Operator's Manual

Lycoming

IO-720 Series

Approved by FAA

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LYCOMING

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IO-720 Series Operator's Manual

Lycoming Part Number: 60297-19

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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 LETTTERS

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.

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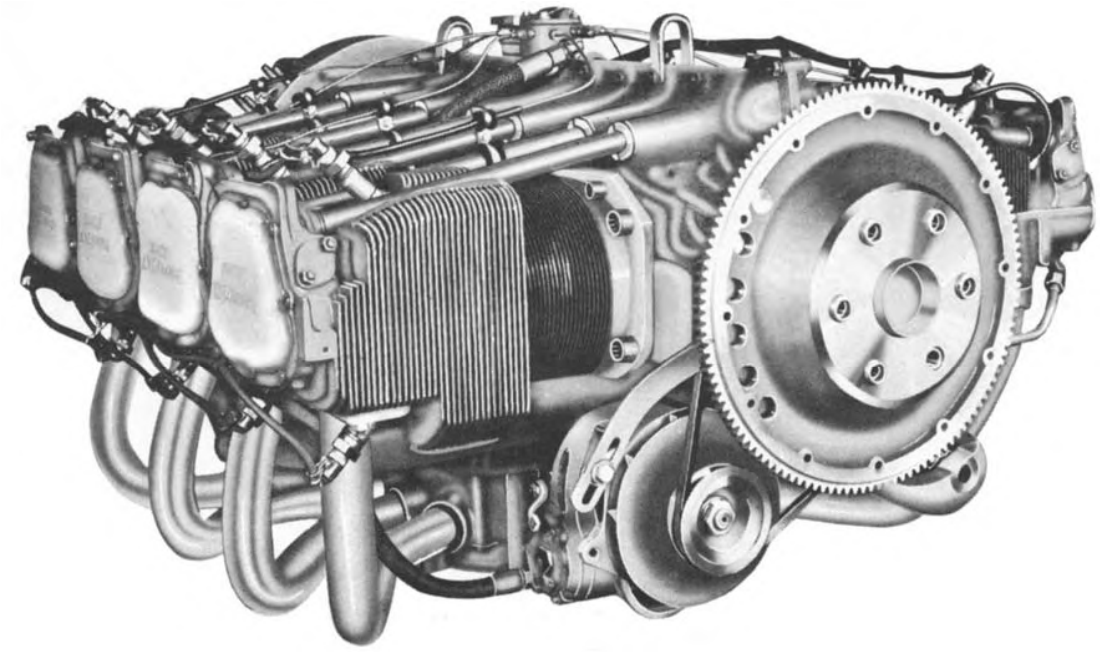

¾ Right Front View – Typical IO-720

SECTION 1
DESCRIPTION

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SECTION 1

DESCRIPTION

The Lycoming model IO-720 is an eight cylinder, direct drive, horizontally opposed, fuel injected, air cooled engine.

When referring to the location of the various engine component parts, 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 where the shroud tubes are located is 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 and even numbers on the left. The direction of rotation for the accessory drives is determined with the observer facing the accessory 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 as an integral part of 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.

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. Piston cooling oil nozzles are incorporated in the crankcase for each piston.

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

Valve Operating Mechanism – A conventional type camshaft is located above and parallel to the crankshaft. The camshaft actuates the hydraulic tappets which operate the valves through push rods and valve rockers. The hydraulic tappets 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 and are retained on the valve stems by means of split keys.

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

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

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

Oil Sump – The sump is provided with two oil drain plugs and an oil suction screen. The induction housing assembly, mounted on the bottom of the sump contains a mounting pad for the fuel injector and connections for the intake pipes.

Propeller Governor – A propeller governor drive AND20010, type XX located on the left front half of the crankcase can be furnished as optional equipment.

Vacuum Pump – A vacuum pump drive in accordance with AND20000 mounted on the accessory housing is available as optional equipment.

Hydraulic Pump – A hydraulic pump in accordance with AND20000 mounted on the accessory housing is available as optional equipment.

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 air through the cylinder fins. The air is then exhausted to the atmosphere through gills or augmenter tubes usually located at the rear of the cowling.

