Take-off	3400	350	------	------	475°F
Normal Rated	3000	325	------	1.45	475°F
75% Rated	2750	244	18.5	1.09	475°F
60% Rated	2550	195	13.5	0.65	475°F

IGSO-540 SERIES

Take-off	3400	380	------	------	500°F
Normal Rated	3200	360	------	1.60	500°F
75% Rated	2750	270	27.0	1.20	500°F
60% Rated	2600	216	17.0	0.72	500°F

* - For maximum service life of the engine, maintain cylinder head temperature between 150°F and 435°F (65°C and 224°C) during continuous operation.

9. LANDING APPROACH. During relatively long glides in making the approach, the throttle should be partially opened at intervals to clear out the engine. Because of the possibility of detuning counterweights, a setting of 3000 RPM is desirable when preparing for a landing. It is suggested this be done at the time landing gear and flaps are being set for landing. At final approach, take-off setting is desirable. Reason for this precaution is so full take-off power will be available in an emergency.

10. ENGINE SHUT-DOWN.

a. Set propeller in minimum blade angle.

b. Idle until there is a decided decrease in cylinder head temperature.

c. Move mixture control to "Idle Cut-Off".

d. When engine stops, turn ignition switch off.

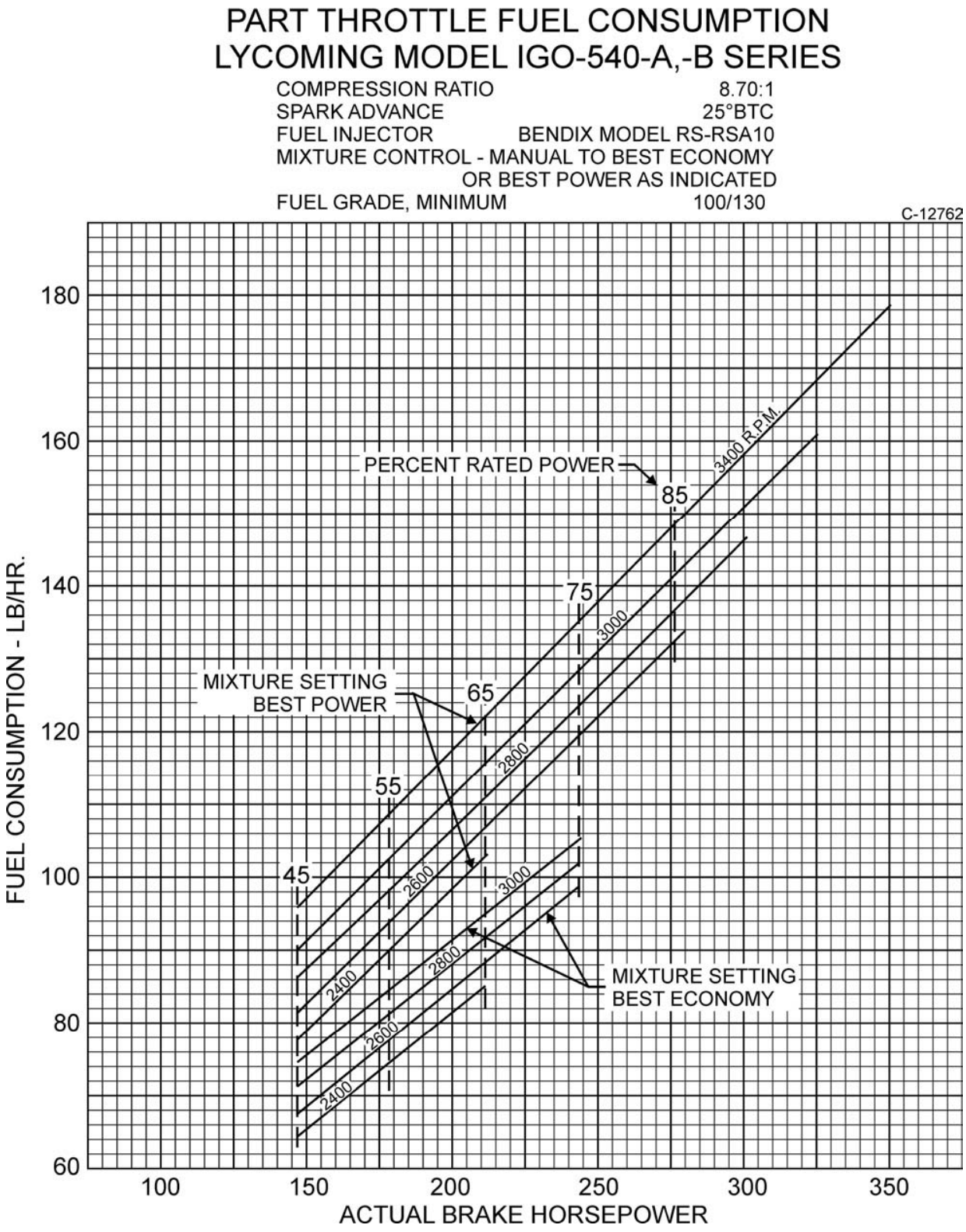

Figure 3-2. Part Throttle Fuel Consumption –
IGO-540 Series

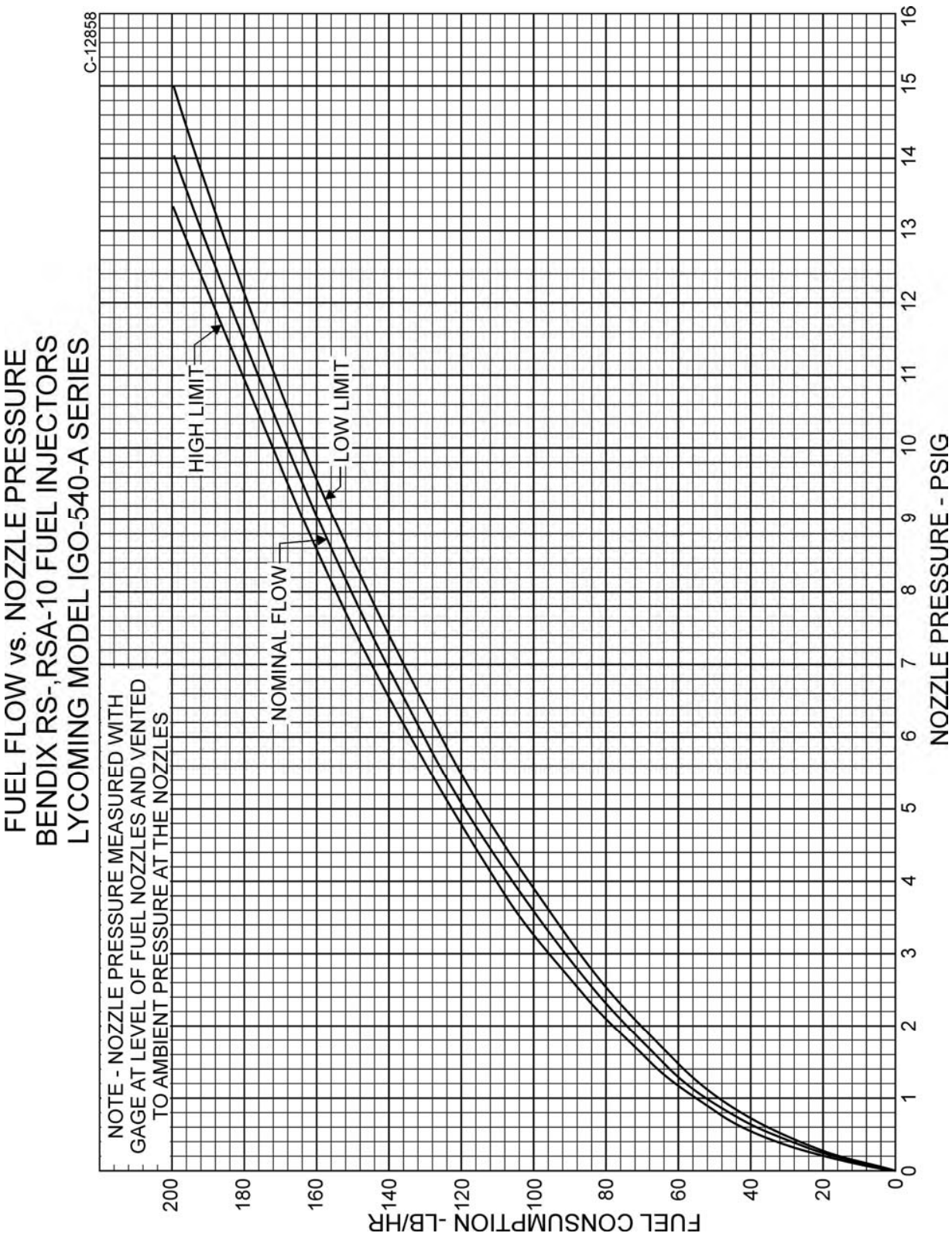

Figure 3-3. Fuel Flow vs Nozzle Pressure –
IGO-540-A Series

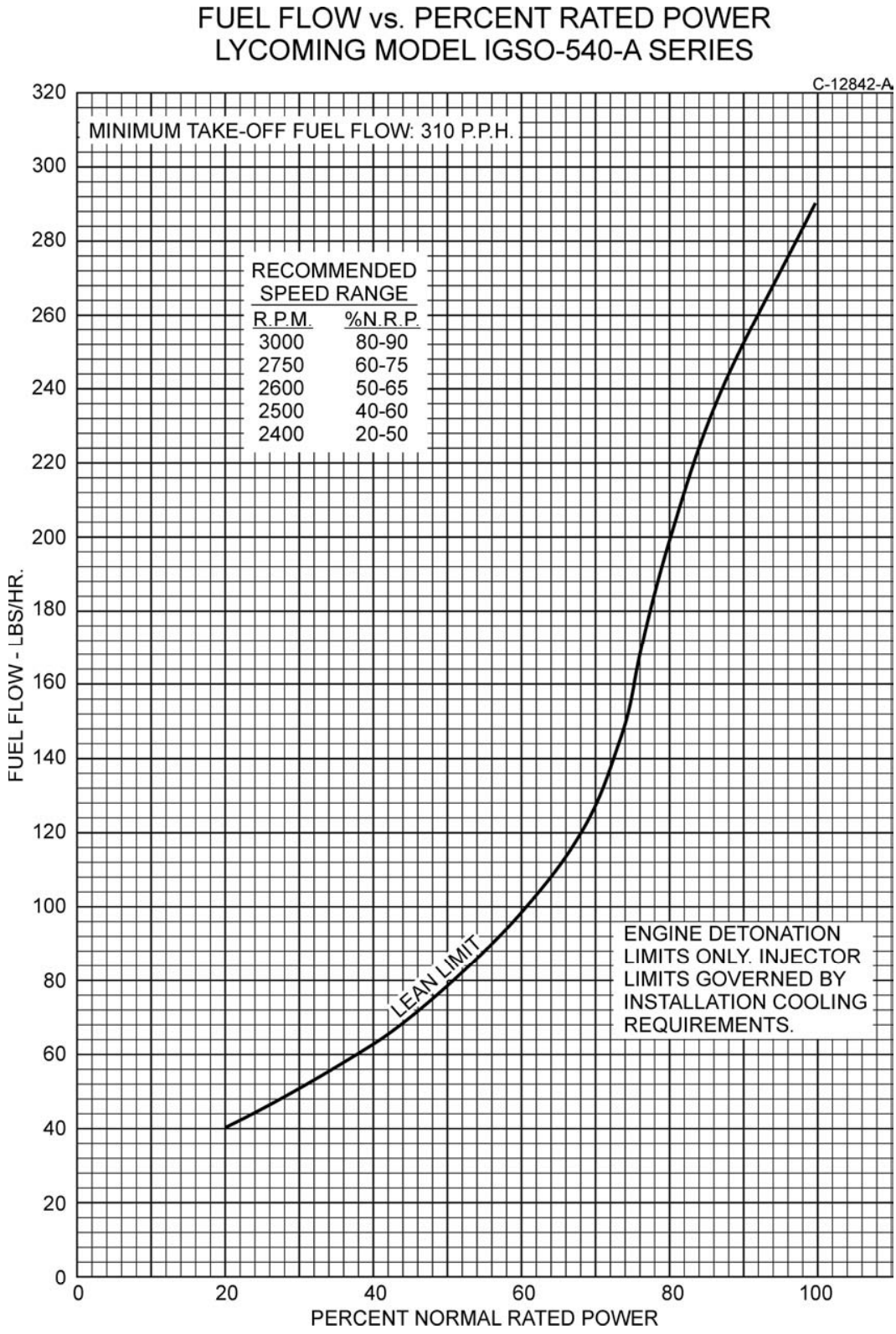

Figure 3-4. Fuel Flow vs Percent Rated Power –
IGSO-540-A Series

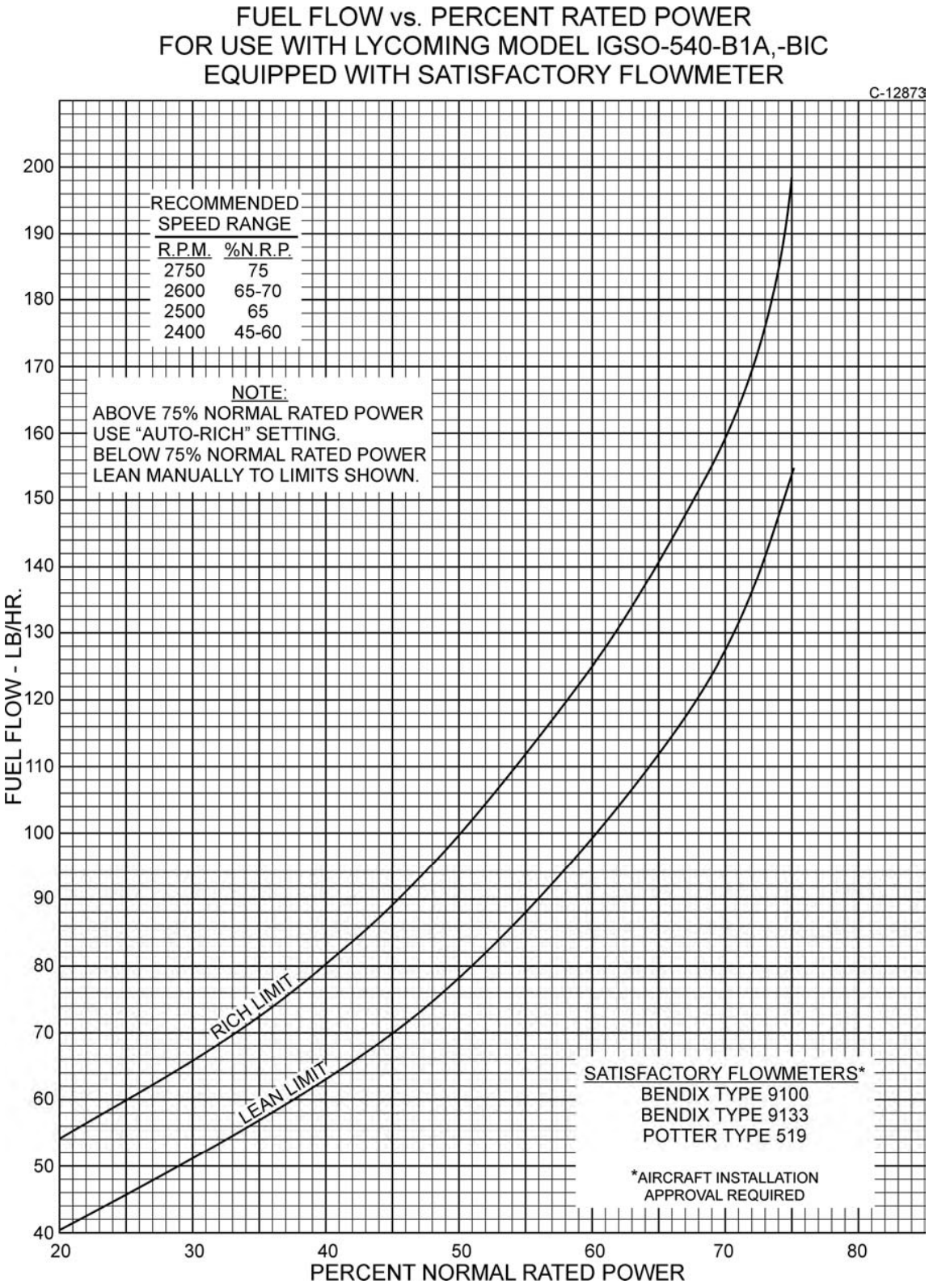

Figure 3-5. Fuel Flow vs Percent Rated Power –
IGSO-540-B Series

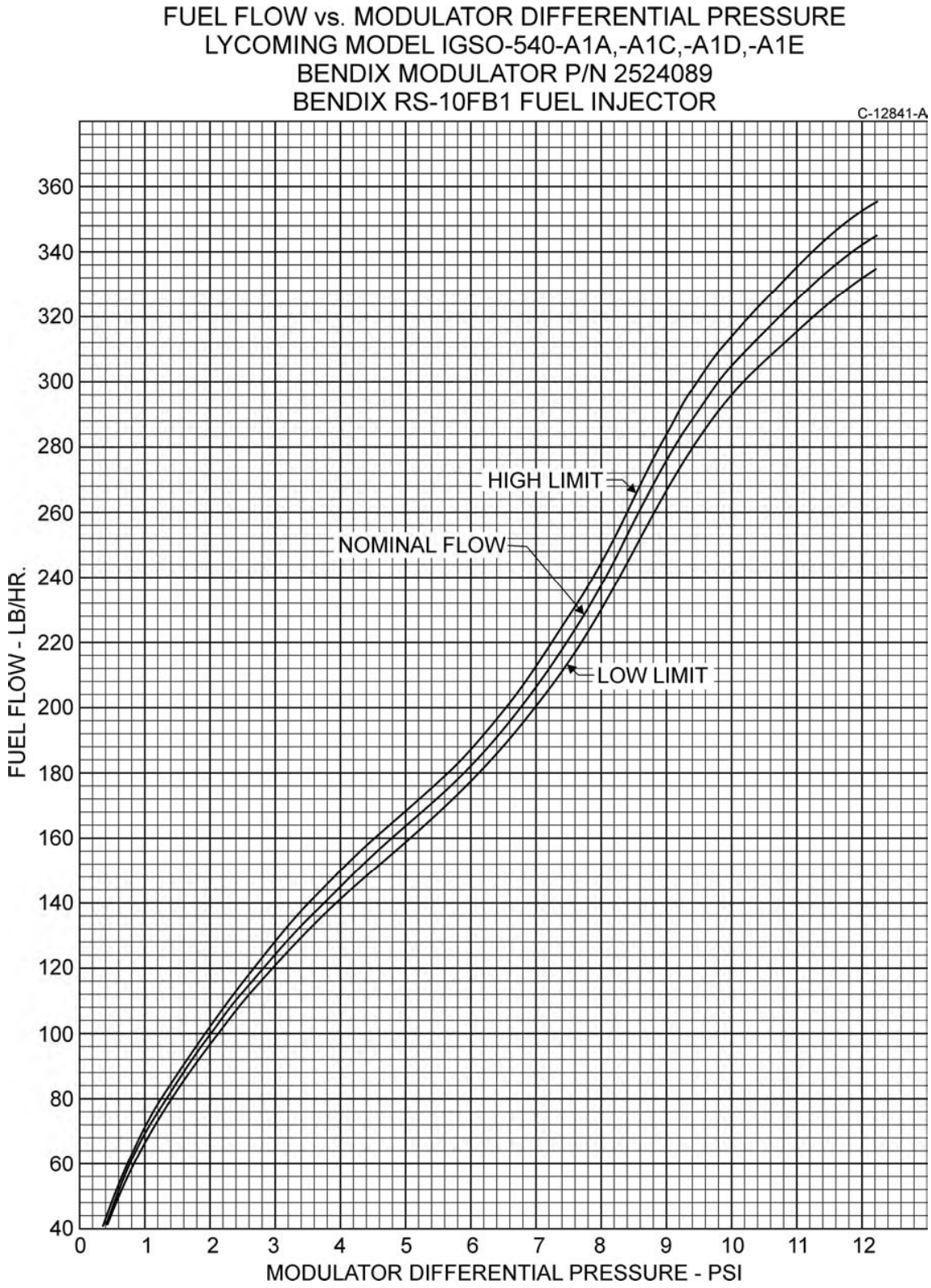

Figure 3-6. Fuel Flow vs Modulator Differential Pressure –
IGSO-540-A Series, except –A1F

