Operator's Manual

Lycoming

TIO-541 Series

Approved by FAA

3rd Edition Part No. 60297-13

LYCOMING

652 Oliver Street
Williamsport, PA. 17701 U.S.A.
570/323-6181

December 2007

TIO-541 Series Operator's Manual
Lycoming Part Number: 60297-13

For additional information:

Mailing address:

Lycoming Engines
652 Oliver Street
Williamsport, PA 17701 U.S.A.

Phone:

Factory: 570-323-6181
Sales Department: 570-327-7268
Fax: 570-327-7101

Lycoming's regular business hours are Monday through Friday from 8:00 AM through 5:00 PM Eastern Time (-5 GMT)

Visit us on the **World Wide Web** at:
http://www.lycoming.com

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 for all Lycoming distributors or, from the factory by subscription. Consult the latest revision 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.

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 sue 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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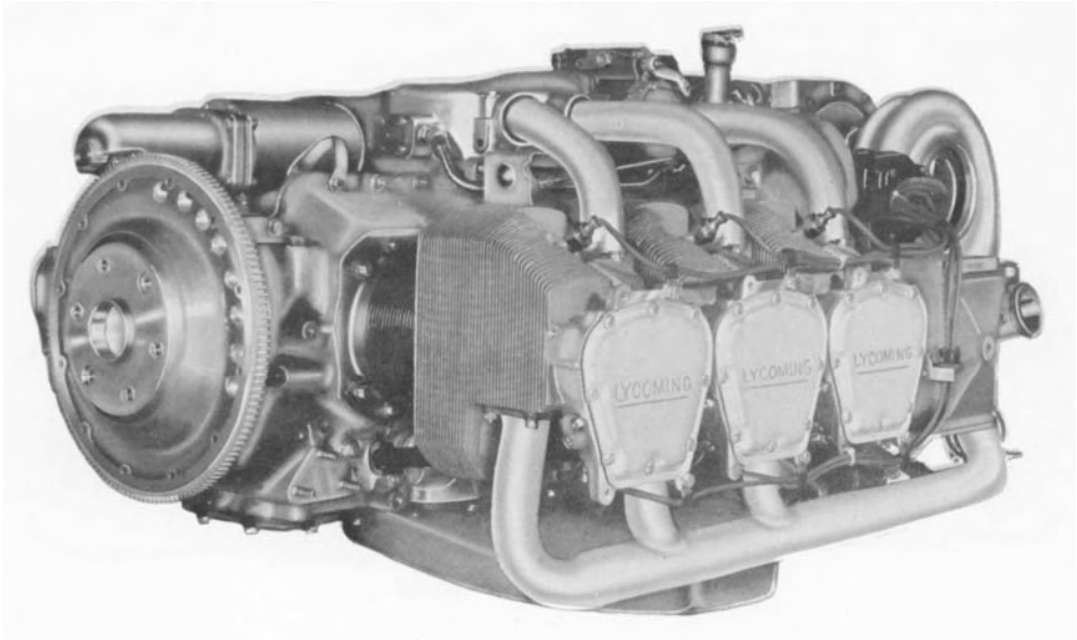
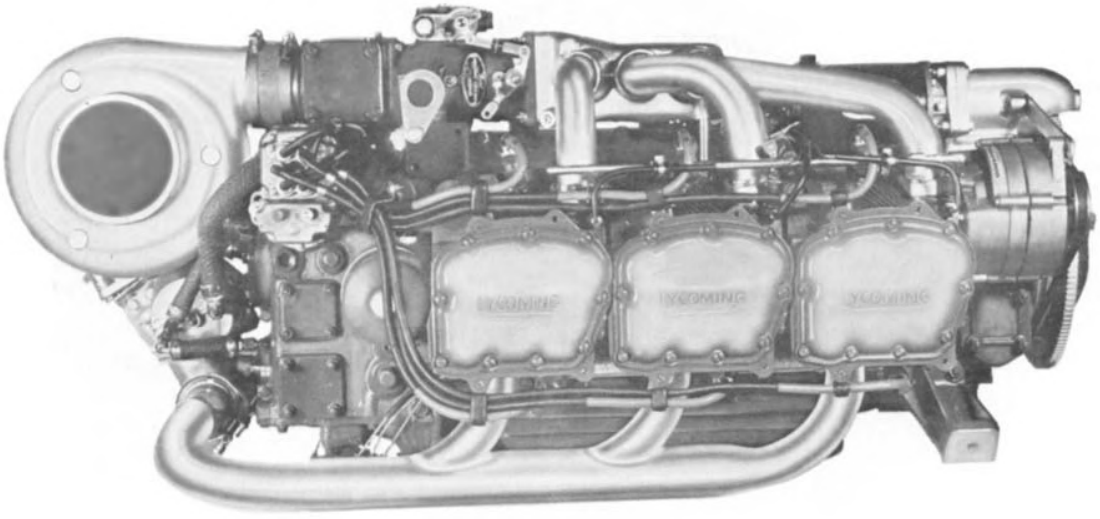
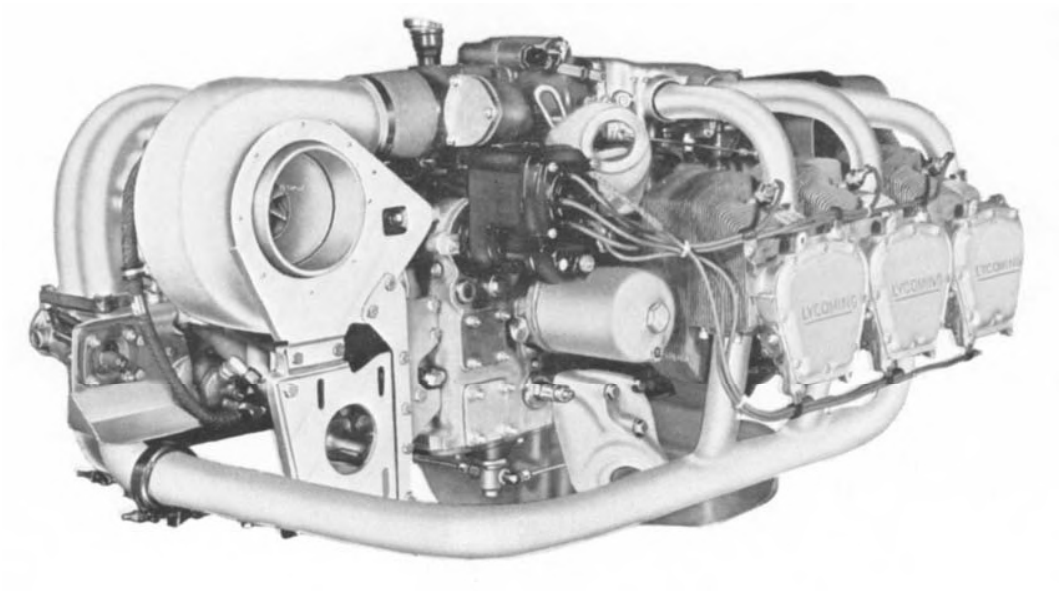


¾ Left Front View – TIO-541-E1B4



Right Side View – TIO-541-A1A



¾ Right Rear View – TIO-541-E1B4

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, ROLLERS AND BUSHINGS.

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SECTION 1
DESCRIPTION

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SECTION 1

DESCRIPTION

General – The Lycoming TIO-541 aircraft engine is a six cylinder, direct drive, horizontally opposed, wet sump, fuel injected, turbocharged, air-cooled model with side mounted accessories and incorporating piston cooling oil jets in the crankcase.

In referring to the location of the various engine components, the parts will be described in their relationship to the engine as installed in the airframe. Thus the power take-off section will be considered the front and the sump section will be considered the bottom. References to the left and right sides of the engine are made with the observer facing the rear of the engine. Thus the front cylinder on the left bank is number 1 and the rear cylinder number 5. The front cylinder on the right bank is number 2 and the rear cylinder is number 6. The direction of rotation for the accessory drives is determined by the observer when facing the accessory mounting pad.

Cylinders – The cylinders are of air-cooled construction with the two major parts, head and barrel, screwed and shrunk together. The heads are made from an aluminum casting with a fully machined combustion chamber. The cylinder barrels are machined from chrome nickel molybdenum steel forgings with deep integral cooling fins. The interior of the barrel is nitrided; requiring the use of chrome plated piston rings.

Rocker shaft bearing supports and the rocker box housings are cast integrally with the cylinder head. The intake and exhaust valves are angled. The intake port is on the top and the exhaust port on the bottom of the cylinder. Long reach spark plugs are employed.

Valve Operating Mechanism – The camshaft is located parallel to and below the crankshaft and operates in aluminum bearings. The camshaft actuates the valves by means of hydraulic lifters, which automatically keep the valve clearance at zero. The valve rockers are supported on full floating steel shafts. The valve springs bear against hardened steel seats.

Crankshaft – The crankshaft is made from a chrome nickel molybdenum steel forging. All bearing journal surfaces are nitrided. The crankshaft is fitted with pendulum type dynamic counterweights.

Crankcase – The crankcase consists of two reinforced aluminum alloy castings divided vertically at the center line of the engine and fastened together by means of thru bolts and nuts. The mating surfaces of the crankcase are joined without the use of a gasket, and the main bearing bores are machined for use of precision type main bearing inserts.

Oil Sump – The oil sump fastens to the bottom of the crankcase. It incorporates two oil drain plugs, the oil suction screen housing, and a boss for mounting the fuel drain manifold assembly.

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 of the rods are retained by means of two bolts and nuts through each cap.

Pistons – The pistons are machined from an aluminum alloy. Two compression rings and an oil regulating ring are located above the piston pin. The pistons are equipped with full floating type pins with a plug located at each end of the pin.

Gears – The gears are of conventional type and are precision machined. They are hardened to insure long life and satisfactory operating qualities.

Cooling System – The air pressure cooling system is actuated by the forward speed of the aircraft. Baffles are provided to build up a pressure between the cowling and the cylinders, thus forcing the air through the cylinder fins. The air is then exhausted through gills usually located at the rear of the engine cowling.

Lubrication System – The lubrication system is of the pressure wet sump type.

Induction System – This engine employs a Bendix RSA type fuel injection system.

The fuel injection system is based on the principle of measuring air flow and uses 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, makes fuel flow proportional to air flow. A manual mixture control and idle cut-off are provided.

Turbocharger System – The turbocharger system is mounted as an integral part of the engine. Its turbine utilizes the engine exhaust gases to drive a compressor, which furnishes air to the engine induction system and air for pressurized cabins.

The variable pressure controller senses the compressor discharge pressure (deck pressure) and in turn regulates the oil pressure, which controls the position of the exhaust bypass valve located on the engine exhaust. The desired compressor discharge pressure is determined by positioning the throttle control, which is linked to the controller cam. Engine oil pressure is utilized as the "muscle" for this control system.

The variable pressure controller employed on the "A" series has two settings, the maximum boost setting and the minimum boost setting. The maximum setting is 37 in. hg. ± 0.5, the minimum setting is 24 – 26 in. hg.

The action of the turbocharger control system is automatic and modulates continuously as engine power, speed and altitude are varied. Bleed air to the cabin, on models –A1A, -E1A4 and –E1C4, is controlled by a sonic nozzle that limits the flow of air to the cabin.

Ignition System – Dual ignition is furnished by two Scintilla –1200 series magnetos. The S6LN-1208 magneto is a retard breaker magneto providing a fixed retard and a long duration spark for easier starting. The S6RN-1209 is a conventional magneto, which is grounded out at the time the engine is started. A source of DC power and a starting vibrator are required to complete the installation. The –1200 series magnetos incorporate an integral feed-thru capacitor and require no external noise filter in the ground leads.

Propeller Governor Drive – A propeller governor drive is furnished as standard equipment. The propeller governor mounting pad is located on the lower right front side of the crankcase.

Accessory Drives – The following accessory drives are furnished as standard equipment: starter, alternator, propeller governor, vacuum pump, hydraulic pump, tachometer and fuel pump. The "E" series incorporates a Freon compressor drive that may be used for air conditioning.

SECTION 2
SPECIFICATIONS

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SECTION 2

SPECIFICATIONS

NOTE

The model specifications shown on the following pages of this section are divided according to model designation. When differences among models can be clearly stated, the specifications of more than one model are combined in a single group; otherwise, each model has its specifications listed separately. Also, as additional models are added to this series, new specification pages containing data pertinent to the new models will be added.

SPECIFICATIONS

TIO-541-E SERIES

FAA Type Certificate E10EA
Rated horsepower, RPM, Alt. ..... 380 @ 2900/15,000 ft.
Performance Cruise horsepower, RPM, Alt. ..... 300 @ 2750/21,000 ft.
Economy Cruise, horsepower, RPM ..... 247 @ 2650
Bore, inches 5.125
Stroke, inches 4.375
Displacement, cubic inches 541.5
Compression ratio 7.3:1
Fuel Injector, Bendix type RSA-10DB1
Magnetos, (1) Scintilla (right) S6RN-1209
Magnetos, (1) Scintilla (left) S6LN-1208
Firing order 1-4-5-2-3-6
Spark occurs, degrees BTC 20
Valve rocker clearance (hydraulic liters collapsed) ..... .040-.105
Dimensions:
  Height, inches 25.17
  Width, inches 35.66
  Length, inches 52.07

Accessory Drive	Drive Ratio	*Direction of Rotation
Starter	16.556:1	Counterclockwise
Alternator	3.250:1	Clockwise
Optional Generator Drive	1.910:1	Clockwise
Optional Generator Drive	2.500:1	Clockwise
Vacuum Pump	1.000:1	Clockwise
Hydraulic Pump	1.000:1	Counterclockwise
Tachometer	0.500:1	Counterclockwise
Propeller Governor	0.895:1	Counterclockwise
Fuel Pump	1.000:1	Counterclockwise

* - Facing drive pad.

SPECIFICATIONS (CONT.)

TIO-541-A SERIES

FAA Type Certificate E10EA
Rated horsepower, RPM, Alt. ..... 310 @ 2575/15,000 ft.
Performance Cruise (75% rated horsepower), Alt. ..... 230/25,000 ft.
Economy Cruise (65% rated horsepower) 185
Bore, inches 5.125
Stroke, inches 4.375
Displacement, cubic inches 541.5
Compression ratio 7.3:1
Fuel Injector, Bendix type RSA-10AD1
Magnetos, (1) Scintilla (right) S6RN-1209
Magnetos, (1) Scintilla (left) S6LN-1208
Firing order 1-4-5-2-3-6
Spark occurs, degrees BTC 20
Valve rocker clearance (hydraulic lifters collapsed) ..... .040-.105
Dimensions:
  Height, inches 21.38
  Width, inches 34.25
  Length, inches 49.09

Accessory Drive	Drive Ratio	*Direction of Rotation
Starter	16.556:1	Counterclockwise
Alternator	3.250:1	Clockwise
Optional Generator Drive	1.910:1	Clockwise
Optional Generator Drive	2.500:1	Clockwise
Vacuum Pump	1.500:1	Clockwise
Hydraulic Pump	1.500:1	Counterclockwise
Tachometer	0.500:1	Counterclockwise
Propeller Governor	0.895:1	Counterclockwise
Fuel Pump	1.000:1	Counterclockwise

* - Facing drive pad.

DETAIL WEIGHTS

TIO-541-A SERIES

1. ENGINE (STANDARD)

Basic engine	421.32
Turbocharger, AiResearch Model T1823	48.25
Mounting bracket, exhaust manifold, controller, oil lines and baffles	36.50
Fuel injector, Bendix RSA-10AD1	8.00
Magneto, Scintilla S6LN-1208	5.85
Magneto, Scintilla S6RN-1209	5.75
Oil cooler	4.50
Oil filter and adapter	2.50
Spark plugs, shielded	3.00
Ignition system, shielded	5.40
Starter and alternator drive	6.53
Starter, 3.38:1, geared, Prestolite with Bendix unit	16.90
Alternator, Delco-Remy 12V., 70A., with mounting bracket	13.00
Intercylinder cooling baffles	1.50
Standard Engine Dry Weight (Pounds)	579.00

2. ENGINE INSTALLATION STANDARD PARTS

Starter switch, magnetic	1.16
Transistor voltage regulator, 12V.	1.25
Overvoltage relay, 12V.	.85
Weight of Installation Parts	3.26

3. ACCESSORIES, DRIVES AND OPTIONAL PARTS

Alternator, Prestolite, 12V., 40A., with bracket	13.00
24V., 50A., with bracket	13.00
Starter, Prestolite, 24V.	16.90
Cylinder Base Thermocouples	0.16
Cylinder Head Thermocouples, Bayonet Type	0.59
Rear Dynafocal Mounting Brackets	9.50
Bed-Type Mounting Brackets	4.60

DETAIL WEIGHTS (CONT.)