Induction System – IO-720 series engines employ a Bendix RSA type fuel injection system. This system is based on the principle of measuring airflow and using the airflow signal in a stem type regulator to convert air force into a fuel force. This fuel force (fuel pressure differential) when applied across the fuel metering section (jetting system) makes fuel flow proportional to airflow.

Metered fuel is carried from the fuel injector by an external line to the flow divider from which it is carried in individual lines to nozzles at each cylinder intake port. Manual mixture control and idle cut-off are provided.

Ignition System – Dual ignition is furnished by two Bendix magnetos. Some models employ the –700 series while others employ the –1200 series. See Table of Models for model application. The –700 series produces low tension current carried by a low tension lead assembly to the transformer from which a high tension lead assembly carries the high tension current back to the magneto where it is distributed by high tension leads to individual spark plug locations. The –1200 series magnetos are of the high-tension type and current is carried direct from the magneto to each spark plug.

Both the –700 and the –1200 series magnetos incorporate an integral feed-thru capacitor and require no external noise filter in the ground leads. A source of DC power and a starting vibrator are required to complete the installation.

Lubrication System – The lubrication system is of the pressure wet sump type. The main bearings, connecting rod bearings, camshaft bearings, valve tappets, and push rods are lubricated by positive pressure. Piston pins, gears, cylinder walls, and other parts are lubricated by means of oil collectors and spray. The oil pump, which is located in the accessory housing, draws oil through a drilled passage leading from the oil suction screen located in the sump. The oil from the pump then enters a drilled passage in the accessory housing, which feeds the oil to a threaded connection on the rear face of the accessory housing, where a flexible line leads the oil to the external oil cooler. Pressure oil from the cooler returns to a second threaded connection on the accessory housing from which point a drilled passage conducts the oil to the oil pressure screen, which is contained in a cast chamber mounted on the accessory housing. In the event that cold oil or an obstruction should restrict the flow of oil to the cooler, an oil cooler bypass valve is provided to pass the pressure oil directly from the oil pump to the oil pressure screen chamber.

The oil pressure screen is provided as a means to filter from the oil any solid particles that may have passed through the suction screen in the sump. After being filtered in the pressure screen chamber, the oil is fed through a drilled passage to the oil pressure relief valve, located in the upper right side of the crankcase in the front of the accessory housing.

The relief valve regulates the engine oil pressure by allowing excessive oil to return to the sump, while the balance of the pressure oil is fed to the main oil gallery in the right half of the crankcase. During its travel through this main gallery, the oil is distributed by means of separate drilled passages to the main bearings of the crankshaft. The drilled passages to the bearings are located in such a manner as to form an inertia type filter. Thus only the cleanest oil will be fed to the bearings. Separate passages from the rear main bearing supply pressure oil to both crankshaft idler gears. Angular holes are drilled through the main bearings to the rod journals. Oil from main oil gallery also flows to the cam and valve gear passages, and is then conducted through branch passages to the hydraulic tappets and camshaft bearings. Oil enters the tappet through indexing holes and travels out through the hollow push rods to the valve mechanism, lubricating the valve rocker bearing and valve stems. Residual oil from the bearings, accessory drives, and the rocker boxes is returned by gravity to the sump, where after passing through a screen it is again circulated through the engine.

Priming System – Priming is provided by the fuel injector. A separate priming system is not required.

NOTE

The letter "D" used as the 4th or 5th character in the model suffix means the basic model configuration has been altered by the use of a dual magneto housed in a single housing. Example: basic model IO-720-B1B becomes IO-720-B1BD.