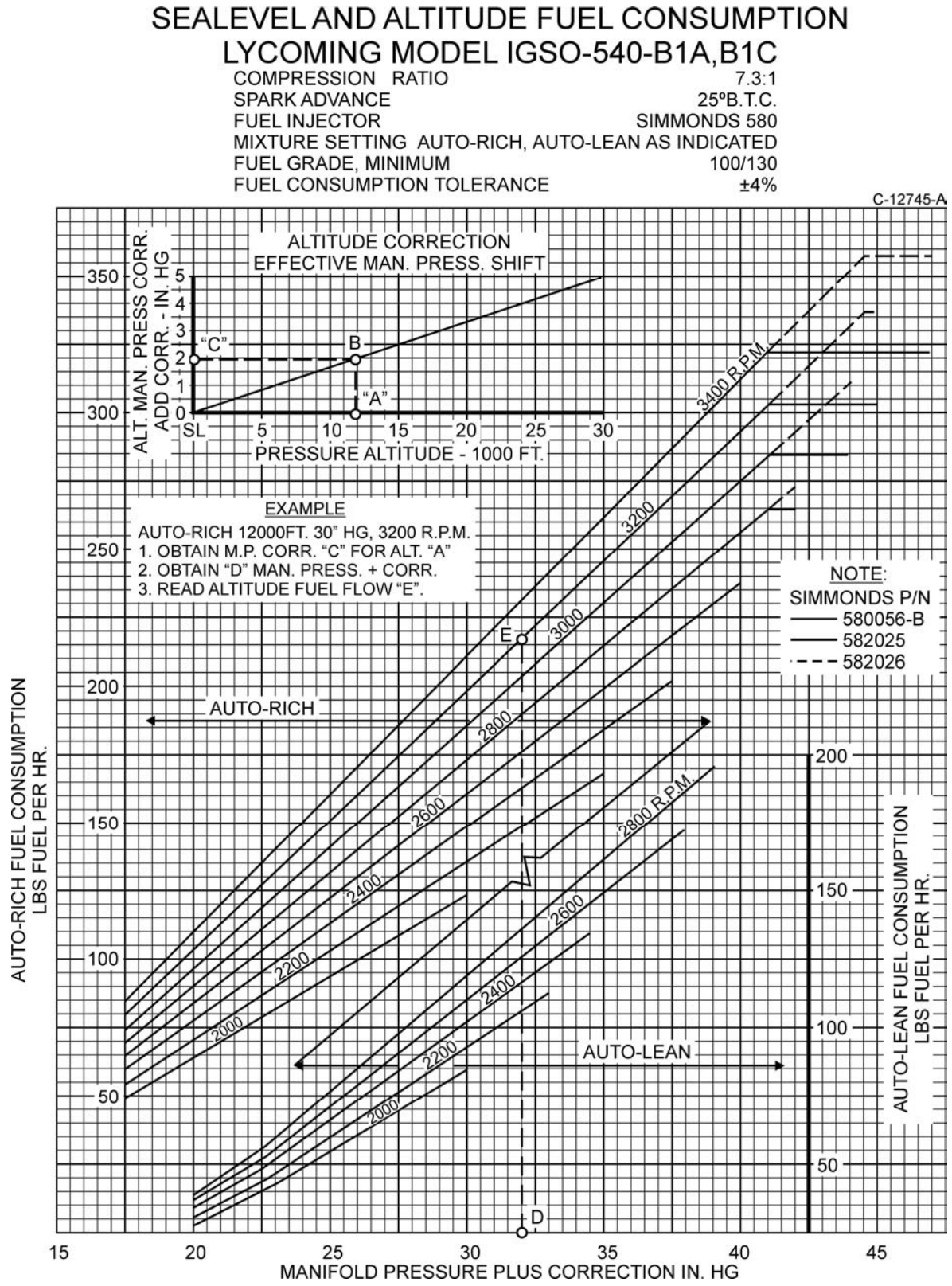

Figure 3-7. Sea Level and Altitude Fuel Consumption – IGSO-540-B Series

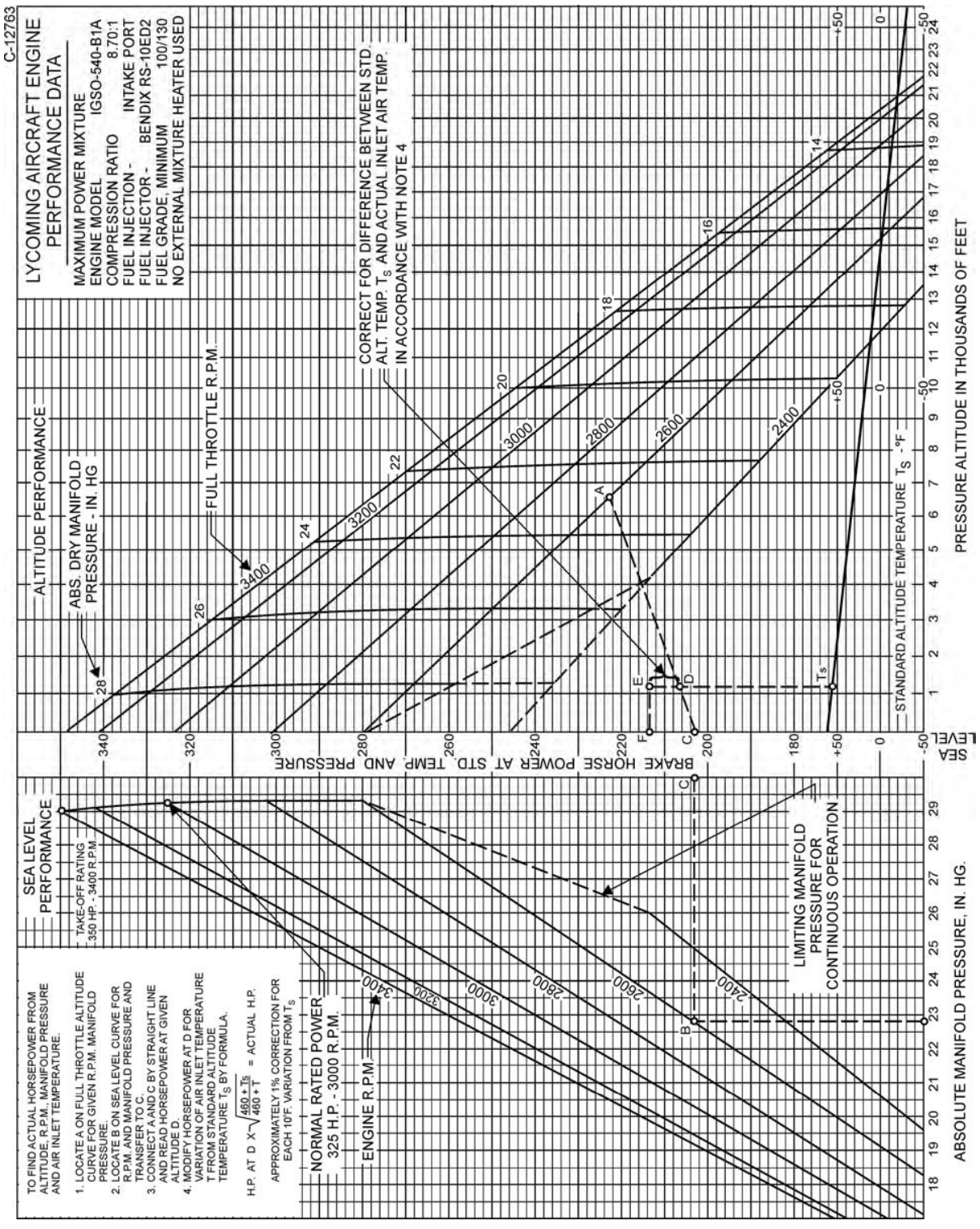

Figure 3-8. Sea Level and Altitude Performance –
IGSO-540-A, -B Series

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 air inlet temperature. This example (using 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 2600 RPM and 22.8 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 2600 RPM and 22.8 in. Hg., horsepower is 207. Point "D").

6. Correct power approximately 1% for each 10° variation in intake air temperatures from the standard altitude temperature shown below. Add correction for temperatures below standard, subtract correct for temperatures above standard. (Example: With an air inlet temperature of 25°F at an altitude of 1500 feet, 54°F - 25°F = 29° variation. 1% for each 10 variation is 2.9% of 207 horsepower is approximately 6 horsepower. Since temperature is below standard, add correction: 207 + 6 = 213 horsepower – Point "E").