TIO-541-E1A4, -E1B4

1. ENGINE (STANDARD)

Basic engine	452.51
Turbocharger, AiResearch Model T8123	48.25
Mounting bracket, exhaust manifold, exhaust bypass valve, controller, oil lines and baffles	43.50
Fuel injector, Bendix RSA-10DB1	8.00
Magneto, Scintilla S6LN-1208	5.85
Magneto, Scintilla S6RN-1209	5.75
Oil cooler	10.50
Oil filter and adapter	3.50
Spark plugs, shielded	3.00
Ignition system, shielded	3.86
Starter and alternator drive	6.53
Starter, 3.38:1 geared, Prestolite with mounting bracket	16.90
Alternator, Prestolite 12V., 40A., with mounting bracket	13.00
Intercylinder cooling baffles	1.50
Compressor drive	2.35
Standard Engine Dry Weight (Pounds)	625.00

TIO-541-E1C4

Basic engine	453.76
Turbocharger, AiResearch Model T1879	40.00
Mounting bracket, exhaust manifold, exhaust bypass valve, controller, oil lines and baffles	41.50
Fuel injector, Bendix RSA-10DB1	8.00
Magneto, Scintilla S6LN-1208	5.85
Magneto, Scintilla S6RN-1209	5.75
Oil cooler, de-congealing	10.50
Oil filter and adapter	3.50
Spark plugs, shielded	3.00
Ignition system, shielded	3.86
Starter and alternator drive	6.53
Starter, 3/38:1 geared, Prestolite with Bendix unit	16.90
Alternator, Prestolite 12V., 40A., with mounting bracket	13.00
Intercylinder cooling baffles	1.50
Compressor drive	2.35
Standard Engine Dry Weight (Pounds)	616.00

DETAIL WEIGHTS (CONT.)

TIO-541-E1D4

1. ENGINE (STANDARD) (CONT.)

Basic engine	451.76
Turbocharger, AiResearch Model T1879	40.00
Mounting bracket, exhaust manifold, exhaust bypass valve, controller, oil lines and baffles	41.50
Fuel injector, Bendix RSA-10DB1	8.00
Magneto, Scintilla S6LN-1208	5.85
Magneto, Scintilla S6RN-1209	5.75
Oil cooler, de-congealing	10.50
Oil filter and adapter	3.50
Spark plugs, shielded	3.00
Ignition system, shielded	3.86
Starter and alternator drive	6.53
Starter, 3/38:1 geared, Prestolite with Bendix unit	16.90
Alternator, Prestolite 12V., 40A., with mounting bracket	13.00
Intercylinder cooling baffles	1.50
Compressor drive	2.35
Standard Engine Dry Weight (Pounds)	614.00

2. ENGINE INSTALLATION STANDARD PARTS

TIO-541-E SERIES

Starter switch, magnetic	1.16
Transistor voltage regulator	1.25
Overvoltage relay, 12V.	0.85
Weight of Installation Parts	3.26

3. ACCESSORIES, DRIVES AND OPTIONAL PARTS

TIO-541-E SERIES

Alternator, Prestolite, 12V., 70A, with bracket	13.00
24V., 50A, with bracket	13.00
24V., 100A., with bracket	22.00
Starter and alternator drive (Ford)	6.53
Starter and generator drive (Lear-Siegler)	7.48
Alternator brackets (Ford)	0.85
Generator brackets (Lear-Siegler)	1.25
Starter, Prestolite, 24V.	16.90
Cylinder Base Thermocouples	0.16

DETAIL WEIGHTS (CONT.)

3. ACCESSORIES, DRIVE AND OPTIONAL PARTS (CONT.)

TIO-541-E SERIES (CONT.)

Cylinder Head Thermocouples, Bayonet Type	0.59
Rear Dynafocal Mounting Brackets	9.50
Bed-Type Mounting Brackets	4.60
Transistor voltage regulator, 24V.	1.25
Overvoltage regulator, 24V.	0.85
Turbocharger blanket	1.00

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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 IN PARTICULAR TO THE WARRANTIES THAT APPEAR IN THE FRONT OF THIS MANUAL REGARDING ENGINE SPEED, THE USE OF SPECIFIED FUELS, 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 AIRPLANE 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 THE WARRANTY PERIOD HAS PASSED.

Care of New Engine – 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 on multi-viscosity ashless dispersant oil conforming to Specification MIL-L-22581 or an FAA or Lycoming approved synthetic lubricant. Oil grades are listed in the Flight Chart, part 9 of this section. The latest revision of Service Instruction No. 1014 contains complete lubricating oil recommendations.

Fuel – The TIO-541 series engine is designed to operate on 100/130 (minimum) octane aviation grade fuel.

NOTE

Under no circumstances should aviation fuel of a lower octane than specified nor automotive fuel (regardless of octane) be used.

Oil Change – It is recommended that the lubrication oil be changed every 50 hours, unless a full flow oil filter in installed. In that case, this period can be extended as stated in latest revision of Lycoming Special Service Publication No. SSP-885.

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 PROCEDURE.

a. Set propeller governor control lever in "Full RPM" position.

b. Turn fuel valve on.

c. Mixture control in "Idle Cut-Off".

d. Crack throttle to approximately ¼ travel.

e. Turn boost pump on and move mixture control to "Full Rich" position until a slight but steady flow is indicated. Then return to "Idle Cut-Off" position.

f. Move ignition switch to "Left" and engage starter. On installations employing a combination magneto starter switch, move the switch to "Start".

g. As engine starts, move mixture control slowly and smoothly to "Full Rich".

h. Turn ignition switch to "Both". Combination spring-loaded switches will return to "Both".

i. When engine starts, set the throttle for "Fast Idle". 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 purged 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 heat the engine or oil before starting. If engine fails to start at the first attempt, another attempt should be made without priming. If this fails, it is possible that the engine is overprimed. Turn switch to "OFF" position, open the throttle slowly and turn the engine over approximately ten revolutions. Proceed with normal start.

CAUTION

ON INSTALLATIONS EQUIPPED WITH COMBINATION MAGNETO STARTER SWITCH, IT IS NOT POSSIBLE TO CRANK THE ENGINE WITH SWITCH IN "OFF" POSITION. WHEN CLEARING THESE ENGINES OF EXCESSIVE FUEL, THEREFORE, THE IGNITION SYSTEM IS "HOT" AND THE ENGINE MAY START AT ANY TIME.

5. GROUND RUNNING AND WARM-UP. The Lycoming TIO-541 is an air-pressure cooled engine that depends on the forward speed of the airplane to maintain proper cooling. Therefore, particular care is necessary when operating this engine on the ground. To prevent overheating, it is recommended that the following precautions be followed:

a. Head airplane into the wind.

b. Operate the engine on the ground only with the propeller in minimum blade angle setting.

c. Avoid prolonged idling at low RPM as this practice may result in fouled spark plugs.

d. Leave mixture control in "FULL RICH" position.

e. Warm up engine at 800 to 1300 RPM.

6. GROUND CHECK.

a. Warm up as described above.

b. Check both oil pressure and oil temperature.

c. Leave mixture in "FULL RICH".

d. Move propeller control through its complete range to check operation and return to full low pitch position. Full feathering check is not recommended on the ground but the feathering action can be checked by running the engine between 1000 and 1500, 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 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 blade angle, set engine to produce 50 – 65% power as indicated by the manifold pressure gage. Mixture control should be in full rich position, and propeller in minimum blade angle. At these settings the ignition system and spark plugs must work harder because of the greater pressures within the cylinders. Under these conditions ignition problems, if they exist, will occur. Magneto checks at low power setting only indicate fuel-air-distribution quality.

(2) Check magneto drop-off. Normal drop-off is 100 RPM. Drop-off should not exceed 175 RPM. Drop-off between magnetos should not exceed 50 RPM. A smooth drop-off past normal is usually a sign of a too lean or too rich mixture.

(3) Do not operate on a single magneto for too long a period. Two to three seconds is sufficient and will prevent plug fouling.

f. The engine is warm enough for take-off when the throttle can be opened without the engine faltering. Take-off with turbocharged engine should not be started if indicated lubricating oil pressure, due to cold temperature, is above maximum. Excessive oil pressure can cause over boost and consequent engine damage. If it is necessary to hold for clearance instructions, operate engine at 1400 to 1500 RPM to provide cooling and minimize spark plug fouling.

CAUTION

Do not exceed 2200 RPM while on the ground.

7. OPERATION IN FLIGHT. These engines are equipped with a dynamic counterweight system and must be operated accordingly. Avoid rapid closing or opening of the throttle.

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

Turbocharger – The exhaust bypass valve controller used with the turbocharger system prevents overboosting of the engine at lower altitudes and maintains a supply of air to the intake manifold to produce sea level power at altitude.

Mixture Control – The mixture control, in addition to incorporating an idle cut-off when fully closed, is used to manually lean the fuel/air mixture.

One of the most important factors in flying an aircraft is to maintain the proper fuel/air mixture. Proper cruise mixture control to the engine will give maximum range, economical operation and maximum service life.

LEANING PRECAUTIONS

Never operate an engine in excess of the maximum cylinder head temperature specified.

For continuous operation cylinder head temperatures should be maintained below 435°F (224°C).

Never exceed the maximum turbine inlet temperature of 1650°F (899°C).

Maintain mixture control in "Full Rich" position for rated take-off, rated maximum continuous climb and cruise powers above 75% unless aircraft operator's manual shows otherwise. However, during take-off from high elevation airports or during climb, roughness or loss of power may result from over-richness. In this event adjust mixture control only enough to obtain smooth operation.

Always enrich mixture before increasing power.

Manual leaning may be monitored most accurately by an exhaust gas temperature gage.

It is recommended that the following be adhered to when manually leaning with the aid of the EGT.

a. Above 75% power.

(1) Never lean beyond 150°F on the rich side of peak EGT unless airframe operator's manual shows otherwise. Monitor cylinder head temperature.

b. 75% Power and Below.

(1) Operate at peak EGT, or if desired, drop 50°F on the rich side of peak EGT.

NOTE

Although operation on the lean side of peak EGT will result in slightly better fuel economy and lower cylinder head temperatures, in some cases unstable engine operation may be encountered.

8. ENGINE SHUT-DOWN. After landing, shut down the engine according to the following procedure:

a. Before the engine is shut down, it must be idled long enough to reduce temperatures.

b. Move the mixture control to "Idle Cut-Off".

c. When engine stops, set ignition switch in the "OFF" position.

9. ENGINE FLIGHT CHART.

Fuel and Oil –

Fuel Aviation Grade.....100/130 octane (minimum)

Fuel Pressure (psi above injector deck pressure) at inlet to fuel injector.

	Maximum	Minimum	Idling
TIO-541-E	60	20	12
TIO-541-A	60	29	12

Lubricating Oil Recommendations – See latest revision of Service Instruction No. 1014 for complete lubricating oil recommendations. TIO-541 series must be operated with ashless dispersant lubricating oil essentially conforming to specification MIL-L-22851. However, newly overhauled engines of this series may be run-in on the test stand with single viscosity oil, grade SAE 50 conforming with specification MIL-L-6082.

*Recommended Grade Oil

Average Ambient Air Temperature	Ashless Dispersant Specification MIL-L-22851
Above 60°F	Use grade equivalent to SAE 50 or SAE 60
Below 30°F	Use grade equivalent to SAE 40

* - Consult latest revision of Service Instruction No. 1014.

*Recommended Oil Temperature

Average Ambient Air Temperature	Desired	Maximum
Above 30°F	180°F	245°F
0° to 70°F	170°F	225°F
Below 10°F	160°F	210°F

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

	-A Series	-E Series
Oil Sump Capacity	14 qts.	13 qts.
Minimum safe quantity of lubricating oil in sump	4 qts.	2-1/2 qts.

These engines are equipped with a full-flow oil filter. This feature extends the normal oil change intervals of 50 hours by 25 to 100 percent, depending on environmental conditions, and provided the filter element is changed after each 50 hours of operation.

Oil Pressure, psi	Maximum	Minimum	Idling
Start and Warm-Up	100		
Normal Oil Pressure	90	55	10

OPERATING CONDITIONS

TIO-541-A SERIES

Operation	HP	Fuel Cons. Gal./Hr.	Max. Oil Cons. Qt./Hr.	*Max. Cyl. Head Temp.
Normal Rated	310	------	2.06	475°F
Performance Cruise (75% Rated)	230	20.5	1.53	475°F
Economy Cruise (60% Rated)	185	13.5	1.23	475°F

TIO-541-E SERIES

Operation	HP	Fuel Cons. Gal/Hr.	Max. Oil Cons. Qt./Hr.	*Max. Cyl. Head Temp.
Normal Rated	380	------	2.11	475°F
Performance Cruise (75% Rated)	300	22.9	1.66	475°F
Economy Cruise (60% Rated)	247	16.7	1.37	475°F