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

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SECTION 2
SPECIFICATIONS

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SECTION 2

SPECIFICATIONS

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 specification 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

IO-720 SERIES

FAA Type Certificate	1E15
Rated horsepower	400
Rated speed, RPM	2650
Bore, inches	5.125
Stroke, inches	4.375
Displacement, cubic inches	722
Compression ratio	8.7:1
Firing order	1-5-8-3-2-6-7-4
Spark occurs, degrees BTC	20°
Valve rocker clearance (hydraulic tappets collapsed)	.028-.080
Propeller drive ratio	1:1
Propeller drive rotation (viewed from rear)	Clockwise

ACCESSORY DRIVES

*Accessory Drive	Drive Ratio	**Direction of Rotation
Starter	13.556:1	Counterclockwise
Alternator	3.250:1	Clockwise
Magneto –700 Series	0.500:1	
Magneto –1200 Series	1.000:1	
Generator	2.500:1	Clockwise
Generator	3.100:1	Clockwise
Vacuum Pump	1.300:1	Counterclockwise
Hydraulic Pump	1.300:1	Clockwise
Tachometer	0.500:1	Clockwise
Prop Governor	0.895:1	Clockwise
Fuel Pump - +	1.000:1	Counterclockwise

* - Where applicable.

** - Facing drive pad.

\+ - Clockwise drive on dual magneto models.

DETAIL WEIGHTS

1. STANDARD ENGINE, DRY WEIGHT

MODEL	LBS.
IO-720-B1A, -B1B, -B1BD	593
IO-720-A1BD	597
IO-720-A1A, -A1B	601
IO-720-C1B	602
IO-720-D1BD, -D1CD	607
IO-720-D1B, -D1C	616

Above weight includes fuel injector, fuel pump drive, fuel pump, magnetos, ignition harness, spark plugs, tachometer drive, starter and alternator drive, starter, alternator, and intercylinder baffles.

DIMENSIONS, INCHES

Model	Height	Weight	Length
IO-720-B1A	20.63	34.25	46.08*
IO-720-B1B	20.63	34.25	46.47*
IO-720-B1BD	20.88	34.25	47.97*
IO-720-D1B, -D1C	22.06	34.25	46.41*
IO-720-D1BD, -D1CD	22.11	34.25	46.80*
IO-720-A1BD	22.53	34.25	46.06*
IO-720-A1A	22.53	34.25	46.08*
IO-720-A1B	22.53	34.25	46.41*
IO-720-C1B	22.53	34.25	46.47*

* - Measured from front face of propeller flange.

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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.

NOTE

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

The minimum fuel octane rating is listed in the flight chart, Part 7 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.*

NOTE

Cranking periods must be limited to ten (10) to twelve (12) seconds with a five (5) minute rest between cranking periods.

a. Normal Start.

(1) Perform pre-flight inspection.

(2) Head aircraft into the wind.

(3) Set propeller governor in "Full RPM" position.

(4) Turn fuel valves on.

(5) Place mixture control in "idle cut-off".

(6) Crack throttle.

(7) Turn boost pump on.

(8) Move mixture control to "full rich" until 5 gal./hour fuel flow is indicated on the fuel flow gage for a period of from 4 to 5 seconds.

(9) Move mixture control to "idle cut-off".

(10) Turn ignition switch to "start".

(11) When engine fires, allow ignition switch to return to "both".

(12) Move mixture control slowly and smoothly to "full rich".

(13) Check oil pressure gage for indicated pressure. If oil pressure is not indicated within thirty seconds stop the engine and determine cause.

NOTE

If engine fails to achieve a normal start, assume it to be flooded and accomplish the following.

1. *Turn boost pump off.*
2. *Move mixture control to "idle cut-off".*
3. *Open throttle full.*
4. *Turn ignition switch to "start".*
5. *When engine is cleared of excess fuel and begins to fire, move mixture control slowly and smoothly to "full rich" and close throttle to idle.*

b. Hot Engines.

(1) Close throttle.

(2) Turn boost pump on.

(3) Prime engine once with mixture control.

(4) As soon as fuel flow is indicated on gage, turn boost pump off and place mixture control in "idle cut-off".

(5) Open throttle at least one inch.

(6) Engage starter.

(7) When engine fires, ease the mixture control slowly and smoothly to "full rich".

c. Cold Engine.

(1) Open throttle ½ inch.

(2) Open fuel valve.

(3) Prime engine by turning the boost pump on and place mixture control in "full rich" for about 3 to 5 seconds.

(4) Proceed with normal start.

NOTE

In extremely cold weather additional priming may be necessary. Preheating the engine and oil will expedite starting.

4. 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.