STANDARD ALTITUDE TEMPERATURES IN DEGREES F

Pressure Altitude (Thousands)	SL	3	6	9	12	15	18	21	24
Standard Altitude Temperature (°F)	59	48	38	27	16	6	-5	-16	-27

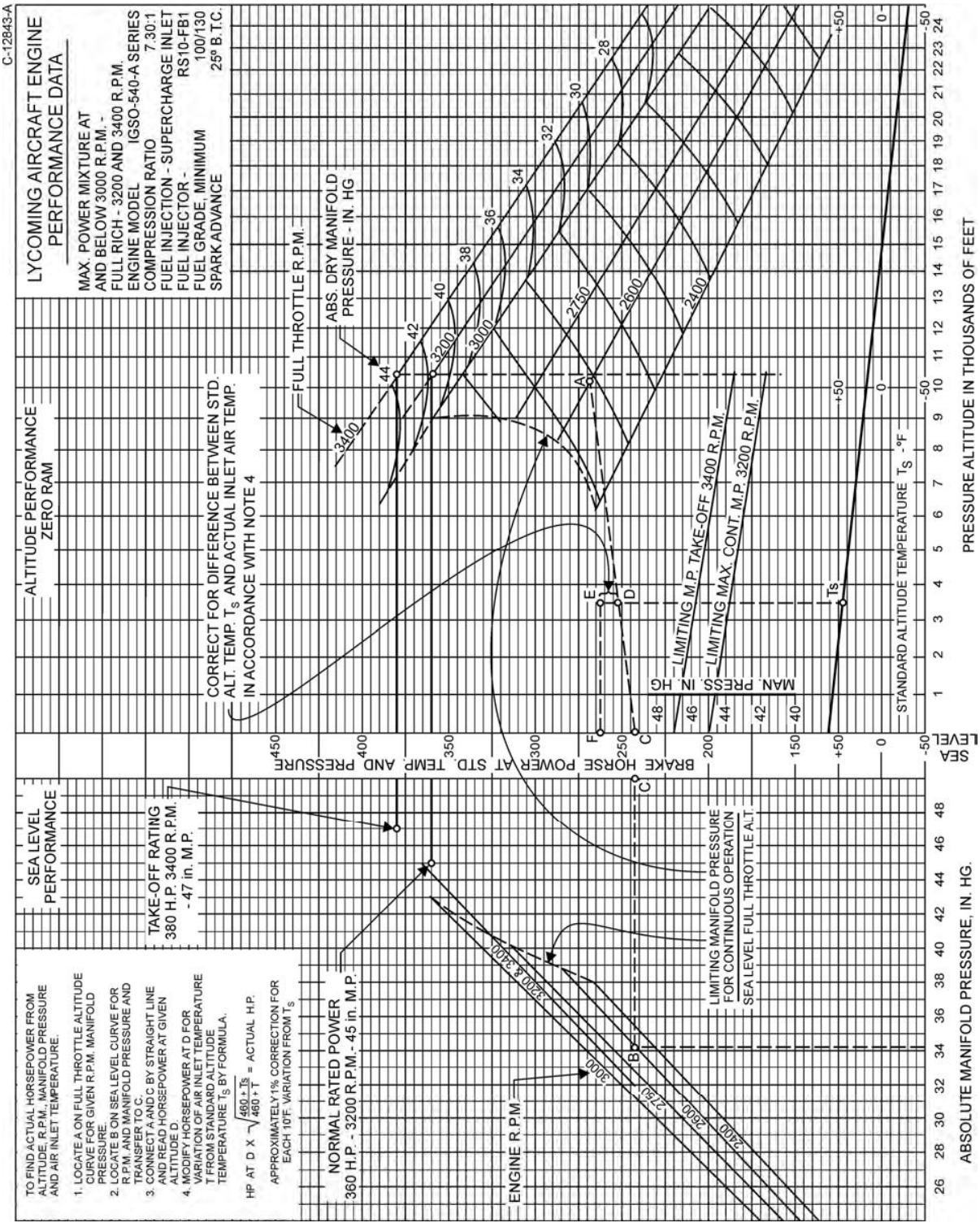

Figure 3-9. Sea Level and Altitude Performance –
IGSO-540-A Series

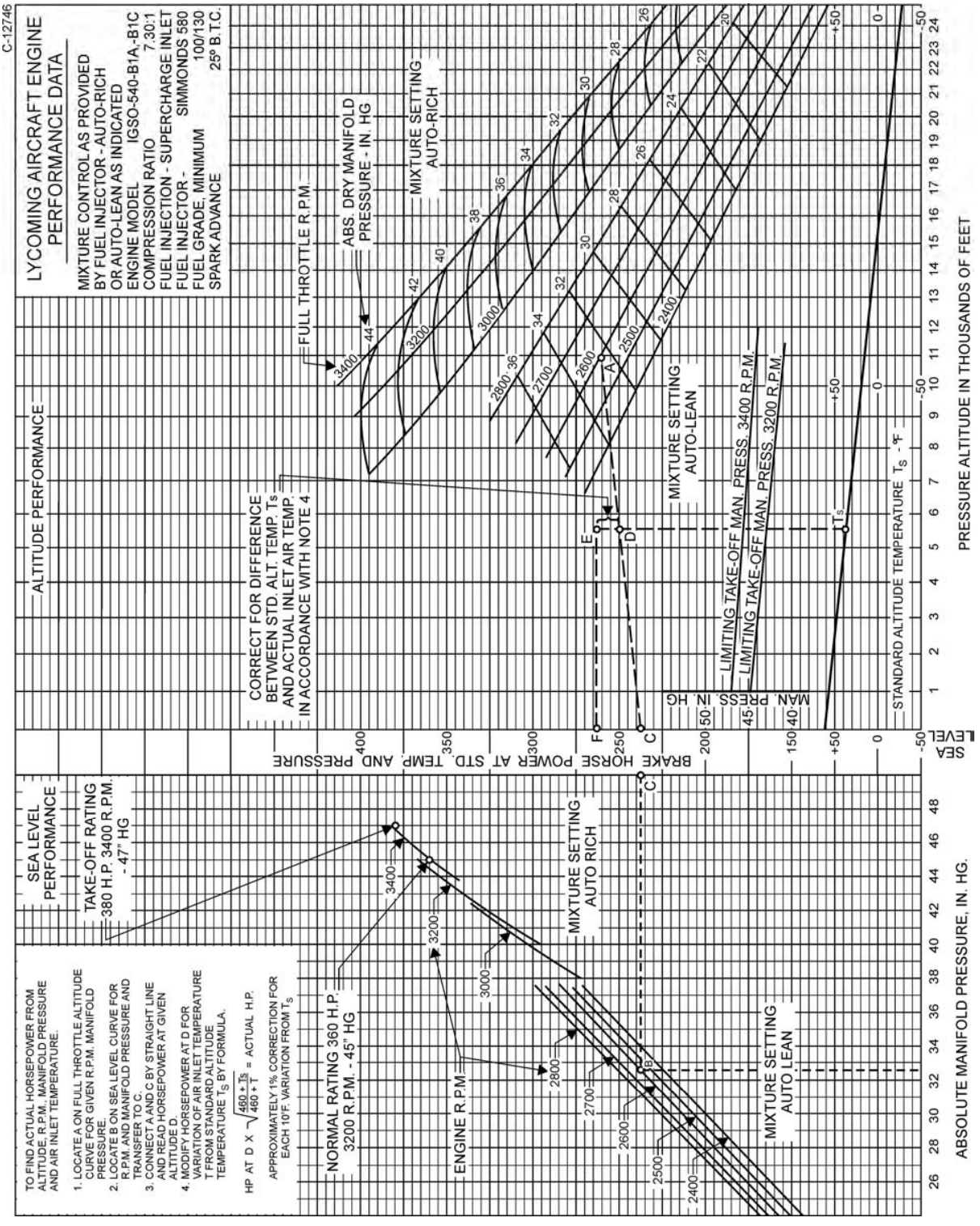

Figure 3-10. Sea Level and Altitude Performance –
IGSO-540-B Series

SECTION 4
PERIODIC INSPECTIONS

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SECTION 4

PERIODIC INSPECTION

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.

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, and mating edges of housings for indication of leaks. 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. After the first twenty-five hours operating time; new, rebuilt or newly overhauled engines should undergo a 50-hour inspection including draining and renewing lubricating oil.

3. 50-HOUR INSPECTION. 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.

(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 (where applicable) 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) Drain and renew lubricating oil on installations employing an external tank of less than 15 qt. capacity.

(3) Remove oil pump filter and clean thoroughly as described in Section 5, 3, b of this manual. Note carefully for presence of metal particles that are indicative of internal engine damage.

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 in.-lbs.).

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 or 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 is described in Section 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.

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 of Special Service Publication No. SSP-1776.

6. NON-SCHEDULED INSPECTIONS. Occasionally, Service Bulletins or Service Instructions are issued by Lycoming 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 Lycoming distributors, or from the factory by subscription. Consult the latest revision of Service Letter No. L114 for subscription information. Maintenance facilities should have an up-to-date file of these publications available at all times.

SECTION 5
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 Lycoming overhaul manual.

1. IGNITION AND ELECTRICAL SYSTEM.

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

b. Timing Magnetos to Engine – Although several combinations of magnetos are used on these series engines (see Table 1 for model application) the timing procedures, in the following paragraphs, are the same for all models.

NOTE

The retard breaker magneto is always installed on the left side of the 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 tending to push the thumb off the spark plug hole. Look into the timing window on the accessory housing and continue rotating the crankshaft until the chamfered tooth of the camshaft gear aligns with the timing pointer.

NOTE

If desired, the inspection plug on the reduction gear housing may be removed and the timing mark on the ring gear used while timing the magnetos to the engine. If the ring gear timing mark is used, however, the operator must be sure that the proper angular relationship between the mark and the No. 1 crankpin has been retained throughout parts replacement and engine build-up.

(2) At this point, the engine is ready for assembly of the magnetos. Remove the inspection plugs from both magnetos and turn the drive shafts in direction of normal rotation until the first painted mark on the distributor gear is aligned in the center of the inspection window. Being sure that the gear does not move from this position, install gaskets and magnetos on the engine. Secure with washers and nuts; tighten only finger tight.

(3) Using a battery powered timing light, attach the positive lead to a suitable terminal connected to the ground 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.