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

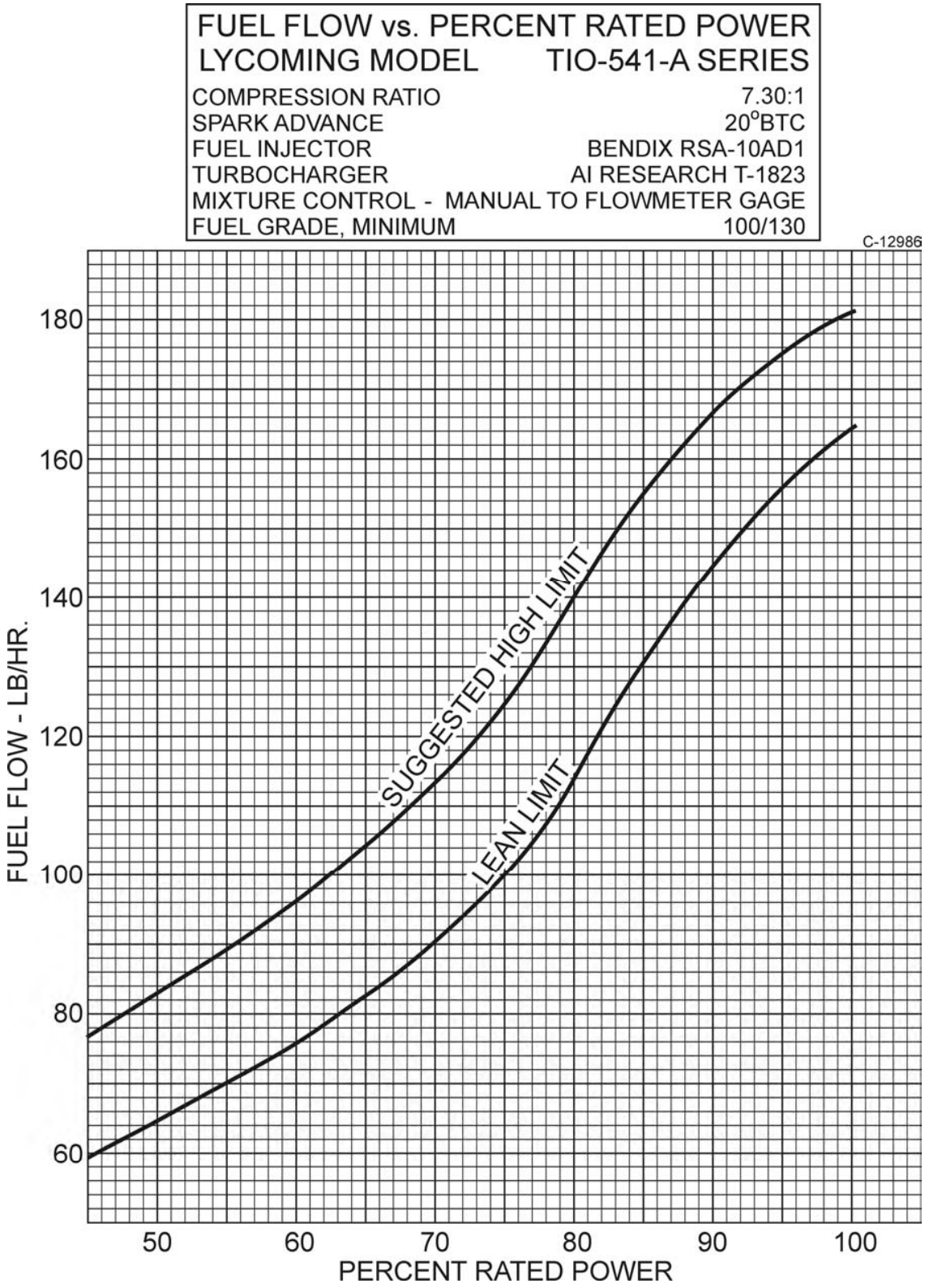

Figure 3-1. Fuel Flow vs Percent Rated Power –
TIO-541-A Series

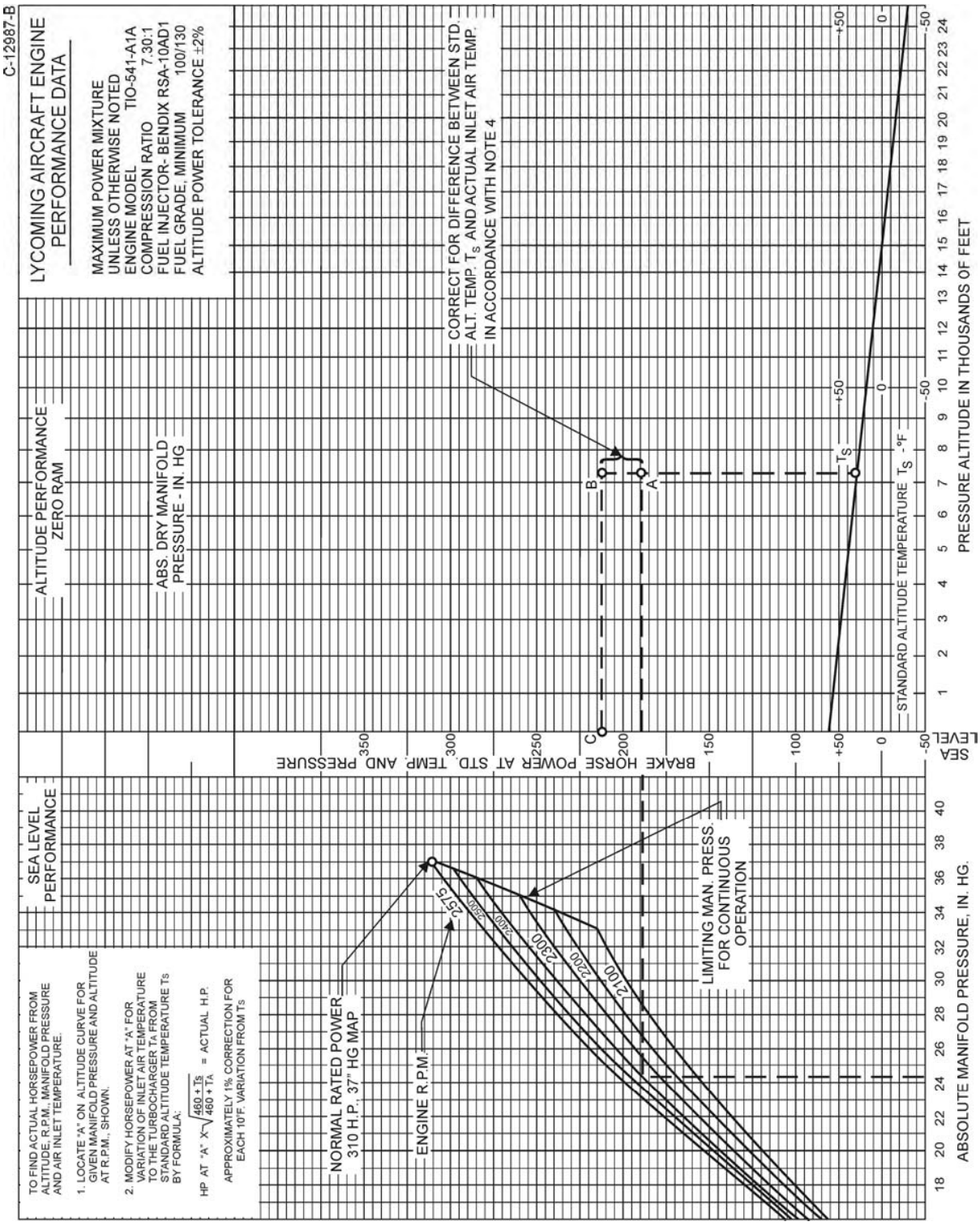

Figure 3-2. Sea Level and Altitude Performance –
TIO-541-A Series

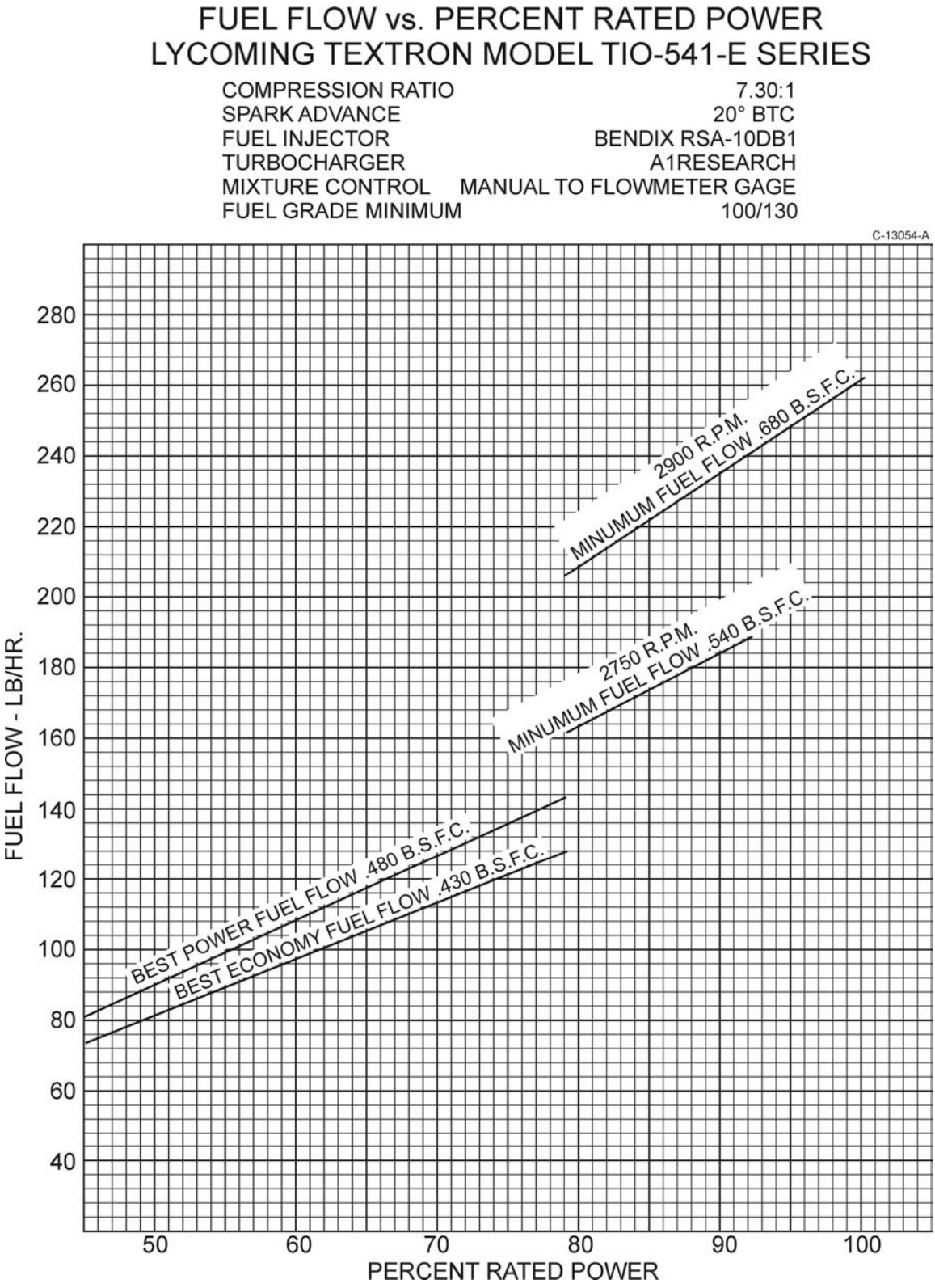

Figure 3-3. Fuel Flow vs Percent Rated Power –
TIO-541-E Series

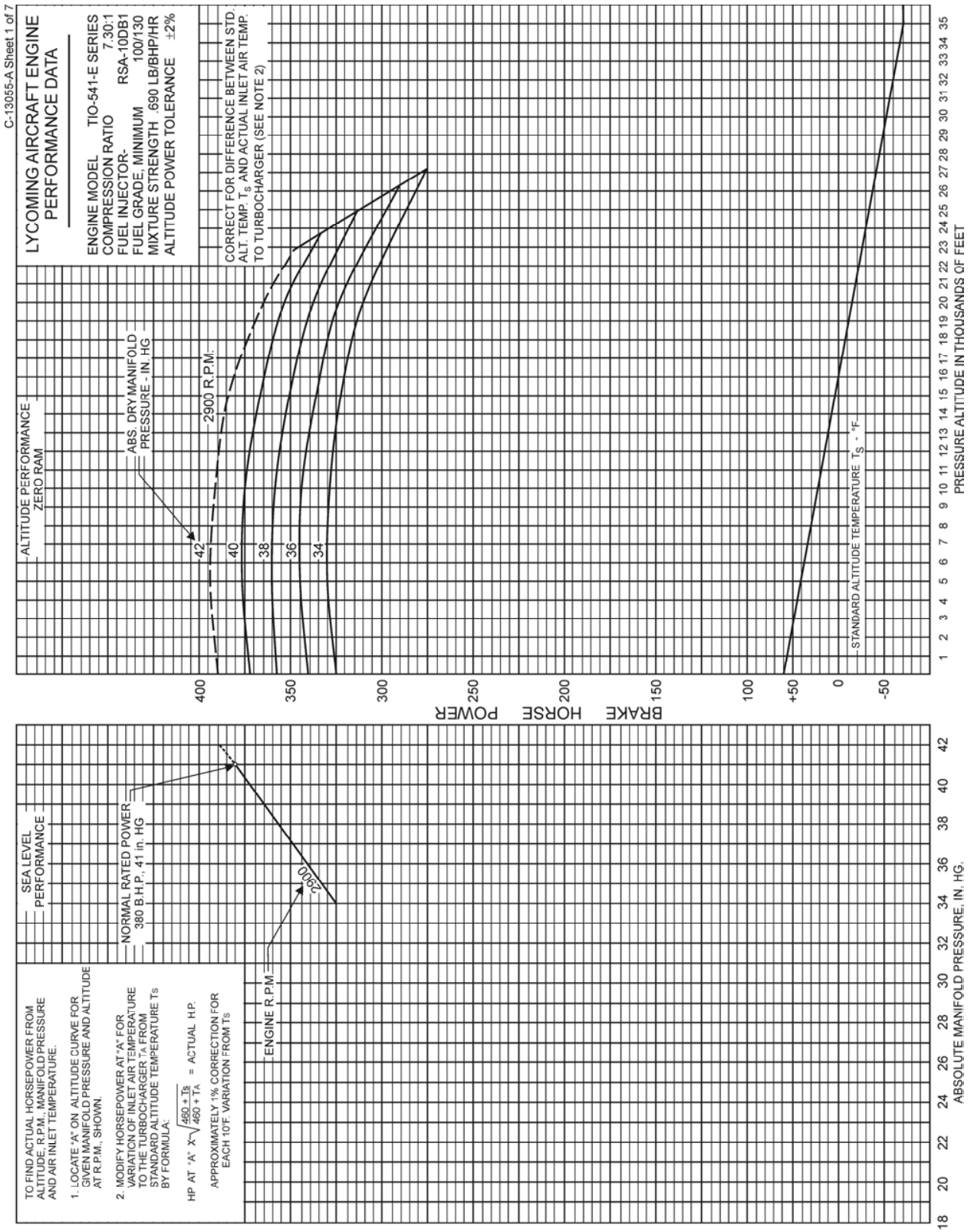

Figure 3-4. Sea Level and Altitude Performance –
TIO-540-E Series – Sheet 1 of 7

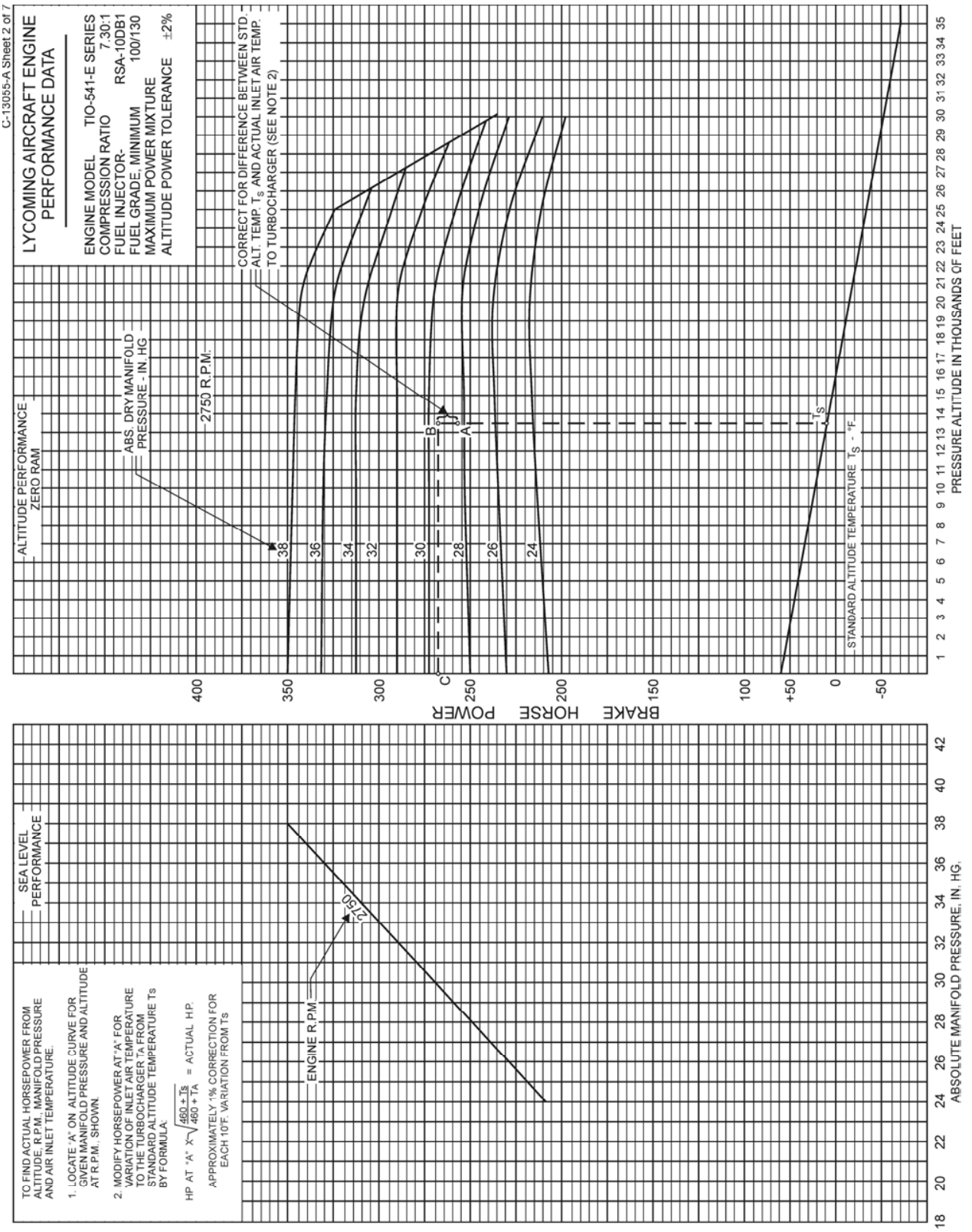

Figure 3-5. Sea Level and Altitude Performance –
TIO-540-E Series – Sheet 2 of 7

USING CURVE TO FIND ACTUAL HORSEPOWER –

The following is an example of how to use the Sea Level and Altitude Performance curves for turbocharged 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 figures from curve Figure 3-5) is for illustration purposes only. Example: With the aircraft flying at 13,500 feet, with a power setting of 2750 RPM, 29 inches of manifold pressure and 48°F air inlet temperature.

1. Locate given manifold pressure and altitude performance curve (Point "A").

2. Correct power approximately 1% for each 10°F variation in air inlet temperature from standard altitude temperature shown below. Add correction for temperature below standard; subtract correction for temperatures above standard. Example: With an air inlet temperature of 48°F at 13,500 feet, 48° less 10° = 38° variation. 1% for each 10° variation is 3.8%. 3.8% of 270 HP is approximately 10 HP. Since temperature is above standard, subtract correction.

3. 270 HP less 10 HP equals 260 HP. (Point "B".)