NOTE

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

a. Head the aircraft into the wind.

b. Leave mixture in "full rich"

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

d. Warm up at approximately 1000-1200 RPM. Avoid prolonged idling and do not exceed 2200 RPM on the ground.

e. Engine is warm enough for take-off when the throttle can be opened without the engine faltering.

5. GROUND CHECK.

a. Warm up as directed in above.

b. Check both oil pressure and oil temperature.

c. Leave mixture in "full rich".

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 gage. Mixture control should be in the full rich position. At these settings the ignition system and spark plugs must work harder because of the greater pressure within the cylinders. Under these conditions ignition problems, if they exist, will occur. Magneto checks at low power settings will only indicate fuel-air distribution quality.

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

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

6. OPERATION IN FLIGHT.

a. Subject engines are equipped with a dynamic counterweight system and must be operated accordingly. Use a smooth, steady movement (avoid rapid opening and closing) of the throttle. Avoid high RPM – low manifold pressure operation.

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

c. Fuel Mixture Leaning Procedure.

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

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

GENERAL RULES

Never exceed the maximum red line cylinder head temperature limit.

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

Maintain mixture control in "Full Rich" position for rated take-off, climb and maximum cruise powers (above approximately 75%). However, during take-off from high elevation airport or during climb roughness or loss of power may result from over-richness. In such a case adjust mixture control only enough to obtain smooth operation – not for economy.

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

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

During let-down flight operations it may be necessary to manually lean engines to obtain smooth operation.

1. *LEANING TO EXHAUST GAS TEMPERATURE GAGE.*

   a. *Maximum Power Cruise (approximately 75% power). Never lean beyond 150°F on rich side of peak EGT unless airframe manufacturer's handbook shows otherwise. Monitor cylinder head temperatures.*

   b. *Best Economy Cruise (approximately 75% power and below). Operate at peak EGT, or if desired, drop 50°F on rich side of peak EGT.*

2. *LEANING TO FLOWMETER.*

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

3. *LEANING WITH MANUAL MIXTURE CONTROL. (Economy cruise, 75% power or less) without flowmeter or EGT gage.)*

   a. *Slowly move mixture control from "full rich" position toward the lean position.*

   b. *Continue leaning until slight loss of power is noted (loss of power may or may not be accompanied by roughness).*