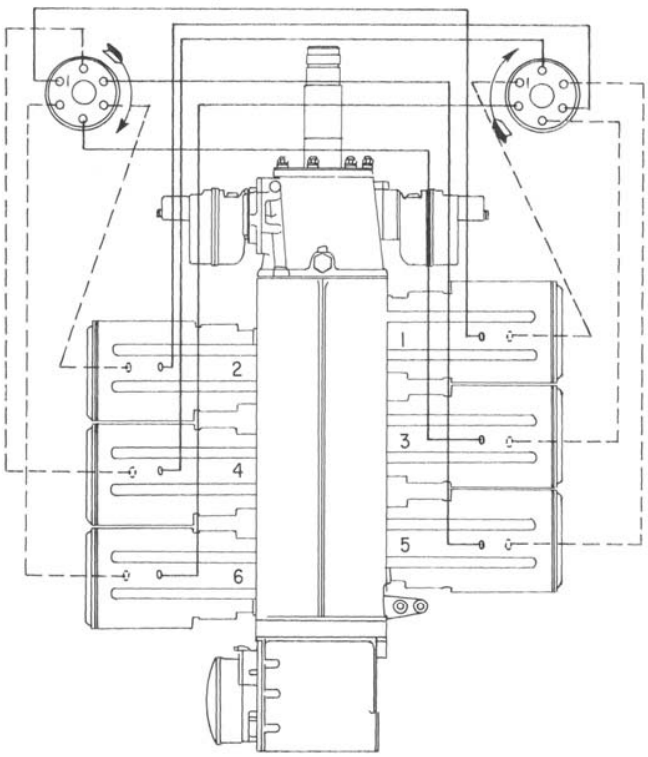

Figure 5-1. Ignition Wiring Diagram

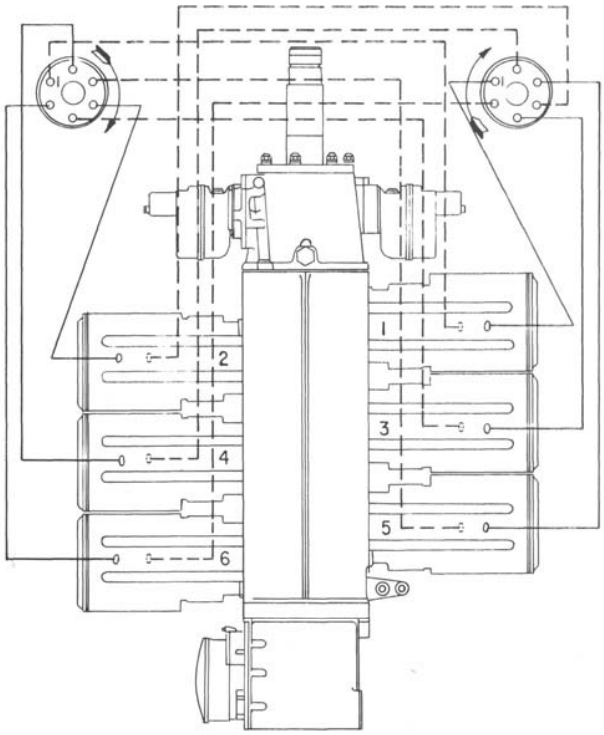

Figure 5-2. Ignition Wiring Diagram (Optional)

NOTE

AC timing lights operate in the reverse manner as described above, the light goes out when the breaker points open.

(4) After both magnetos have been timed, check, as described below, to ascertain that both magnetos are set to fire together.

(5) Back off crankshaft a few degrees, the timing lights should go out. Bring the crankshaft slowly back in direction of normal rotation until the chamfered tooth on the camshaft and the pointer are in alignment. At this point, both lights should go on simultaneously. Tighten nuts to specified torque.

c. 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 or leaking, only a fuel soluble lubricant, such as clean engine oil or Loctite hydraulic sealant may be used on the tapered pipe threads. Do not use any other form of thread compound.

b. 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.

c. Fuel Grades and Limitations –

All Models..... 100/130 octane, minimum

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 the latest revision of Service Instruction No. 1070 regarding specified fuel for 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 – Bendix.

(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 level 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.

f. Adjustment to Regulate Fuel Flow (Simmonds) – Consult the latest revision of Lycoming Service Instruction No. 1069 for procedures for fuel injector adjustment in the event fuel flow is found to be out of limits.

3. LUBRICATION SYSTEM.

a. Oil Grades and Limitations – Service the engine in accordance with the following recommendations. See Section 3, step 8.

b. Oil Filter – Clean the engine oil filter as follows: Under normal conditions, washing the filter assembly with Varsol and compressed air will be sufficient. If the filter is heavily carboned, it may be dipped in a decarbonizing solution (usually heated). A great many decarbonizing agents are available, including such products as Gunk, Penetrol and many others. The loosened carbon can be washed away with Varsol and compressed air. The filter may also be cleaned by boiling in water and a commercial detergent for a period of ten minutes, rinsed and dried with compressed air.

c. Oil Pressure Relief Valve – These engines are equipped with an adjustable oil pressure relief valve enabling oil pressure to be maintained within specified limits. If the pressure under normal operating conditions should consistently be out of limits, adjust the valve as follows: With the engine thoroughly warmed up and running at a maximum of 2200 RPM, observe the reading on the oil pressure gauge. Stop the engine, remove the crown nut, loosen the locknut and turn the adjusting screw in the direction required for correction. Screw in to increase pressure, out to decrease pressure. When the valve has been satisfactorily adjusted, tighten the locknut, install the crown nut and lockwire.

d. Pre-Oiling Procedure – Following installation or a prolonged period of idleness proceed as follows:

(1) Fill the oil tank to proper level.

(2) Disconnect the oil inlet connection at the oil pump and drain a sufficient amount of oil to eliminate any possible obstruction or air in the inlet passage.

(3) Reinstall oil inlet connection.

(4) Remove one spark plug from each cylinder.

(5) Put fuel and ignition switches in "off" position.

(6) Turn engine with starter until a minimum pressure of 20 lbs. is indicated on the gauge.

(7) Allow starter to cool and again engage starter for several ½ minute periods. Allow starter to cool after each engagement.

NOTE

Lack of pressure build-up or rapid drop-off of pressure is an indication of air in the line. To remedy this, repeat steps (2) and (3) and continue until pressure is indicated.

(8) Reinstall spark plugs.

NOTE

These steps are necessary in all dry sump engines to avert possible high speed bearing failure during initial starts.

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 when the cylinder is removed from the engine. Remove rotator cap from exhaust valve.

(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 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 hand push 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.

(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 thru-stud threads with any one of the following lubricants, or combination 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:

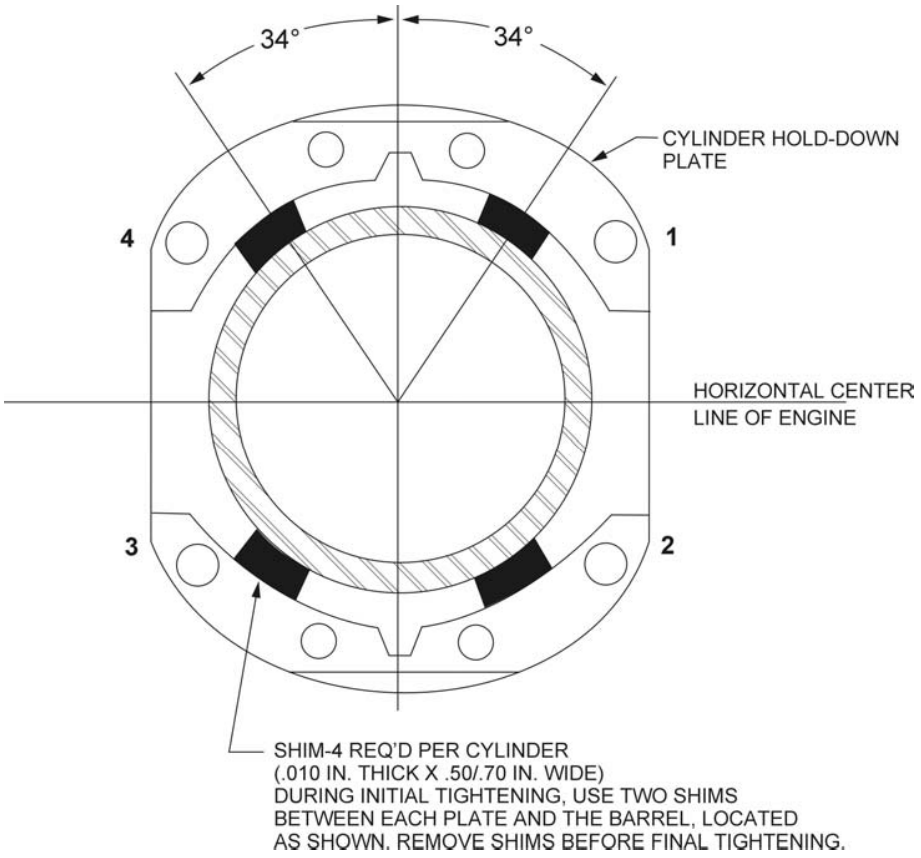

Figure 5-3. Location of Shims Between Cylinder Barrel and Hold-Down Plates (Where Applicable) and Sequence of Tightening Cylinder Base Hold-Down Nuts

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 5-3, and tighten ½ inch hold-down nuts to 300 in.-lbs. (25 ft.-lbs.) torque, using the sequence shown in Figure 5-3.

(b) Remove shims, and using the same sequence, tighten the ½ inch cylinder base nuts to 600 in.-lbs. (50 ft.-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 in.-lbs. (25 ft.-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 rod, as required to correct clearance.

NOTE

Inserting a longer push rod will decrease the valve clearance.

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

SECTION 6
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.

TROUBLE	PROBABLE CAUSE	REMEDY
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.
	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.	Drain fuel injector and fuel lines.
	Internal failure.	Check oil screens for metal particles. If found, complete overhaul of the engine may be indicated.

TROUBLE	PROBABLE CAUSE	REMEDY
Failure of Engine to Idle Properly	Incorrect idle mixture.	Adjust mixture (Bendix). Replace pump (Simmonds).
	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.
	Dirt in injector nozzle (single point injection).	Run engine at full power to clear nozzle. Clean or replace if running at full power is not effective.
	Low oil pressure to injector pump (Simmonds).	Be certain oil pressure is at minimum of 35 psi.
	Sticking Z shaft (Simmonds).	Replace injector pump.
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 by authorized personnel is indicated.
	Mixture too lean; indicated by overheating or backfiring.	Check fuel lines for dirt or other restrictions. Readjustment of fuel injector 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.

TROUBLE	PROBABLE CAUSE	REMEDY
Low Power and Uneven Running (Cont.)	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.
	Leaking nozzle (single point injection).	Replace nozzle.
	Dirt in injector nozzle (single point injection).	Run engine at full power. Clean or replace nozzle if not cleared at full power.
	Low oil pressure to injector (Simmonds).	Be certain oil pressure is at a minimum of 35 psi.
	Improper magneto to engine timing.	Retime magnetos to engine.
Failure of Engine to Develop Full Power	Leak in induction system.	Tighten all connections and replace defective parts.
	Throttle lever out of adjustment.	Adjust throttle lever.
	Improper fuel flow.	Check strainer, gauge and flow at the fuel inlet.
	Restriction in air scoop.	Examine air scoop and remove restrictions.
	Improper fuel.	Drain and refill tank with recommended fuel.
	Faulty ignition.	Tighten all connections. Check system with tester. Check ignition timing.
	Sticking Z shaft (Simmonds).	Replace injection pump.
Rough Engine	Cracked engine mount.	Replace or repair mount.
	Defective mounting bushings.	Install new mounting bushings.
	Uneven compression.	Check compression.