STANDARD ALTITUDE TEMPERATURE IN DEGREES F

Pressure Altitude (Thousands)	SL	2	4	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

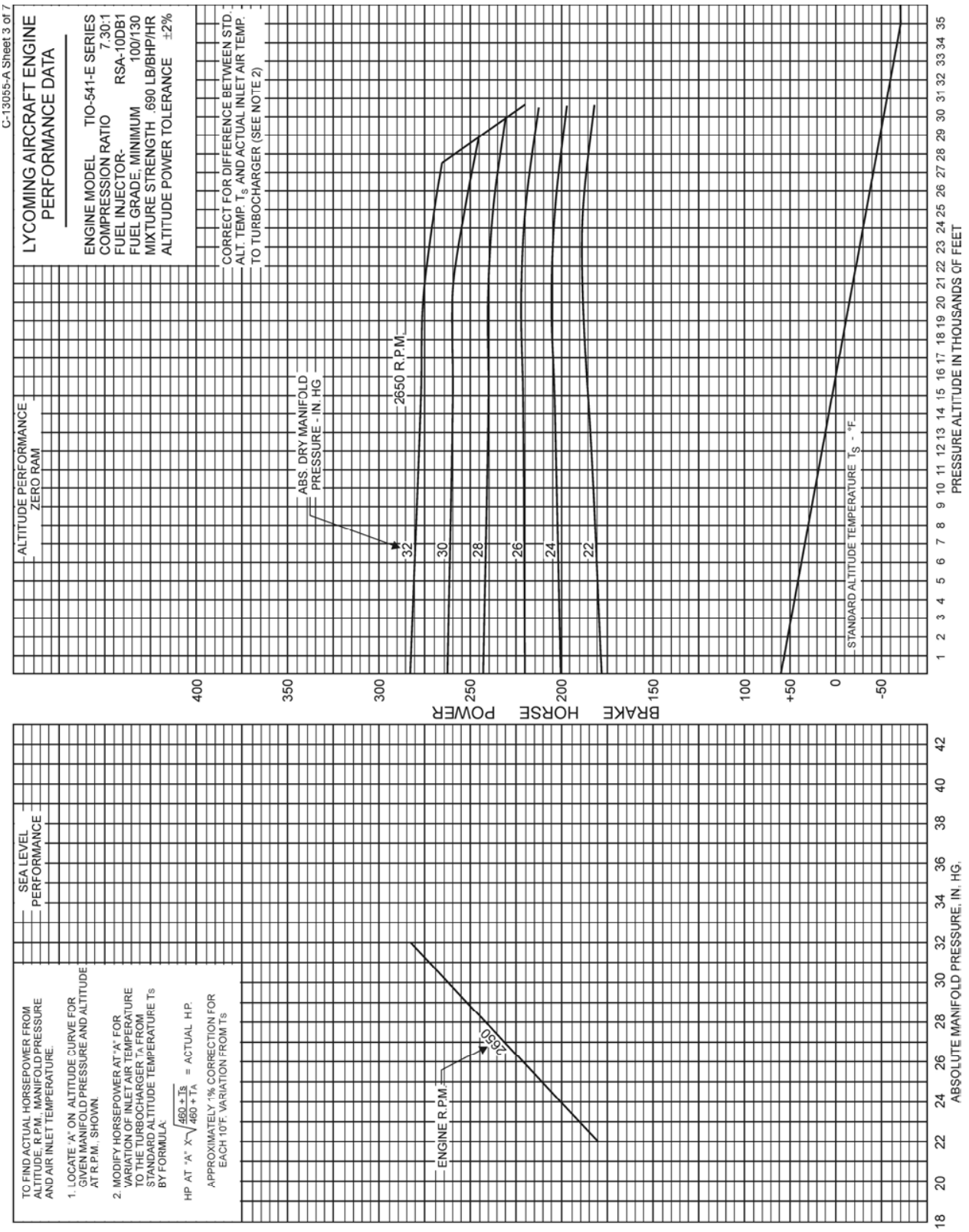

Figure 3-6. Sea Level and Altitude Performance –
TIO-541-E Series – Sheet 3 of 7

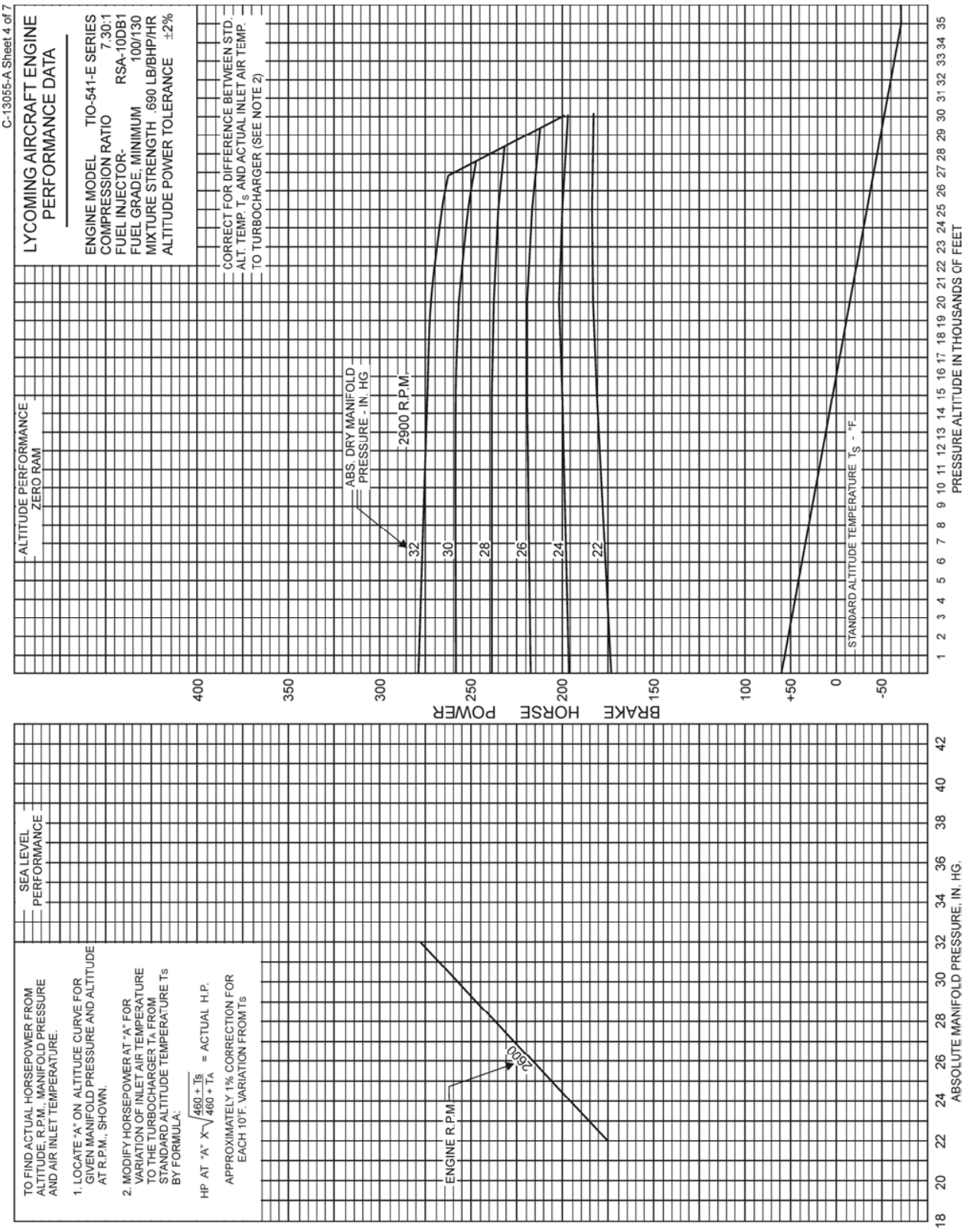

Figure 3-7. Sea Level and Altitude Performance –
TIO-541-E Series – Sheet 4 of 7

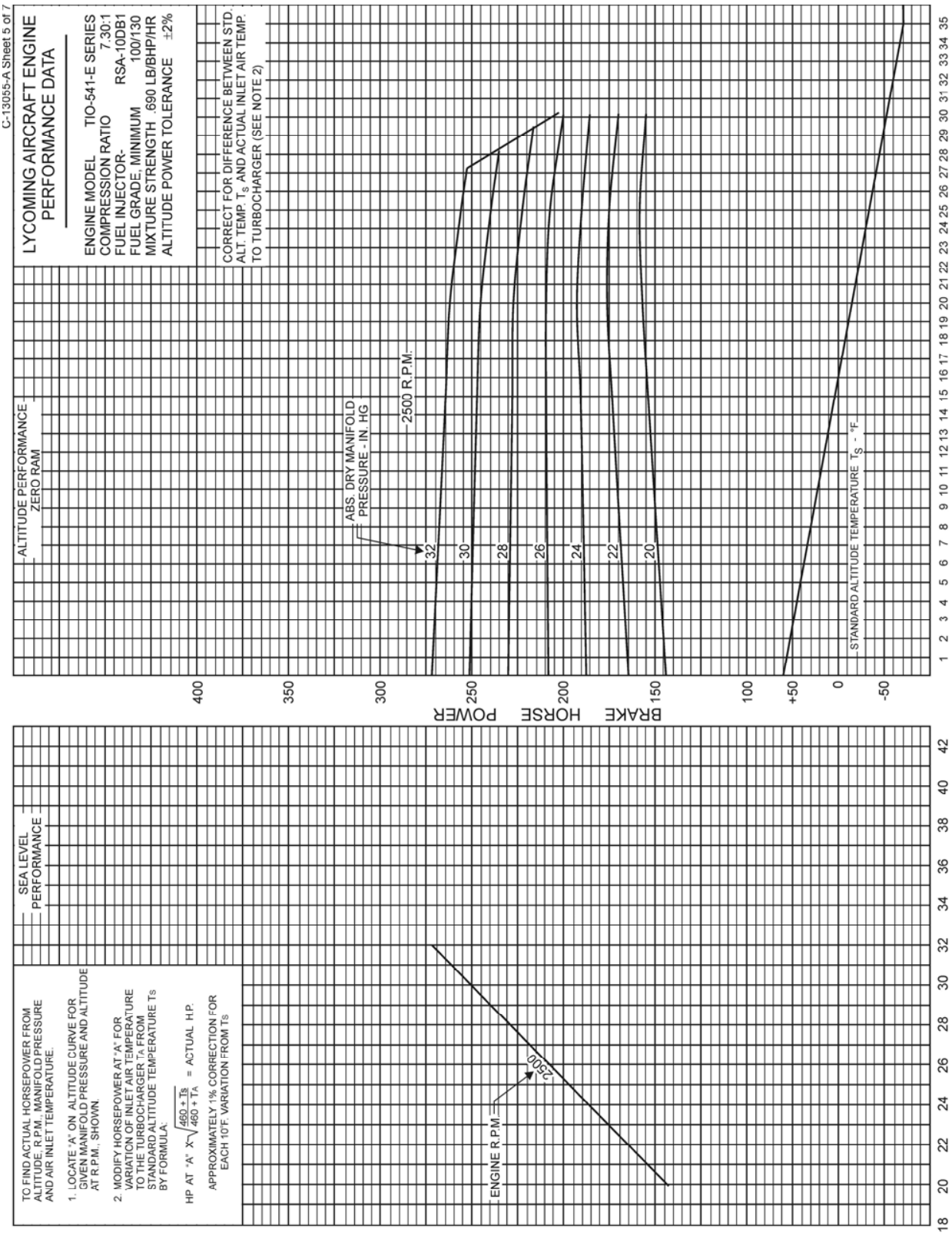

Figure 3-8. Sea Level and Altitude Performance –
TIO-541-E Series – Sheet 5 of 7

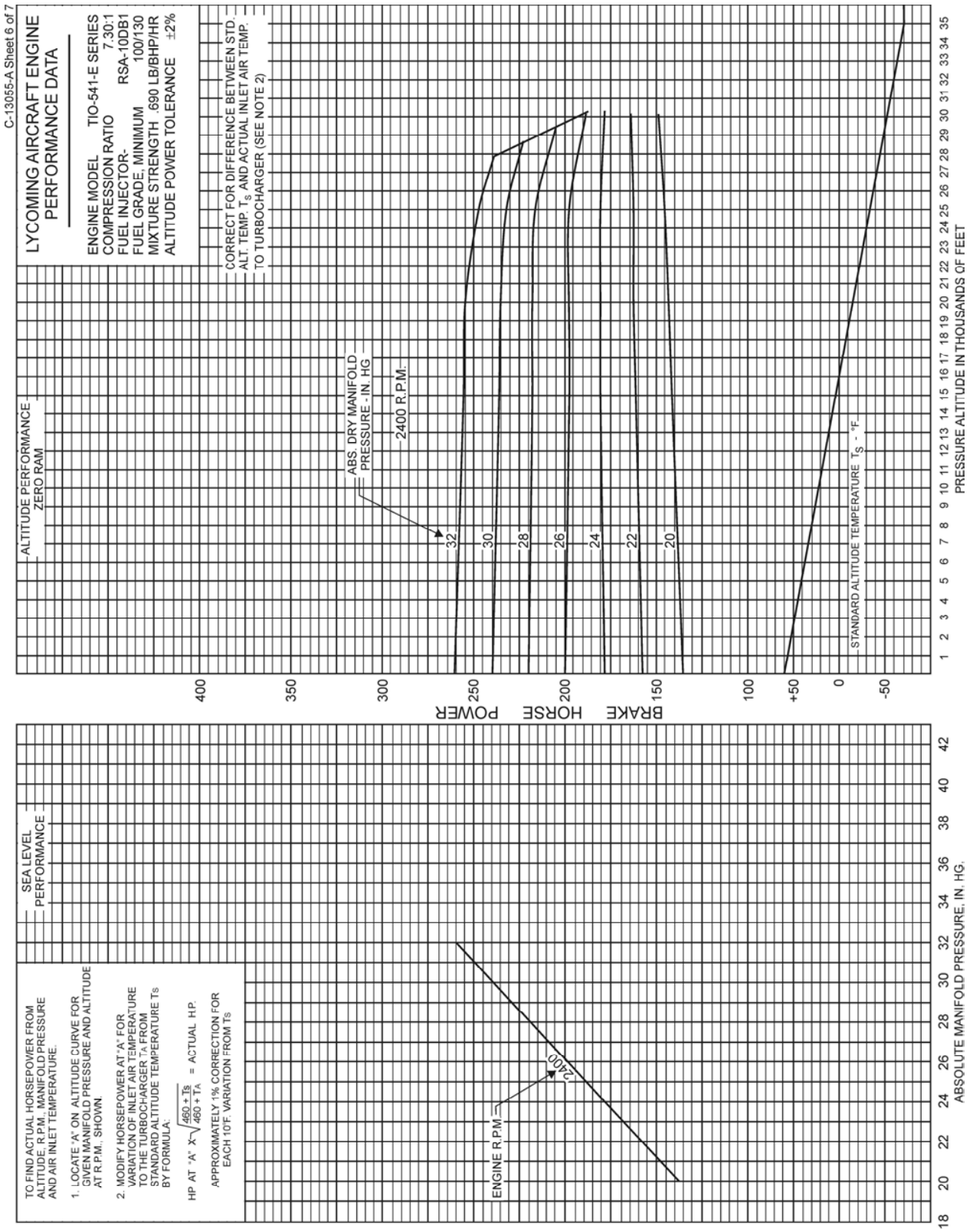

Figure 3-9. Sea Level and Altitude Performance –
TIO-541-E Series – Sheet 6 of 7

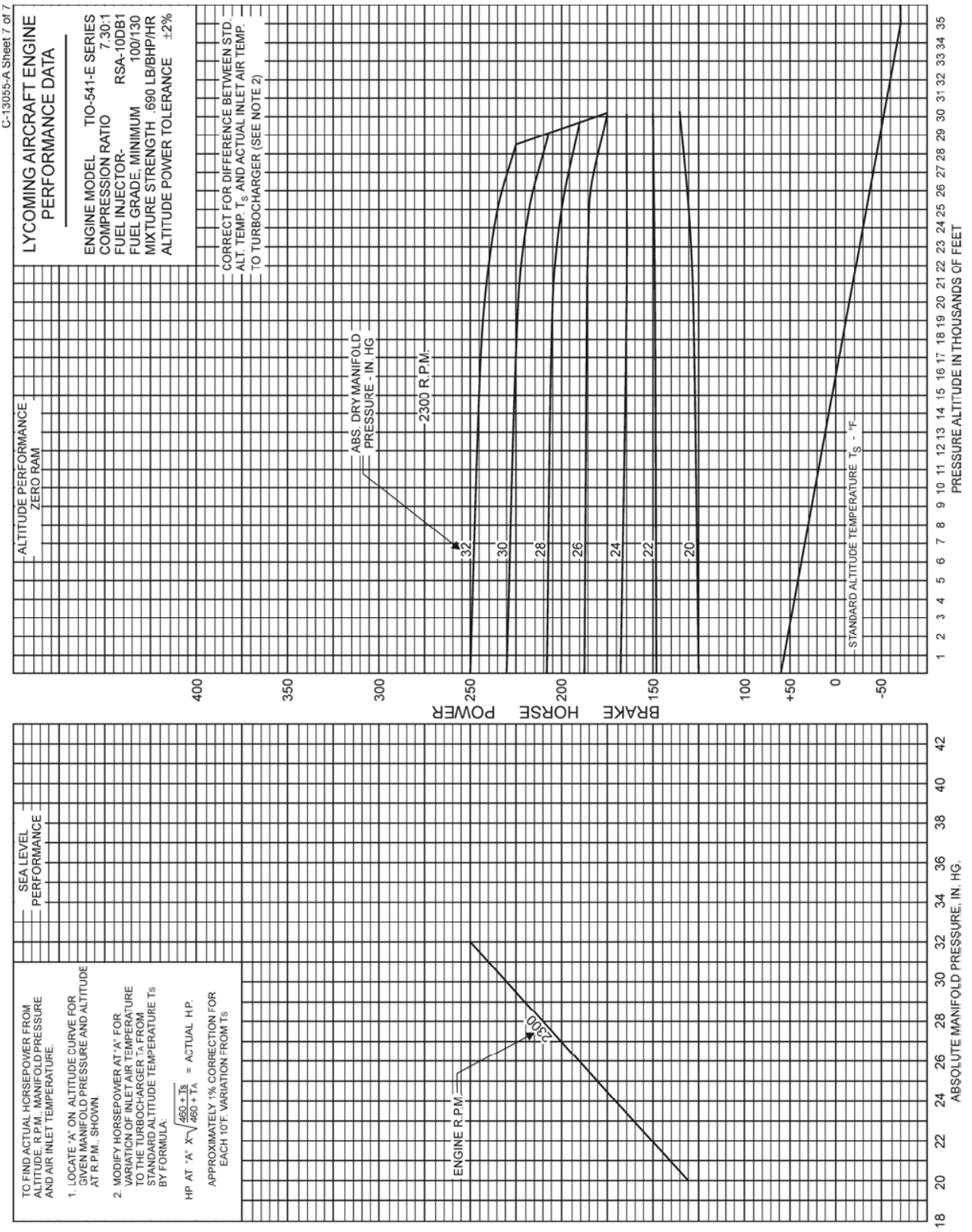

Figure 3-10. Sea Level and Altitude Performance –
TIO-541-E Series – Sheet 7 of 7

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SECTION 4
PERIODIC INSPECTIONS

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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 overemphasized. Statistics prove that 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 injector and 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 engine 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.

j. Inspect safe tying of all drain plugs and covers.

k. Inspect engine for evidence of leakage.

l. Check engine crankcase breather for restriction to breather.

2. DAILY PRE-FLIGHT (TURBOCHARGER SYSTEM).

a. Inspect mounting and connections of turbocharger for security, oil leakage, and air or exhaust gas leakage.

NOTE

Exhaust gas leakage may be indicated by streaks of exhaust deposits at joints and inside scorching of nacelles. Oil streaks under wings indicate possible oil leaks at controllers or broken seals at the exhaust bypass valve.

3. 25-HOUR INSPECTION (ENGINE). After the first 25 hours operating time, new, rebuilt or newly overhauled engines should undergo a 50-hour inspection including draining and renewing lubricating oil. If a new alternator drive belt has been installed during the past 25 hours, check for correct tension adjustment.

4. 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.

(2) Examine spark plug leads of cable and ceramics for corrosion and deposits. This condition is evidence of either leaking spark plugs, or 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. Spark plug elbows and shielding nuts must be secure.

(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 – Remove and clean the fuel inlet strainers. Remove and clean fuel injector fuel strainer. Reinstall strainers.

NOTE

The above steps are most essential to insure proper operation of the fuel inspection system. Failure to comply could cause irreparable damage.

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; check for security of anchorage and for wear caused by rubbing or vibration; check for dents and cracks.

(2) Install new element in external full flow oil filter.

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, install new 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 the 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 the leakage exceeds these conditions, the cylinder should be replaced.

5. 50-HOUR INSPECTION (TURBOCHARGER). All fluid power lines and mounting bracket incorporated in turbocharger system should be checked for leaks, tightness, and any damage that may cause a restriction.

Check for accumulation of dirt or other interference with the linkage between the bypass valve and the actuator, which may impair operation of turbocharger. Clean or correct cause of interference.

The vent line from the actuator should be checked for oil leakage. Any constant oil leakage is cause for replacement of piston seal.

NOTE

The above operations should be performed in addition to those listed under "Daily Pre-Flight (Turbocharger)" inspection.

6. 100-HOUR INSPECTION (ENGINE). 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 any clamps or loose wires and check terminals for security and cleanliness.

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

b. Lubrication System – Drain and renew lubricating oil. Install new filter element.

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 is described in Section 5, 1, b of this manual.

NOTE

Engines equipped with pressurized ignition systems should be checked using the Bendix Model 11-10090 (Lycoming Special Tool ST-395) airflow tester as described in latest revision of Service Instruction No. 1308.

d. Engine Accessories – Engine mounted accessories such as pumps, temperature and pressure sensing units should be checked for secure mounting and tight connections. Check alternator drive belt for proper tension.

e. Cylinders – Check cylinders visually for cracked or broken fins.

f. Fuel Injector Nozzles and Fuel Lines – Check fuel injector nozzles for looseness, tighten to 15 – 20 ft.-lbs. torque. Check fuel lines for dye stains at connections (indicating leakage) and security of lines. Repair or replacement must be accomplished before the aircraft resumes operation.

g. Engine Mounts – Check engine mounting bolts and bushings for security and excessive wear. Replace any bushings that are excessively worn.

NOTE

All the above operations should be performed in addition to these listed under "Daily Pre-Flight" and "50-Hour (Engine)".

7. 100-HOUR INSPECTION (TURBOCHARGER). Inspect all air ducting and connections in turbocharger system for leaks. Make inspection both with engine shut down and with engine running. Check at manifold connections to turbine inlet and at engine exhaust manifold gasket for possible at leakage.

CAUTION

DO NOT OPERATE THE TURBOCHARGER SYSTEM IF LEAKS EXIST IN THE DUCTING, OR IF AIR CLEANER IS NOT FILTERING EFFICIENTLY. DUST LEAKING INTO AIR DUCTING CAN DAMAGE TURBOCHARGER AND ENGINE.

Check for dirt or dust build-up within the turbocharger. Check for uneven deposits on the impeller. Consult AiResearch Industrial Div. Manual TP-21 for method to remove all such foreign matter.

NOTE

All the above operations should be performed in addition to those listed under "Daily Pre-Flight" and "50-Hour (Turbocharger)" inspection.

8. 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 the limits shown in the latest revision of Special Service Publication No. SSP-1776.

9. 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.

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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 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 that harness is correctly installed. Mark location of clamps and clips to be certain that the replacement is clamped at correct locations.

b. Timing Magnetos to Engine – Magnetos are timed to the engine in the following manner:

NOTE

The retard breaker magneto is 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 inside the cylinder, tending to push the thumb off the spark plug hole. Continue rotating the crankshaft in direction of normal rotation until the 20°BTC advance timing mark on the front face of the starter ring gear is in exact alignment with the small hole located on the front face of the starter housing at the eight o'clock position.

NOTE

If the crankshaft is accidentally turned in the direction opposite normal rotation, repeat the above procedure since accumulated backlash will make the final timing incorrect.

(2) At this point, the engine is ready for assembly of the magnetos. Remove the inspection plug from a magneto and turn the drive shaft in direction of normal rotation until the first painted chamfered tooth 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 gasket and magneto on the engine. Secure with washers and nuts; tighten only finger tight. Repeat for second magneto.

(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.

(4) Rotate a 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.

NOTE

Use only the main breaker points when timing the retard breaker magneto to the engine. Never attempt to time using the retard breaker points.

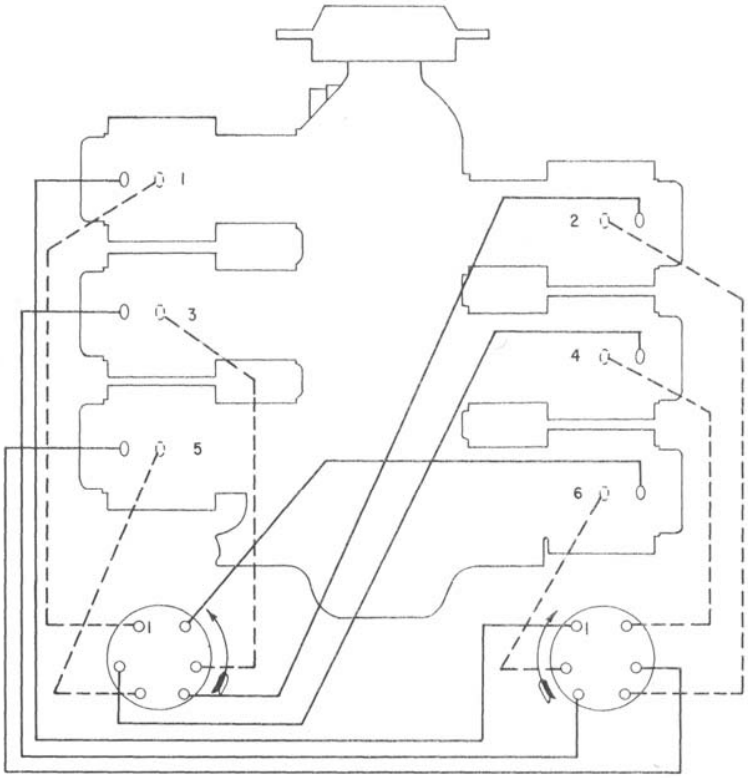

Figure 5-1. Ignition Wiring Diagram

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

(6) 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. Reinstall inspection plugs.

NOTE

Some timing lights operate in reverse of the manner described above; the lights come on when the breaker points open. Check your timing light instructions.