TROUBLE	PROBABLE CAUSE	REMEDY
Low Oil Pressure	Insufficient oil.	Fill 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 gauge.	Replace gauge.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.
	Oil relief valve out of limits.	Adjust oil relief valve.
High Oil Temperature	Insufficient air cooling.	Check air inlet and outlet for deformation or obstructions.
	Insufficient oil supply.	Fill to proper level with specified oil.
	Low grade of oil.	Replace with oil conforming to specifications.
	Clogged oil lines or strainers.	Remove and clean.
	Excessive blow by.	Usually caused by worn or stuck rings.
	Failing or failed bearings.	Examine sump for metal particles. If found, overhaul of engine is indicated.
	Defective temperature gauge.	Replace gauge.
Excessive Oil Consumption	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.

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive Oil Consumption (Cont.)	Incorrect installation of piston rings.	Install new rings.
	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.
Engine Does Not Stop	Fuel leakage at primer (where applicable).	Check primer system.
	Idle cut-off malfunctioning.	Correct linkage.
	Faulty ignition switch.	Replace switch.

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SECTION 7
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 desiccant and preservative oil from the engine. Preservative 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 and safety-wired. Fill the external tank 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 HYDRAULICING, 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 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 FUEL INJECTORS FOR INSTALLATION.

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

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.

Fuel Injector (Simmonds) – Inject clean fuel into the fuel inlet connection with the fuel outlet uncapped until clean fuel flows from the outlet.

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 two (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 (2) ounces of corrosion preventive oil. Assemble spark plugs and do not turn crankshaft after cylinders have been sprayed.

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 Lycoming aircraft engines for corrosion prevention only, and not for lubrication. See the latest revision of Lycoming Service Instruction No. 1014 and Service Bulletin No. 318 for recommended lubricating oil.