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 Lines – In the event a line or fitting is replaced, only a fuel soluble lubricant, such as clean engine oil or Loctite Hydraulic Sealant may be used on the tapered 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. Install a new screen if either of these conditions exists. 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 65-70 in.-lbs. torque.

c. Fuel Grades and Limitations – Aviation grade fuel 100/130 octane minimum is the specified fuel for these engines. 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 –

(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) Close throttle 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.

NOTE

The idle mixture must be adjusted with the fuel boost pump "ON".

(4) When the idling speed has 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 "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 that 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.

NOTE

TIO-541-E series engines must be operated with ashless dispersant lubrication oil as described in latest revision of Service Bulletin No. 318.

b. The adjustable oil relief valve, located at the right rear side of the engine below the oil filter, enables the operator to maintain the oil pressure within 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 the engine and screw the adjusting screw in to increase pressure or out to decrease pressure. The adjusting screw may be turned with either a screw driver or a box wrench.

4. CYLINDERS.

a. Removal of Cylinder Assembly –

(1) Remove exhaust manifold.

(2) Remove intake pipe, fuel drain lines, baffle and any clips that might interfere with the cylinder removal.

(3) Disconnect ignition cable at spark plugs and remove spark plugs.

(4) Remove rocker box cover and rotate crankshaft until piston is approximately at top center of the compression stroke. This approximate position may be located by observing top of piston through the spark plug hole and by watching the valve action.

(5) Pull rocker shafts into cylinder head far enough to remove valve rockers and washers. Remove valve stem cap from exhaust valve. Valve rocker shafts can be removed when cylinder is removed from the engine.

(6) Remove push rods by grasping ball end and pulling out of shroud tube. Remove shroud tube by grasping tube and turning 90° either way. This releases detent on tube from spring. Remove the tubes by first releasing them from the seal seat in the cylinder head and then withdrawing tubes from shroud tube adapter on crankcase. Remove shroud tube seal sleeves and seals from outer end of tubes, also remove seals from adapter. Discard all seals. Place washers, springs, and seal sleeves in proper compartment of cleaning basket.

NOTE

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

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

(8) Use the old cylinder base oil seal ring and crisscross over cylinder base studs and around connecting rod to prevent rod from striking crankcase.

NOTE

In the event that a spark plug Heli-coil must be replaced, it must be replaced with a .010 oversize Heli-coil.

b. Removal of Valves and Valve Springs from Cylinder –

(1) Place cylinder over a block of wood to hold the valves in a closed position.

(2) Compress valve springs, using a valve spring compressor.

(3) Remove tapered split keys from the end of valve stems. The valve springs and valve spring seats may now be removed from cylinder head.

(4) Hold valve stems so that valves will not fall out. Remove cylinder from holding block.

(5) Remove valves from the inside of the cylinder.

c. Removal of Piston from Connecting Rod – Insert the piston pin puller tube through the piston pin. Assemble the puller nut and proceed to remove the piston pin.

d. Removal, Disassemble, Cleaning, Inspection and Reassembly of Hydraulic Lifters –

(1) Remove capscrews that secure shroud tube adapter over the lifter.

(2) Remove adapter gasket. Lifter can be withdrawn by fingers.

(3) Being careful not to scratch socket, insert a screw driver into lifter and push. This will force the trapped oil out of the vent hole and release the pressure on the circlip.

(4) Remove and discard the circlip.

CAUTION

UPON RELEASE, CIRCLIP MAY SPRING UP WITH GREAT FORCE. BE CAREFUL!

(5) Remove the spring, plunger and socket from the lifter and clean the parts and the lifter body in solvent. Inspect the lifter body for the following imperfections.

Spalling – If the face of the lifter shows small nicks or indentations near the center of the face, it is considered pitted or spalled. The pitting will constitute small irregular holes, not to be confused with Rockwell hardness check marks, which are round and even. The area covered by spalling will vary with different lifters, but regardless of the degree, the lifter must be replaced.

Scoring – The lifter face is scored when small scratch-like lines are found on the surface. These marks are usually found near the outer edge of the face and will appear to radiate from the center. Other scoring marks may be present and extend to the center of the lifter face. Any lifter, with this condition in evidence, must be replaced.

Face Wear – The operation of the lifter provides that the lifter rotates during wiping operation of the cam. This will form a groove, or path. This path will extend all the way across the face and deeper penetrations will be noted at the center of the face. If the wear is excessive, it will be noticeable to the touch if the fingernail is rubbed across the lifter face. This condition requires replacement of the lifter body.

(6) Reassemble the spring, plunger and socket into the body and secure with a new circlip.

NOTE

The lifter must be perfectly dry to obtain proper dry tappet clearance.

(7) Install the lifter assembly in its position in the crankcase. Install a new shroud tube adapter gasket and secure the shroud tube adapter with capscrews.

e. Assembly of Valves in Cylinder –

(1) Prelubricate valve stems and interior of valve guides with Molytex Grease O or equivalent and insert each valve stem in its respective guide.

(2) Place cylinder over a wood block so that the valves are held against the seats and assemble the lower spring seat, auxiliary valve spring and outer valve spring over the valve stem and guide. Place the upper spring seat on top of the springs.

NOTE

Place dampener end of spring (close-wound coils marked with dye or lacquer) toward the cylinder.

(3) Using a valve spring compressor, compress the valve springs and place the split keys in the groove around the upper end of the valve stem. Slowly release the pressure on the valve spring compressor and allow the upper spring seat to lock itself in place around the valve keys.

f. Assembly of Cylinder and Related Parts –

(1) Rotate crankshaft so that the connecting rod of the cylinder being assembled is at top center position with both tappets on the low side of the cam in a position that corresponds with both valves closed.

(2) Assemble piston with rings so that the cylinder number stamped on the piston pin boss is toward the front of the engine. The piston pin should be a hand push fit. During assembly always use a generous quantity of oil, both in the piston pin hole and on the piston pin.

(3) Assemble a 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.

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.*

(4) Using a piston ring compressor, assemble the cylinder over the piston with the intake port at the top and the exhaust port on the bottom.

(5) Push the cylinder all the way on, catching the ring compressor as it is pushed off, and install applicable cylinder base hold-down nuts. Tighten hold-down nuts to specified torque in the manner described in the following paragraphs.

NOTE

The front two ½ inch thru-studs on each cylinder pad are not secured by screw threads. Therefore, torque must be applied at both ends simultaneously. At any time a cylinder is replaced, it is necessary to retorque the cylinder base nuts on the opposite cylinder.

(6) Tighten the ½ inch cylinder base nuts to 300 in.-lbs., starting at top left and proceeding counterclockwise.

(7) Repeat the tightening sequence and tighten all ½ inch nuts to 600 in.-lbs. torque. Be certain all nuts are tightened in the sequence stated.

(8) Tighten the 3/8 inch nuts to 300 in.-lbs. toque. Sequence is optional.

(9) During the final tightening procedure, bearing crush or crankcase shift may have occurred, relieving the load on certain ½ inch nuts. Therefore, as a final check, repeat step (7) above to determine if all ½ inch cylinder base nuts are tightened to 600 in.-lbs. Hold torque wrench on each ½ inch nut for about 5 seconds. If the nut does not turn, it is presumed to be tightened to the proper torque.

CAUTION

AFTER INSTALLATION OF CYLINDER IS COMPLETED, REMOVE ANY NICKS IN THE CYLINDER FINS BY FILING OR BURRING.

(10) Assemble new shroud tube oil seals in the shroud tube adapter on the crankcase and on outer end of the push rod shroud tubes; then assemble a shroud tube seal sleeve over each of the outer seals, centering the sleeve on the seal.

(11) Assemble shroud tube spring over inner ends of the shroud tubes so that the detent notches are approximately 90° removed from detents on the tubes. Use shroud tube washers (maximum of two) to bring minimum overlap between the spring and detent lugs to 1/8 inch and insert tube ends through oil seals in the adapter. Hold both push rod shroud tubes with detent at inner end at unlocked position and insert the outer ends of tubes in holes in cylinder head rocker box. See that all seals are inserted squarely, and turn each shroud tube 90° thus locking the tubes by engaging the detents with the notches in the spring. Select the proper push rods, dip ball ends in preservative oil and insert full length through shroud tubes.

(12) Assemble cap on end of exhaust valve stem and assemble each rocker in its respective position between the bosses; insert the thrust washer between the rocker and inner box and slide valve rocker shaft in place to retain the rocker.

(13) 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 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 lifter spring. While holding the spring compressed, check clearance with feeler gage; the clearance should be between 0.040 and 0.105 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 valve clearance.

(14) Install rocker box covers, inter-cylinder baffles, spark plugs, intake pipes, ignition cables, fuel drain lines, exhaust manifold, plus any clips that may have been removed at disassembly.

5. TURBOCHARGER EXHAUST BYPASS VALVE SETTINGS. The butterfly valve in the exhaust bypass valve is set to a predetermined open and closed clearance. The open and closed positions and directions on how to set them are called out in Figures 5-2 and 5-3.

6. SETTING FUEL INJECTOR AND CONTROLLER LINKAGE.

The fuel injector and controller linkage must be set as described below to provide the proper amount of turbocharging and fuel metering to the engine.

a. Remove no. 2 and 4 intake pipes on TIO-541 engines and necessary baffling. Cover intake ports to prevent foreign objects from falling into cylinder. Disconnect aircraft throttle cable from cross shaft control lever. Remove injector connecting rod from both the cross shaft control lever and the throttle lever.

NOTE

In order to insure proper settings, all washers and spacers must be installed properly as specified in Figure 5-10.

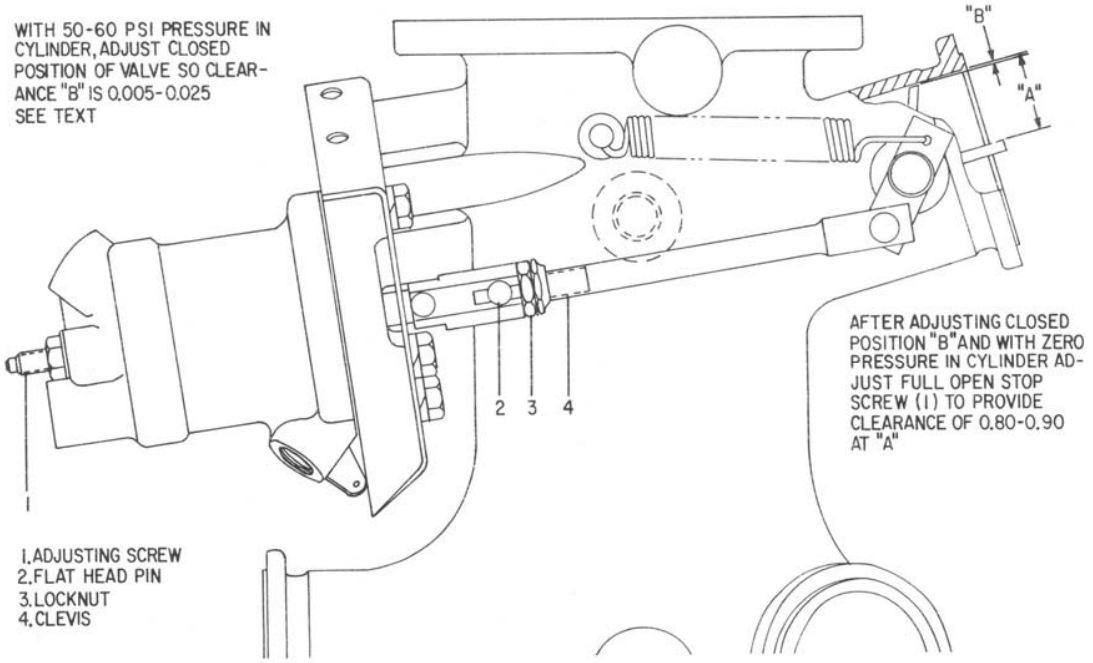

Figure 5-2. Open and Closed Position of Exhaust Bypass Valve – TIO-541-A1A, -E1A5, -E1B4

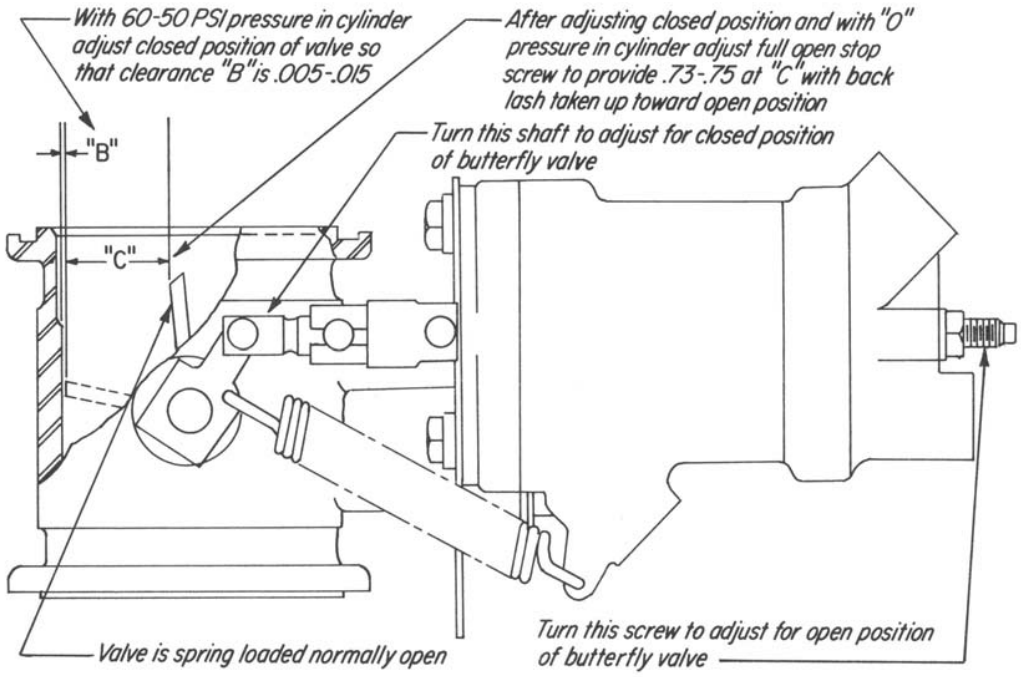

Figure 5-3. Open and Closed Position of Exhaust Bypass Valve – TIO-541-E1C4, -E1D4

b. Position the cross shaft control lever using fixture ST-319 thus: Mount the fixture over no. 4 cylinder hold-down 3/8 inch studs and nuts. Secure with two (P/N 383-B) nuts. If unable to secure with nuts because of insufficient thread, hold the fixture by hand. The fixture in position is shown in Figure 5-4.

c. Back off idle stop adjusting screw until it just touches the injector stop pin when the throttle butterfly is fully closed. Check clearance with a piece of shim stock or a .0015-inch feeler gage. See Figure 5-5.

d. Place gage (ST-318) over injector stop pin with side marked ".040" down and between pin and end of idle stop adjusting screw. Do not turn from full closed setting at this time. See Figure 5-6.

e. Align hole in ball end of injector connecting rod; hole in cross shaft control lever and hole in fixture. Insert fixture pin through all three holes. See Figure 5-4. With throttle lever held firmly against gage on injector, adjust the connecting rod length (maintaining approximately equal thread engagements on both ends) and attach to throttle lever. Remove fixture (ST-319) and attach injector connecting rod to the cross shaft control lever using hardware shown in Figure 5-10. Remove gage (ST-318).

f. Replace gage (ST-318) on injector stop pin with the side marked ".025" up. This is the desired clearance between the pad of the throttle arm and the injector stop pin with the throttle lever in full open position. Move cross shaft control lever forward to put injector throttle lever in full open position and maintain a constant pressure between the throttle arm pad and the gage while completing the following step. See Figure 5-7.

g. Remove the controller connecting rod at the controller end. Push the controller arm against the full boost stop pin (forward). See Figure 5-8. With the controller arm in this position and the throttle lever in the position obtained in the preceding step, adjust the controller connecting rod (maintaining approximately equal thread engagement on both ends) to match hole locations in both the controller arm and the connecting rod. Attach the connecting rod to the controller arm and remove the gage from the injector stop pin. See Figure 5-9.

h. Check to make certain that all connecting rods are installed with the proper hardware (see Figure 5-10); jam nuts and linkage nuts are tight, and safety the linkage nuts with cotter pins.

i. Reset the idle stop adjusting screw until correct idle is obtained. If throttle lever on the aircraft console is misaligned, adjustment may be made either at the ball end of the aircraft throttle cable or by moving the bracket which holds the throttle cable to the engine. Attach aircraft throttle cable to top hole of the cross shaft control lever.

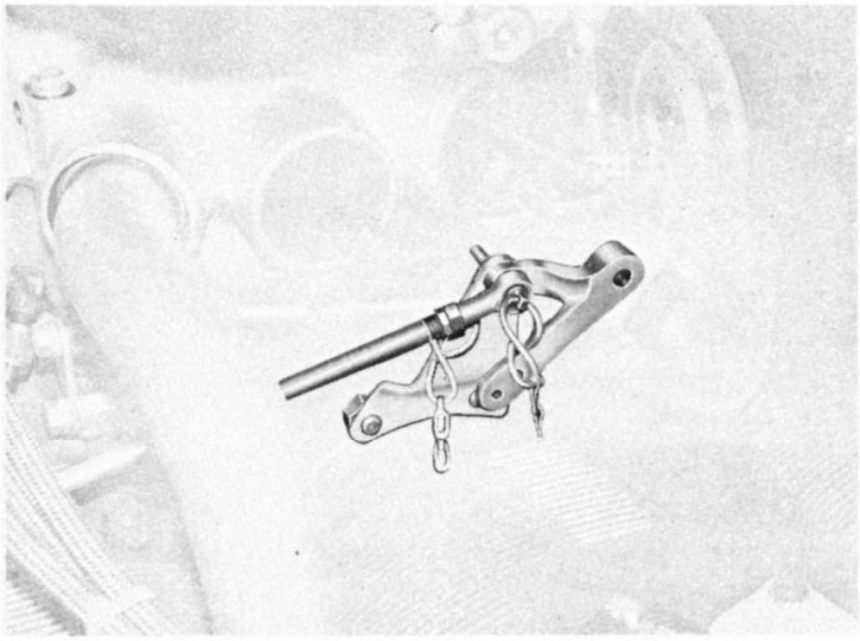

Figure 5-4. Fixture ST-319 Installed and Showing Cross Shaft Control Level in Closed Throttle Position