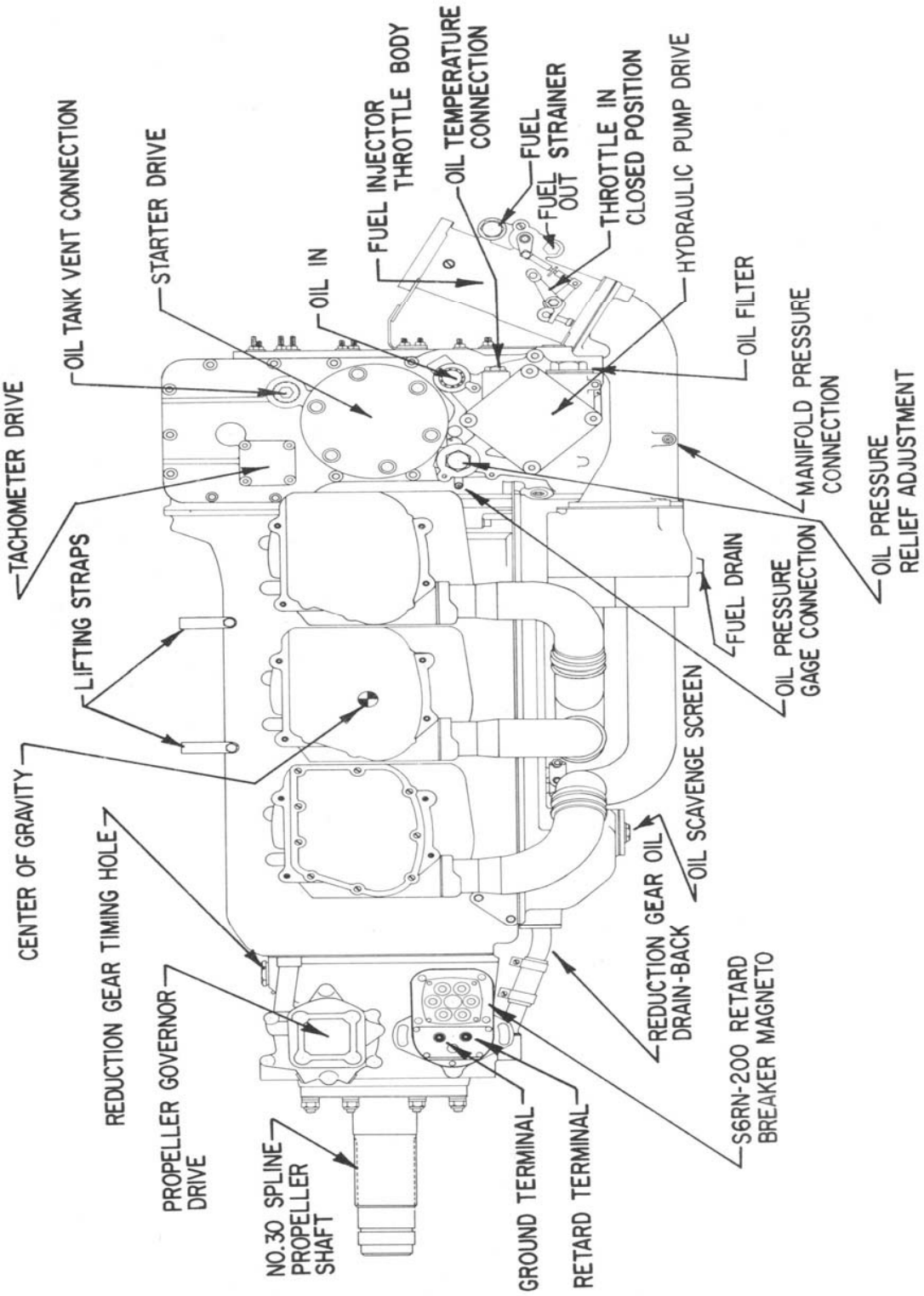

Figure 7-1. Installation Drawing – Typical IGO-540 Series – Left Side View

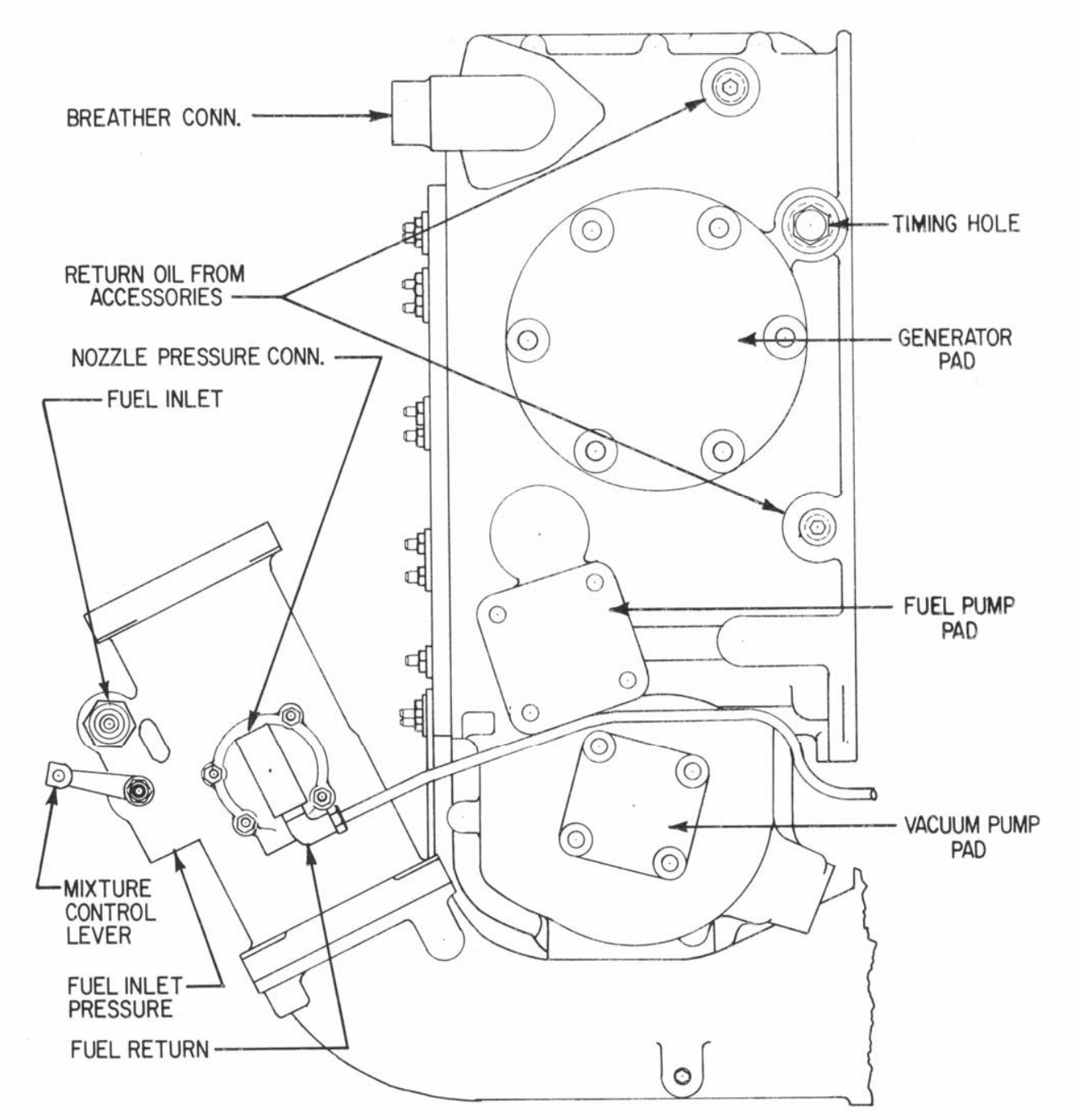

Figure 7-2. Installation Drawing – Typical IGO-540 Series – Right Side View

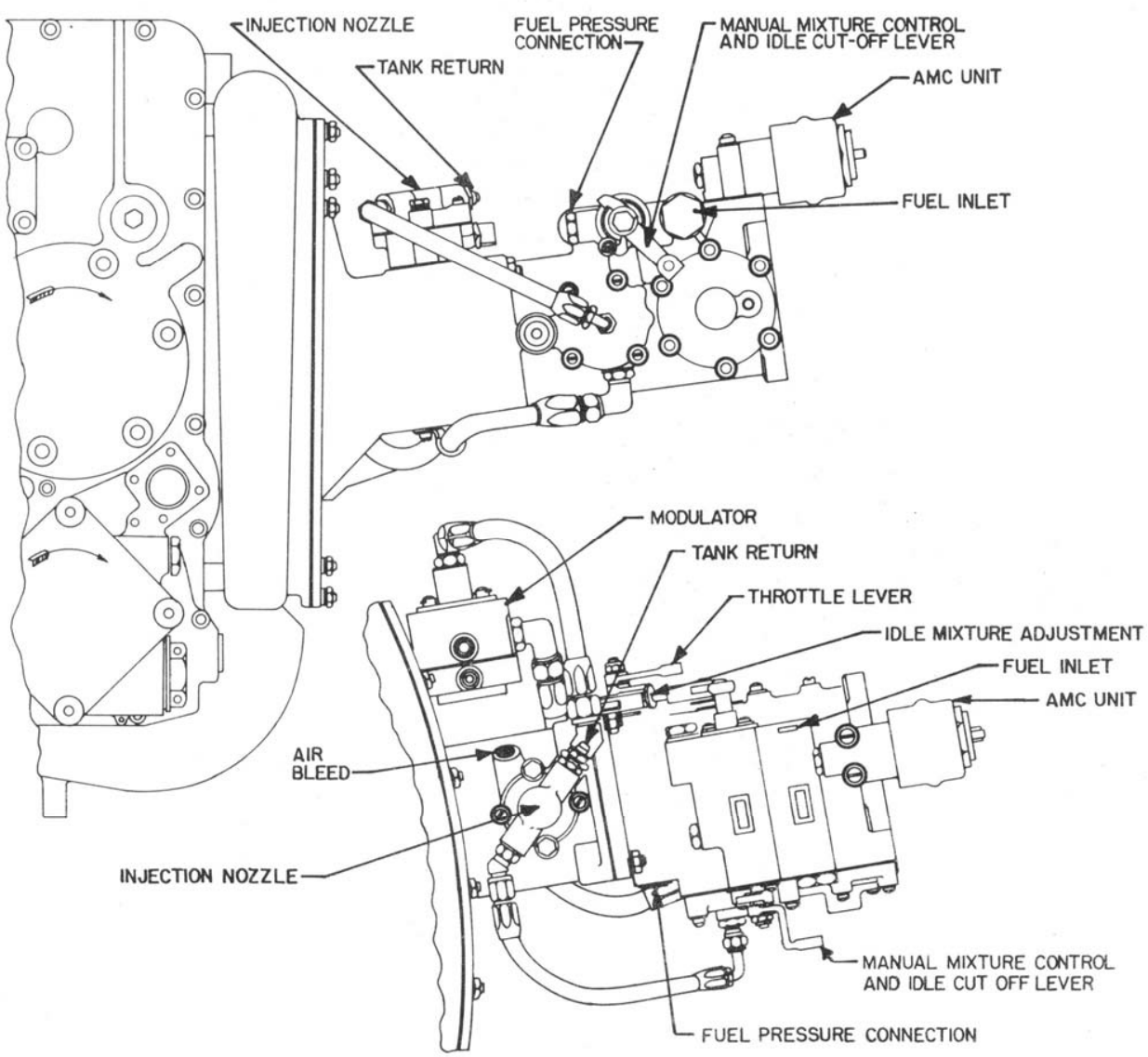

Figure 7-3. Installation Drawing – IGSO-540-A1C, -A1E Fuel Injector – Top and Left Side View

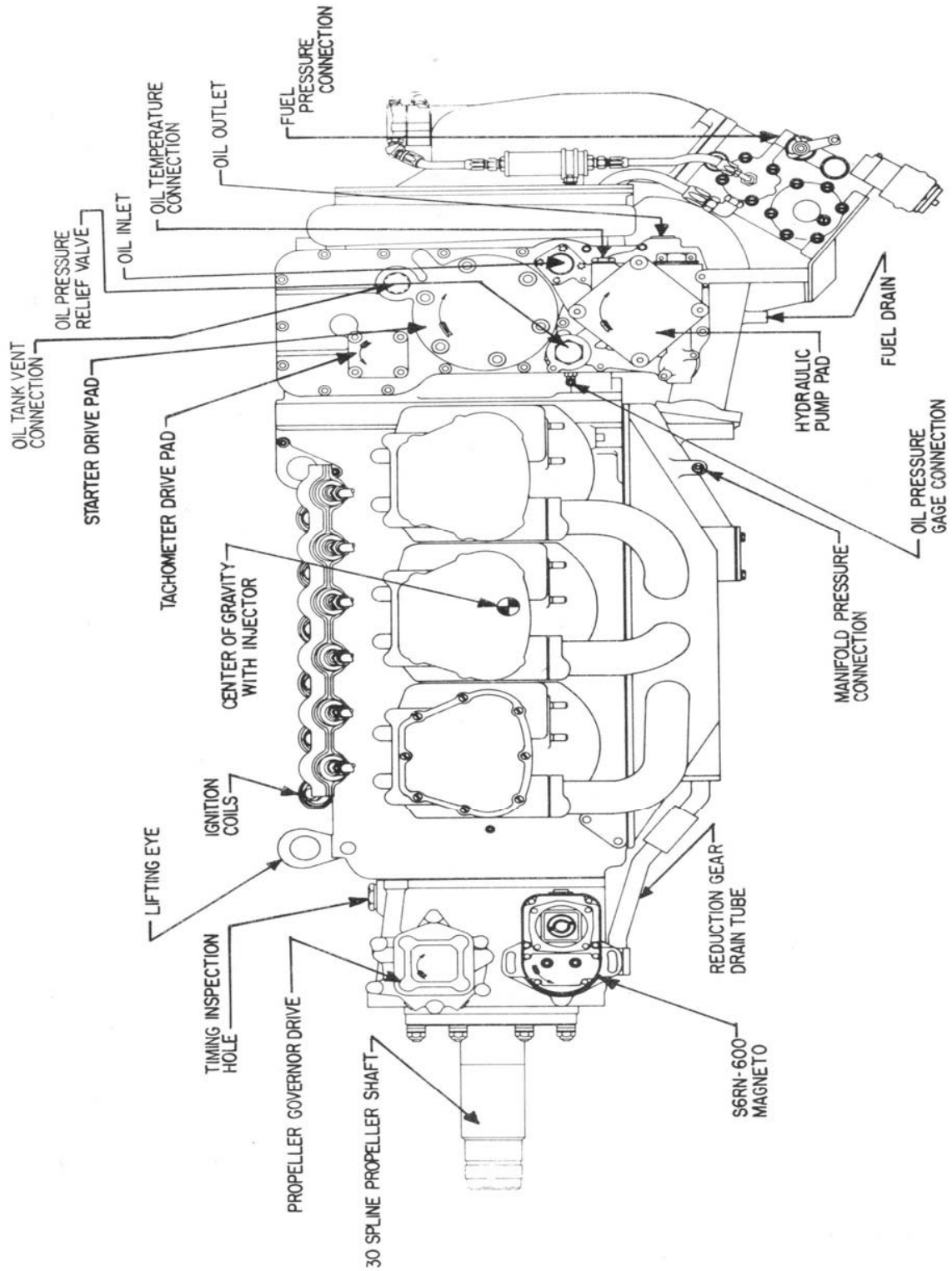

Figure 7-4. Installation Drawing – IGSO-540-A Series –
Left Side View

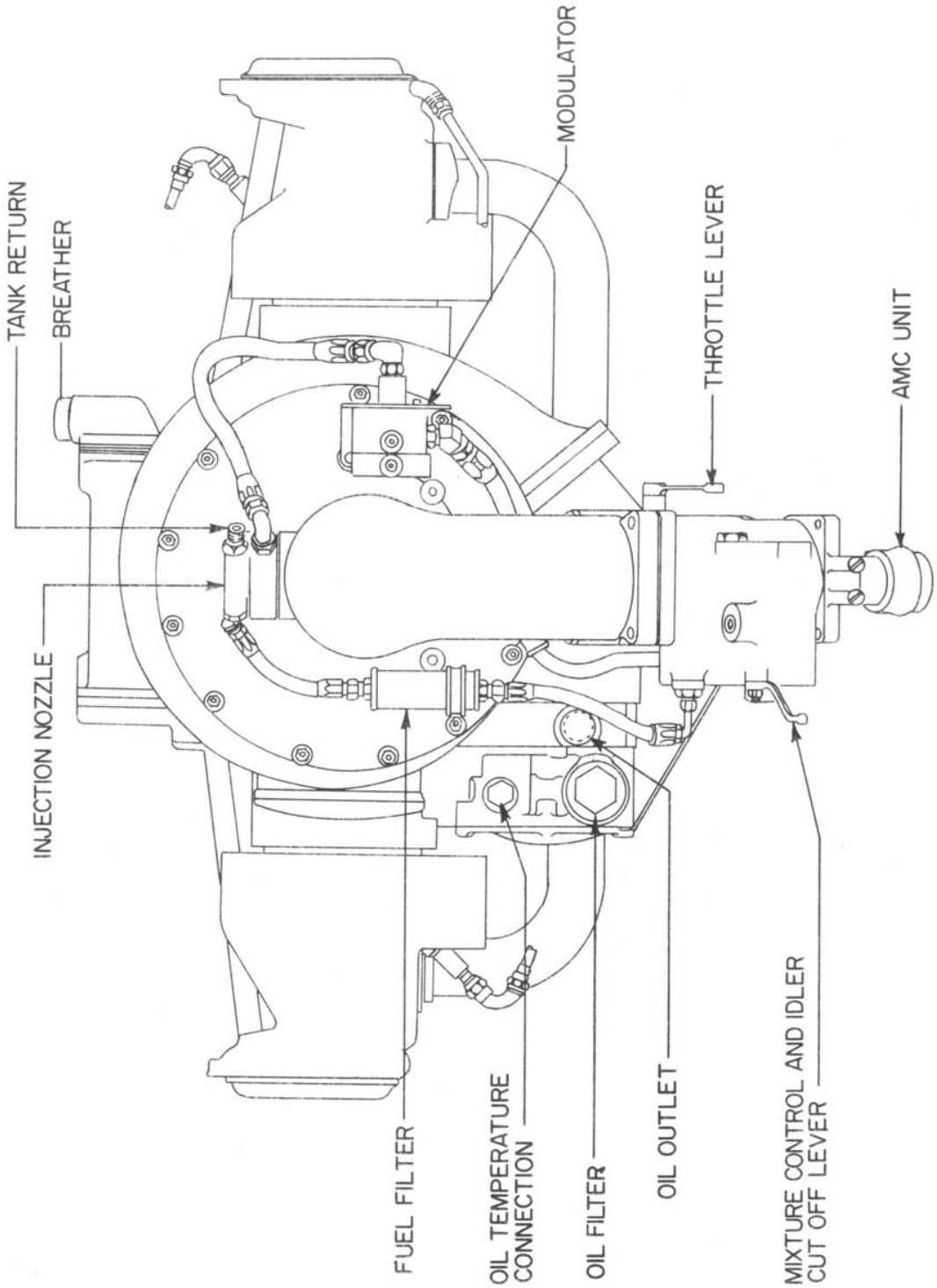

Figure 7-5. Installation Drawing – Typical IGSO-540-A Series – Rear View

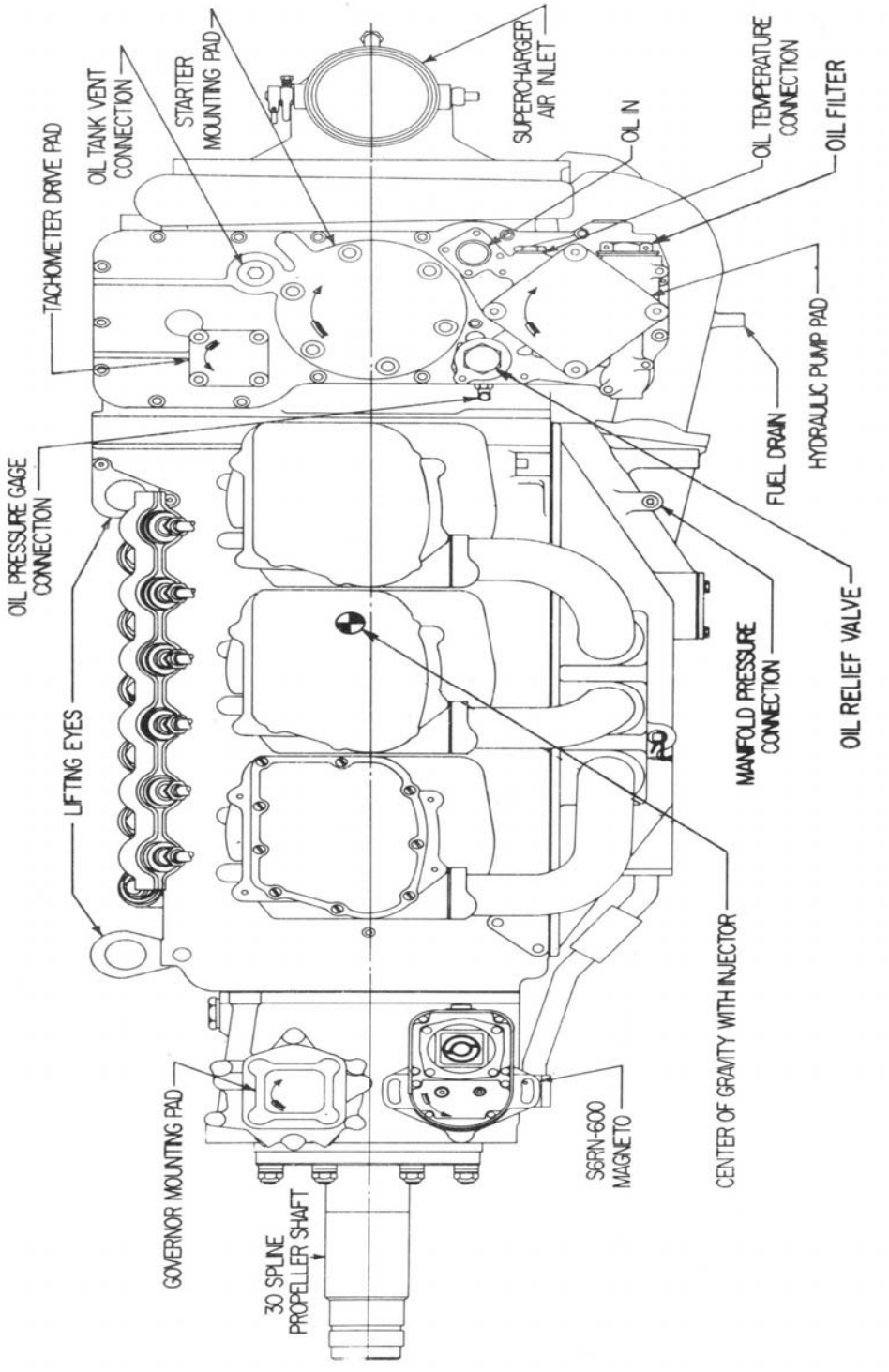

Figure 7-6. Installation Drawing – Typical IGSO-540-B Series – Left Side View

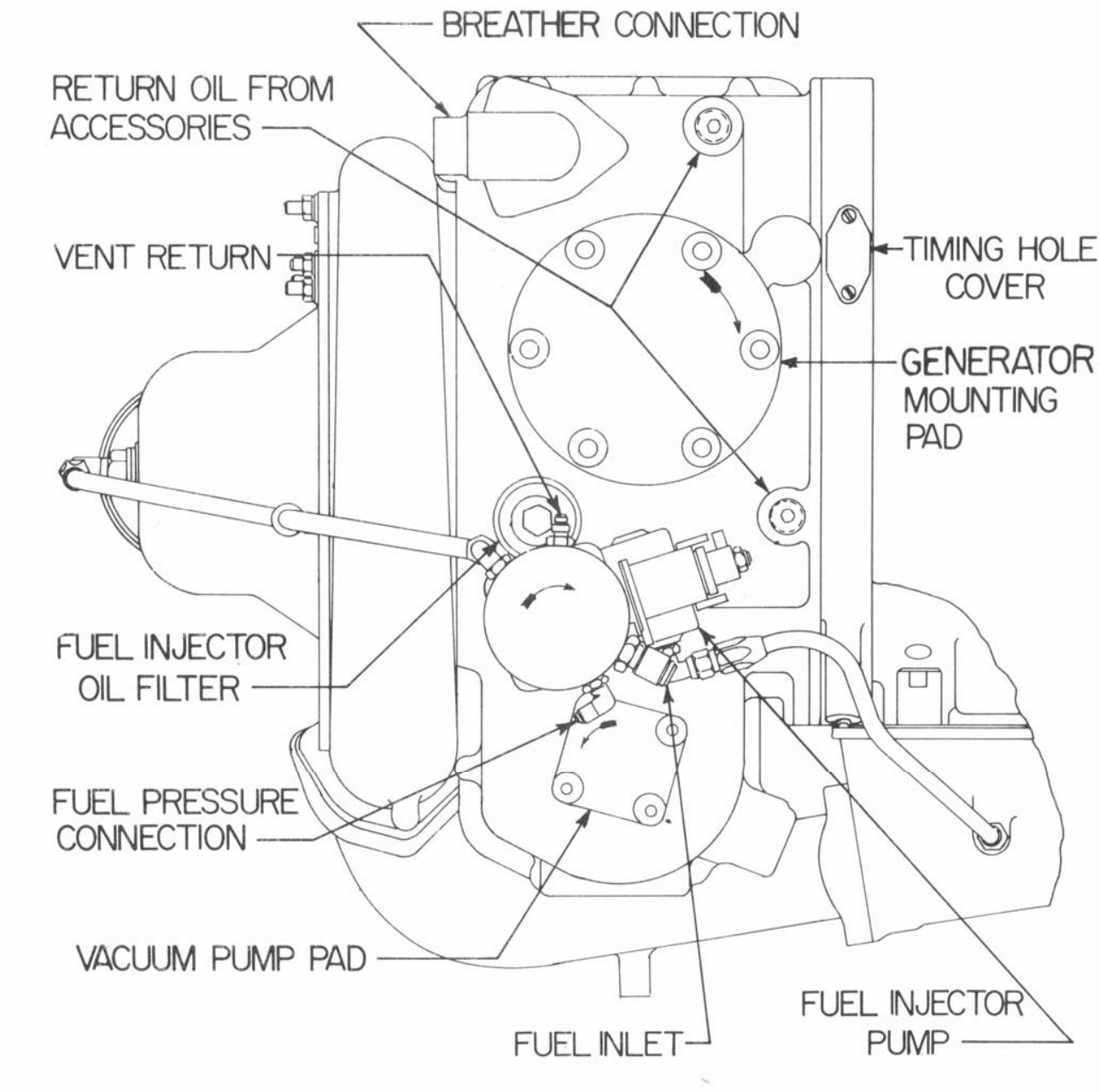

Figure 7-7. Installation Drawing – Typical IGO-540-B Series – Right Rear View

SECTION 8
TABLES

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SECTION 8

TABLES

FOR TIGHTENING TORQUE RECOMMENDATIONS AND INFORMATION CONCERNING TOLERANCES AND DIMENSIONS THAT MUST BE MAINTAINED IN LYCOMING AIRCRAFT ENGINES, CONSULT LATEST REVISION OF SPECIAL SERVICE PUBLICATION NO. SSP-1776.

CONSULT LATEST REVISION 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 the 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

			Temperature				Pressure				Temperature			Fuel Flow	
Time	RPM	MAP	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

Power Check

Idle Check

Adjustment Required

After Completion of Ground Run

1. Visually inspect engine(s)
2. Check oil levels

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

			Temperature				Pressure				Temperature			Fuel Flow	
Time	RPM	MAP	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															

Adjustment 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.

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.

C	F-C	F	C	F-C	F
-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
-28.9	-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
37.78	100	212.0	198.89	390	734.0
43.33	110	230.0	204.44	400	752.0
48.89	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	237.78	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

FULL THROTTLE HP AT ALTITUDE
(Normally Aspired 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

INCH FRACTION 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	.4986	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