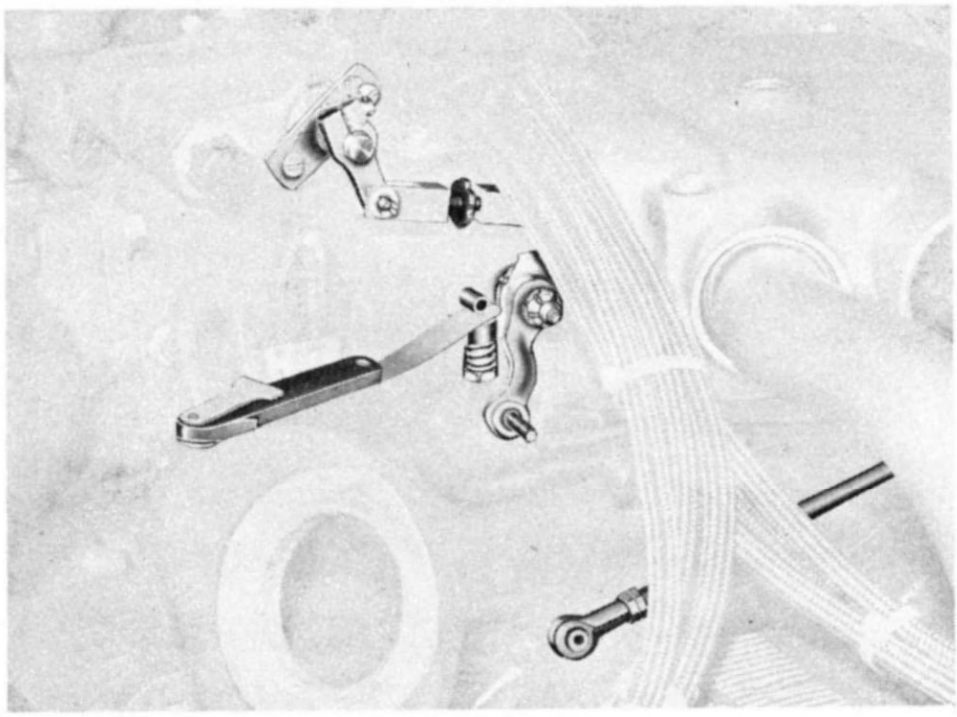

Figure 5-5. Setting Idle Adjusting Screw at Injector Stop Pin

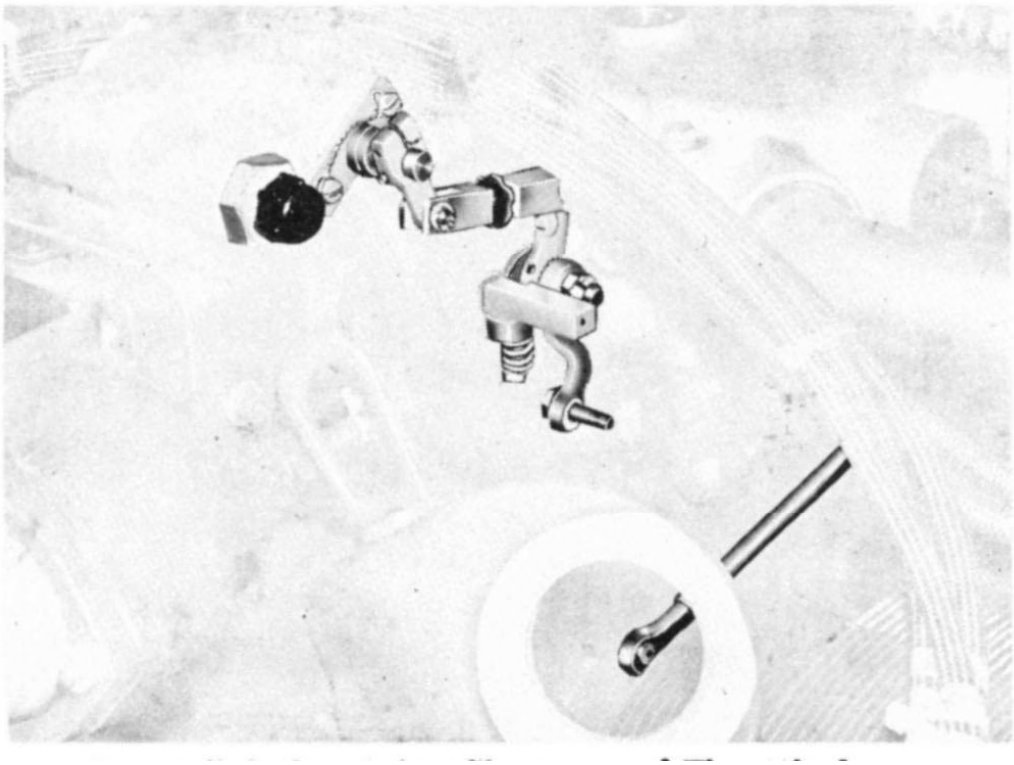

Figure 5-6. Obtaining Clearance of Throttle Lever in Closed Position

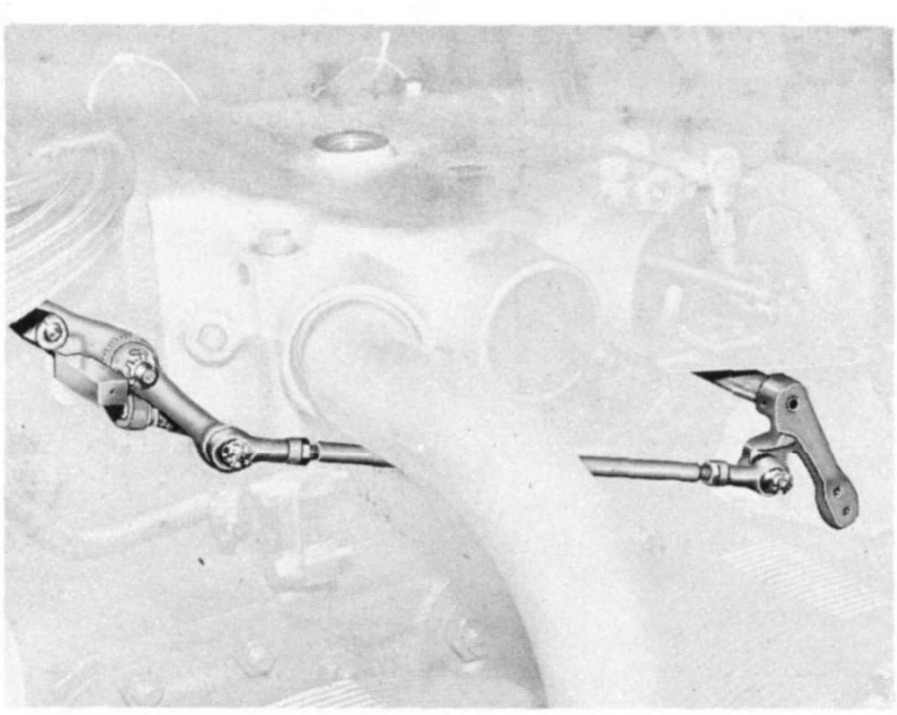

Figure 5-7. Obtaining Clearance of Throttle Lever in Full Open Position

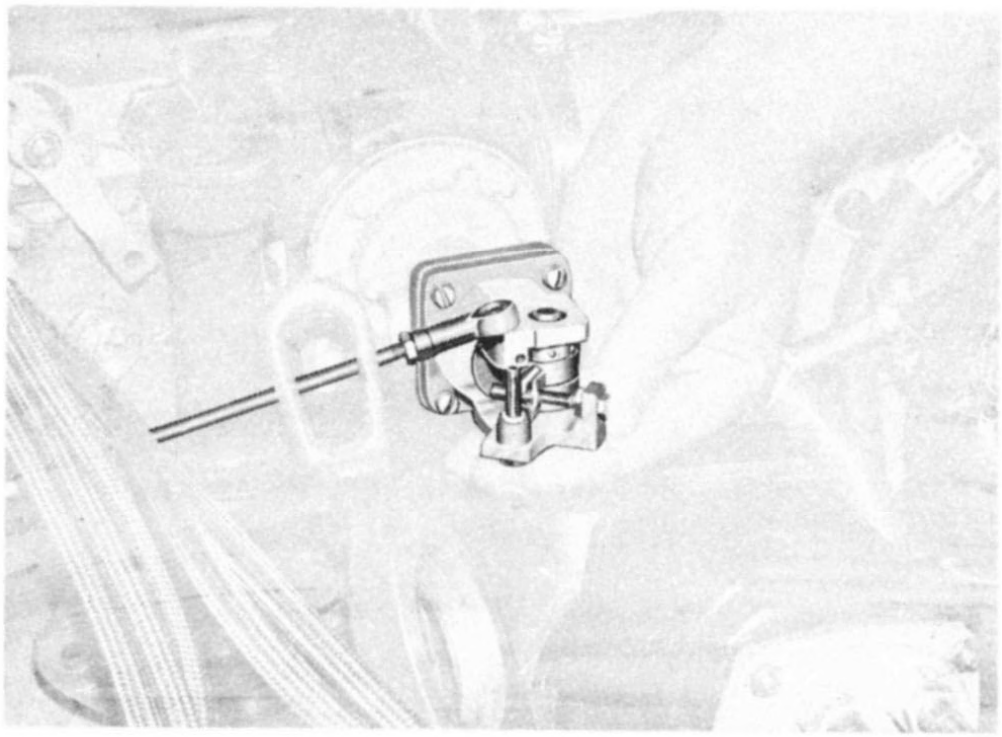

Figure 5-8. View Showing Controller Arm in Full Boost Position

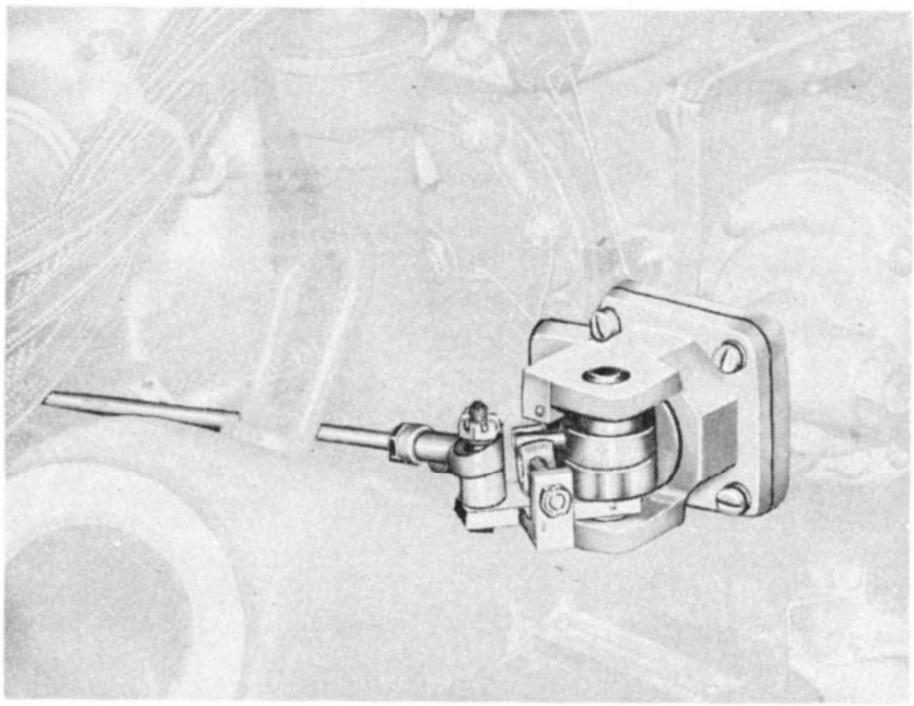

Figure 5-9. View Showing Controller Connecting Rod Secured
To Controller Arm in Full Boost Position

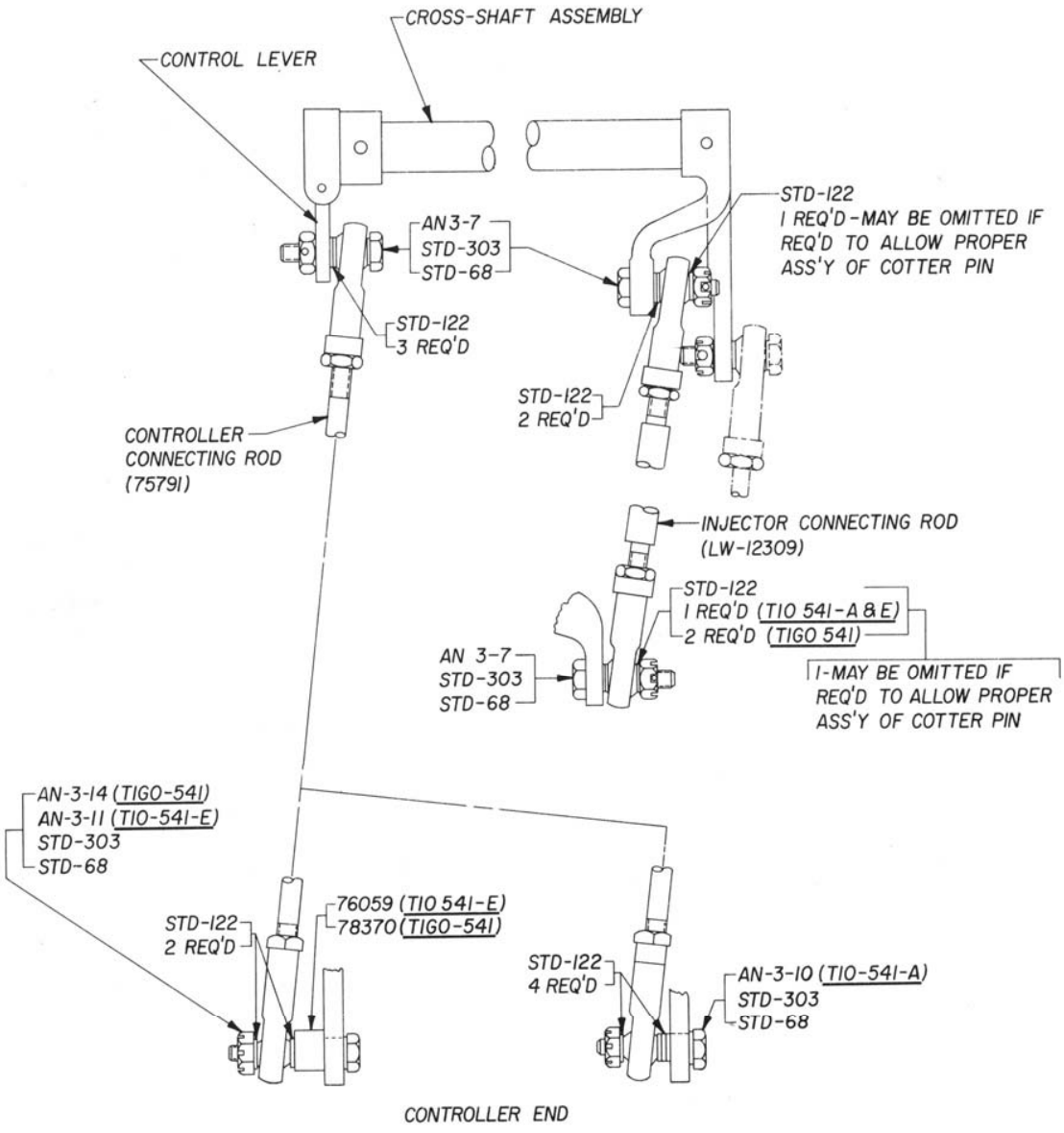

Figure 5-10. Fuel Injector and Controller Rods Attaching Parts

SECTION 6
TROUBLE-SHOOTING – ENGINE

TROUBLE-SHOOTING – TURBOCHARGER

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SECTION 6

TROUBLE-SHOOTING

Experience has proven that the best method of trouble-shooting is to decide on the various possible 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 aircraft engines and turbochargers; 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.	Unload engine by standard clearing procedure.
	Incorrect throttle setting.	Open throttle to ¼ of its range.
	Defective spark plugs.	Clean and adjust or replace spark plugs.
	Defective ignition wire.	Check with tester and replace any defective wires.
	Improper operation of magneto.	Clean points. Check timing.
	Internal failure.	Check oil screens for metal particles. If found, complete overhaul of engine is indicated.
Failure of Engine to Idle Properly	Incorrect idle mixture.	Adjust mixture control.
	Incorrect idle speed.	Adjust idle speed.
	Leak in induction system.	Tighten all connections and replace any defective parts.
	Uneven cylinder compression.	Check condition of piston rings and valve seats.
	Faulty ignition system.	Check ignition system.

TROUBLE	PROBABLE CAUSE	REMEDY
Low Power and Uneven Running	Mixture too rich; indicated by sluggish engine, red exhaust flame. Extreme cases indicated by black smoke at exhaust.	Readjustment of fuel injector is indicated.
	Mixture too lean; indicated by overheating and back firing.	Check fuel lines for restrictions. Readjust mixture.
	Leak in induction system.	Tighten all connections, replace any 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 timing.
	Defective ignition wire.	Check wires with tester, replace any defective wires.
	Defective spark plug terminal connectors.	Check and replace connectors if necessary.
Failure of Engine to Develop Full Power	Leak in induction system.	Tighten all connections, replace any defective parts.
	Throttle lever out of adjustment.	Check travel of throttle linkage.
	Improper fuel flow.	Check strainers and flow at fuel injector.
	Restriction in air scoop.	Examine air scoop and remove any obstructions.
	Improper fuel.	Drain and refill tank with fuel of recommended grade.
	Faulty ignition.	Check ignition system.
Rough Engine	Cracked engine mount.	Replace or repair mount.
	Defective mounting busing.	Replace bushing.
	Uneven compression.	Check condition of piston rings and valve seats.

TROUBLE	PROBABLE CAUSE	REMEDY
Low Oil Pressure	Insufficient oil.	Fill sump with oil.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	Dirty oil strainers.	Remove and clean oil strainers.
	High oil temperatures.	See "High Oil Temperatures" in "Trouble" column.
	Defective pressure gage.	Replace gage.
	Stoppage in oil pump intake passage.	Check line for obstruction.
High Oil Temperature	Insufficient oil supply.	Fill sump with oil of recommended grade.
	Low grade of oil.	Drain and fill sump with oil conforming to specifications.
	Clogged oil lines or strainers.	Clean oil lines and strainers.
	Excessive blow-by.	Usually caused by worn or struck rings.
	Failed or failing bearings.	Examine oil strainers for metal particles. If found, overhaul of engine is indicated.
	Defective temperature gage.	Replace gage.
Excessive Oil Consumption	Low grade of oil.	Fill sump with oil conforming to specifications.
	Failing or failed bearings.	Examine oil strainers for metal particles. If found, overhaul of engine is indicated.
	Worn piston rings.	Install new rings.
	Incorrect installation of piston rings.	Install new rings.
	Failure of rings to seat (new nitrided barrels).	Climb to cruise altitude at full power and operate at 75% cruise power setting until consumption stabilizes.

2. TROUBLE-SHOOTING – TURBOCHARGER

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive Noise or Vibration	Improper bearing lubrication.	Supply required oil pressure. Clean or replace oil line. If trouble continues, overhaul turbocharger.
	Leak in engine intake or exhaust manifold.	Tighten loose connections, or replace manifold gaskets as necessary.
Engine Will Not Deliver Rated Power	Clogged manifold system.	Clean all ducting.
	Foreign material lodged in compressor impeller or turbine.	Disassemble and clean.
	Excessive dirt build-up in compressor.	Thoroughly clean compressor assembly. Service air cleaner and check for leakage.
	Leak in engine intake or exhaust manifold.	Tighten loose connections, or replace manifold gaskets as necessary.
	Rotating assembly bearing seizure.	Overhaul turbocharger.
	Restriction in return lines from exhaust bypass valve to variable pressure controller.	Remove and clean lines.
	Variable pressure controller out of adjustment.	Adjust variable pressure controller.
	Oil pressure too low.	Tighten fittings, replace lines or hoses. Increase oil pressure.
	Oil inlet to exhaust bypass valve clogged.	Remove oil line at inlet and clean orifice.
	Variable pressure controller malfunction.	Adjust controller. Install new controller if needed.
	Exhaust bypass valve not closing because of low oil pressure or butterfly shaft binding.	Check for oil pressure difficulty. Examine shaft for evidence of binding.

TROUBLE	PROBABLE CAUSE	REMEDY
Engine Will Not Deliver Rated Power (Cont.)	Impeller binding, frozen or fouling housing.	Check bearings for evidence of failure. Overhaul turbocharger.
	Piston seal in exhaust bypass valve actuator leaking.	Replace piston seal.
Critical Altitude Lower Than Specified	Controller not getting enough oil pressure to close bypass valve.	Check pump outlet pressure, oil filters and lines for leaks or obstructions.
	Chips under metering valve in controller holding it open.	Replace controller.
	Metering jet in exhaust bypass valve actuator plugged.	Remove exhaust bypass valve actuator and clean jet.
	Exhaust bypass valve actuator piston seal leaking excessively.	Clean cylinder and replace piston seal.
	Exhaust bypass valve sticking.	Clean and free action.
Engine Surges or Smokes	Air in oil lines or exhaust bypass valve actuator.	Bleed system.
	Controller metering valve stem seal leaking oil into manifold.	Replace controller.
	Exhaust bypass valve actuator to bypass valve linkage binding.	Correct cause of binding.
	Clogged breather.	Check breather for restriction to air flow.
	NOTE	
	Smoke would be normal if engine has idled for a prolonged period.	
High Deck Pressure (Compressor Discharge Pressure)	Controller metering valve not opening.	Replace controller.
	Exhaust bypass valve sticking closed.	Shut off valve in return line inoperative.
	Controller return line restricted.	Clean or replace line.
	Oil pressure too high.	Reduce oil pressure.
	Exhaust bypass valve actuator piston locked in closed position.	Disassemble actuator, check condition of piston and packing.
	Variable pressure controller malfunction.	Replace controller.

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SECTION 7
INSTALLATION AND STORAGE

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SECTION 7

INSTALLATION AND STORAGE

1. UNPACKING.

General – Lycoming TIO-541 series aircraft engines are securely packed for shipment, one to the crate in a horizontal position. The attaching parts are packed in a separate carton within the engine crate.

Unpacking – Open shipping crate. Remove inner carton containing loose attaching parts. Attach lifting cable to lifting eyes. With a suitable hoist take up the slack cable. Remove the bolts and lift engine clear of shipping crate. With the engine in this position, remove the bottom plugs from each cylinder and rotate crankshaft a few revolutions to drain the oil from the cylinders. Assemble spark plugs and clean the exterior of the engine thoroughly.

2. PREPARATION OF ENGINE FOR INSTALLATION. Before installing an engine that has been prepared for storage, remove all dehydrator plugs and preservative oil. 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 content shall fall into the engine, that portion of the engine must be disassembled and thoroughly cleaned before using 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 plugholes. 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 drain 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 filled with lubricating oil. The latest revision of Service Instruction No. 1014 contains complete lubricating oil recommendations. The crankshaft should again be turned several revolutions to saturate the interior of the engine with 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 not in sufficient quantity to prove harmful. 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 be 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.

The oil strainers should be removed and cleaned in gasoline or some other hydrocarbon solvent. The fuel filter screen located in the fuel inlet of the throttle body should also be removed and cleaned in a hydrocarbon solvent. Inject clean fuel into the fuel inlet with the fuel outlets uncapped until clean fuel flows from the outlets. Do not exceed 15 psi inlet pressure. 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 lubricating oil.

Inspection of Engine Mounting – If the aircraft is one from which an engine has been removed, make sure that the engine mounts are not bent or damaged by distortion or misalignment. If so, abnormal stresses can be produced within the engine.

Attaching Engine to Mounts – See aircraft manufacturer's recommendations for method of mounting engine.

Engine Accessories – Considerable time and effort can be saved if the accessories are assembled on the engine before installation in the airframe.

CORROSION PREVENTION IN ENGINES INSTALLED IN INACTIVE AIRCRAFT

Corrosion can occur, especially in new or overhaul 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 the 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 if 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.

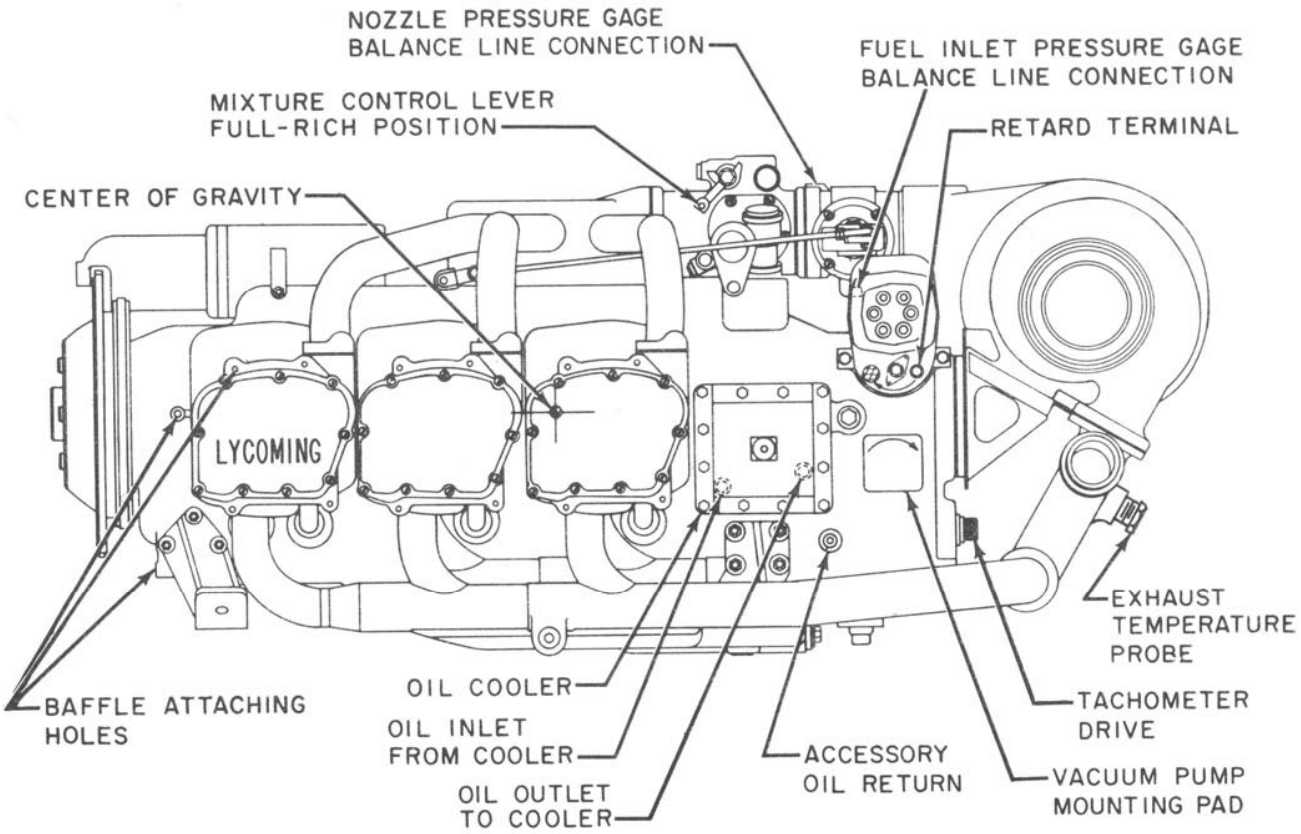

Figure 7-1. Installation Drawing – Left Side View – TIO-541-A Series

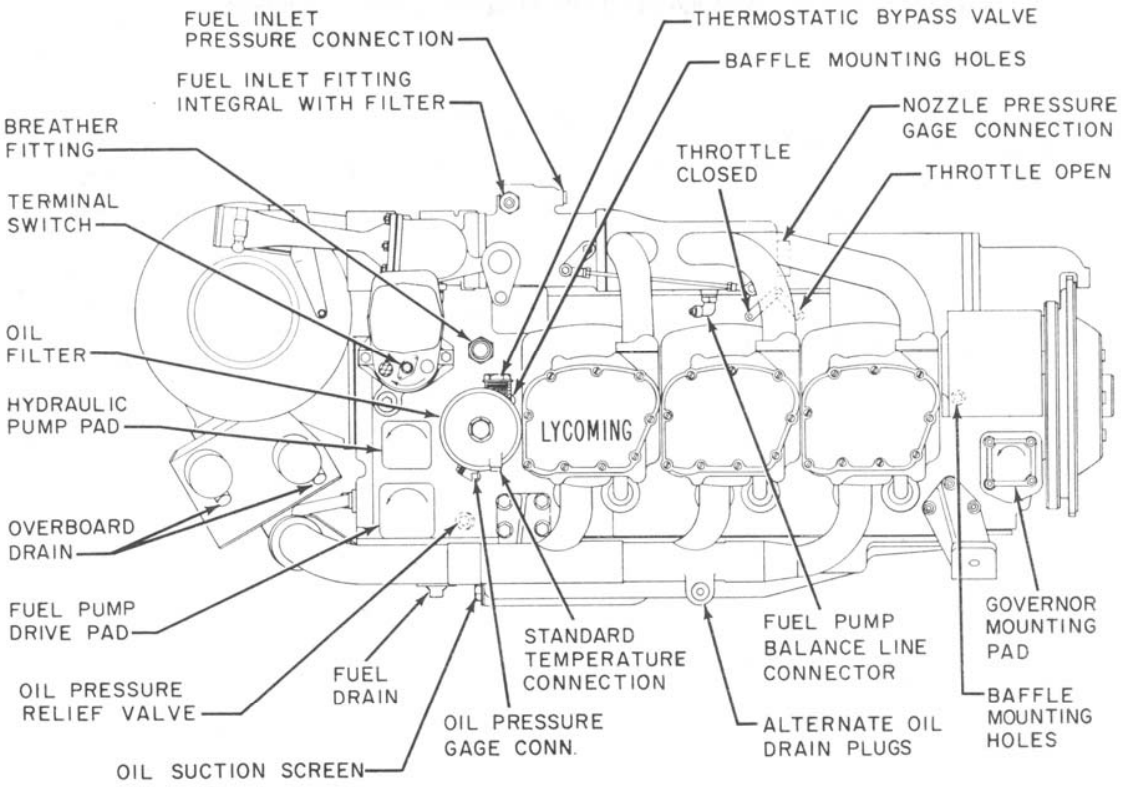

Figure 7-2. Installation Drawing – Right Side View – TIO-541-A Series

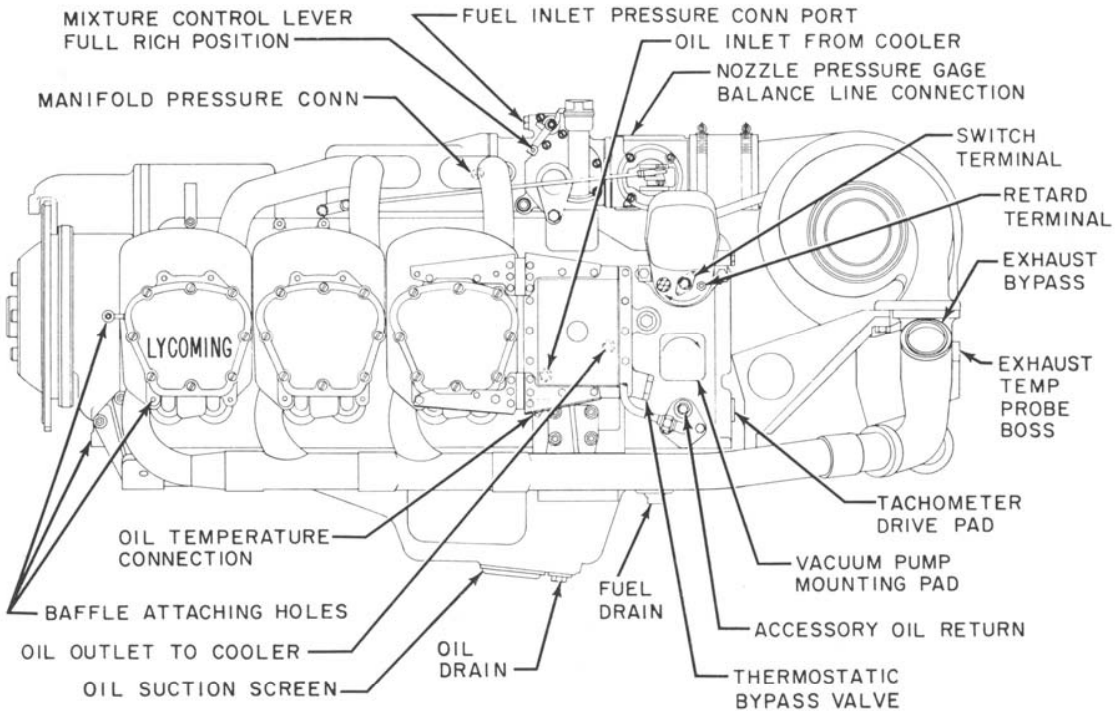

Figure 7-3. Installation Drawing – Left Side View – TIO-541-E Series

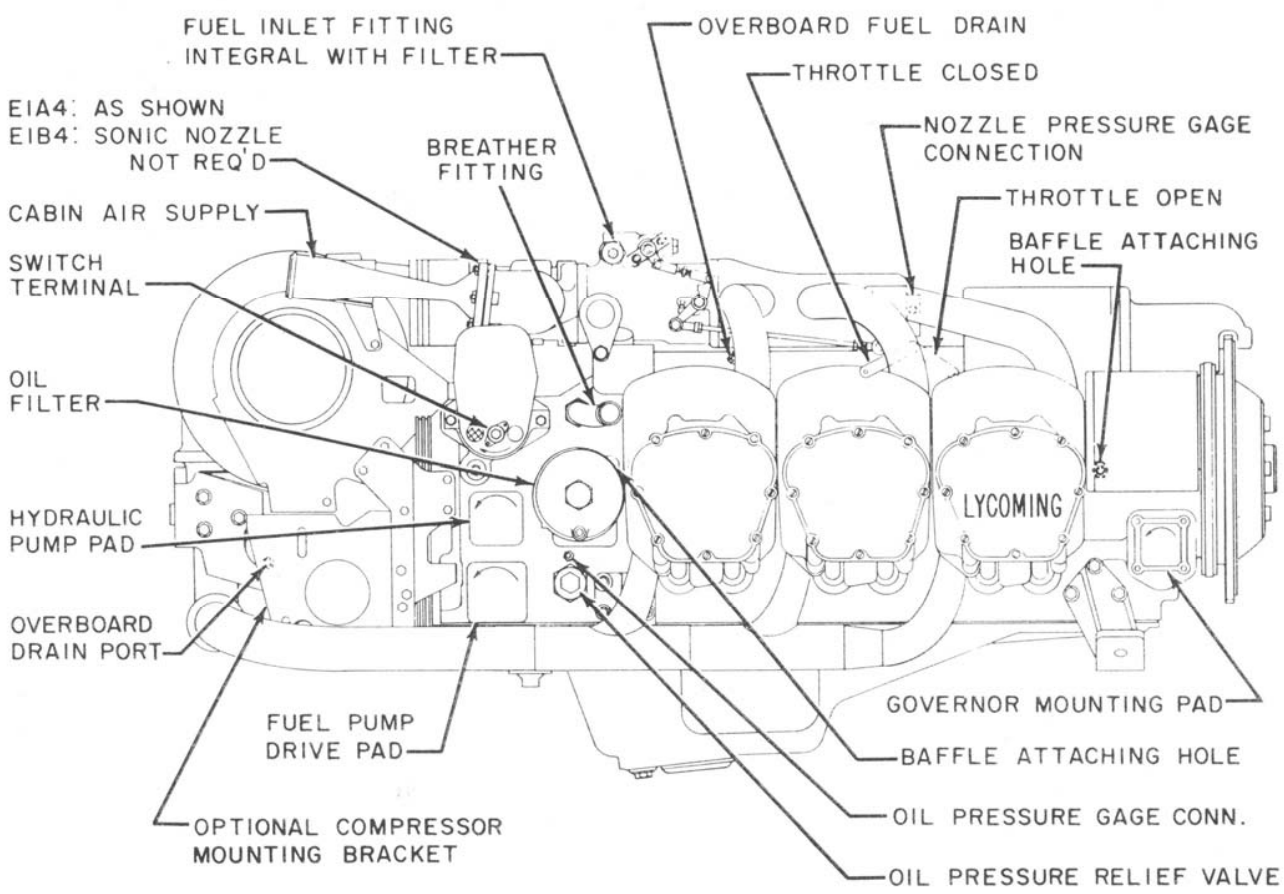

Figure 7-4. Installation Drawing – Right Side View – TIO-541-E Series

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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 LYCOMING SERVICE INSTRUCTION NO. 1029 AND NO. 1150 FOR THE PROPER PROCEDURE FOR TIGHTENING CYLINDER BASE HOLD DOWN NUTS TO CORRECT TORQUE.

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.

TABLE OF SPEED EQUIVALENTS

Sec./Mi.	M.P.H.	Sec./Mi.	M.P.H.	Sec./Mi.	M.P.H.
72.0	50	27.7	130	17.1	210
65.5	55	26.6	135	16.7	215
60.0	60	25.7	140	16.4	220
55.4	65	24.8	145	16.0	225
51.4	70	24.0	150	15.6	230
48.0	75	23.2	155	15.0	240
45.0	80	22.5	160	14.4	250
42.3	85	21.8	165	13.8	260
40.0	90	21.2	170	13.3	270
37.9	95	20.6	175	12.8	280
36.0	100	20.0	180	12.4	290
34.3	105	19.4	185	12.0	300
32.7	110	18.9	190	11.6	310
31.3	115	18.4	195	11.2	320
30.0	120	18.0	200	10.9	330
28.8	125	17.6	205	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.

C	F-C	F	C	F-C	C
-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

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	.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