   c. *Enrich until engine runs smoothly and power is regained.*

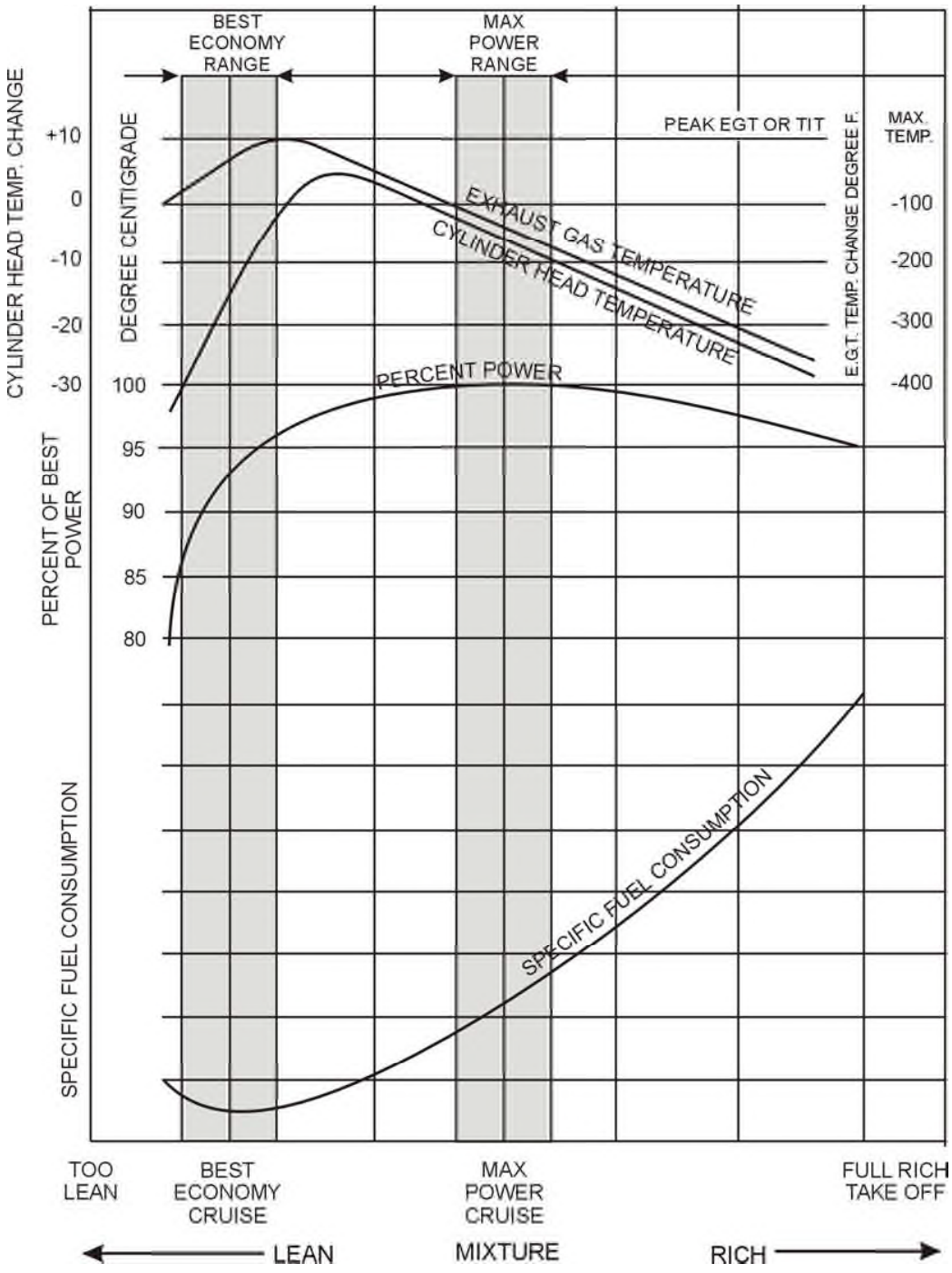

Figure 3-1. Representative Effect of Leaning on Cylinder Head Temperature, EGT (Exhaust Gas Temperature), Engine Power and Specific Fuel Consumption at Constant Engine RPM and Manifold Pressure

7. ENGINE FLIGHT CHART.

FUEL AND OIL – All Models

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

NOTE

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

** - See latest revision of Service Instruction No. 1070.

Average Ambient Air Temperature	*Recommended Grade Oil MIL-L-6082 Single Viscosity Grades	MIL-L-22851 Ashless Dispersant Grades
All Temperatures	--	15W-50 or 20W-50
Above 80°F	60	60
Above 60°F	50	40 or 50
30°F to 90°F	40	40
0°F to 70°F	30	30, 40 or 20W-40
Below 10°F	20	30 or 20W-30

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

OIL SUMP CAPACITY

Nominal.....17 U.S. Quarts
Maximum.....19 U.S. Quarts
Minimum Safe Quantity in Sump.....3 U.S. Quarts

OPERATING CONDITIONS

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

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

OPERATING CONDITIONS (CONT.)

Oil Pressure, psi	Maximum	Minimum	Idling
Normal Operation	90	60	25
Start and Warm-Up	100		
Fuel Pressure, psi	**Max.**	**Min.**	**Idle Min.**
IO-720-A, -C Series			
Inlet to fuel pump	40	-4	
Inlet to fuel injector	40	18	12
IO-720-B Series			
Inlet to fuel injector	35	25	
IO-720-D Series			
Inlet to fuel pump	55	-2.0	
Inlet to fuel injector	40	18	12

Operation	HP	Fuel Cons. Gal./Hr.	Max. Oil Cons. Qts./Hr.	*Max. Cyl. Head Temp.
Normal Rated	400	33.9	1.78	475°F
Performance Cruise (75% Rated)	300	23.3	1.00	475°F
Economy Cruise (65% Rated)	240	16.0	0.80	475°F

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

8. ENGINE SHUT-DOWN.

a. Set propeller at 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.

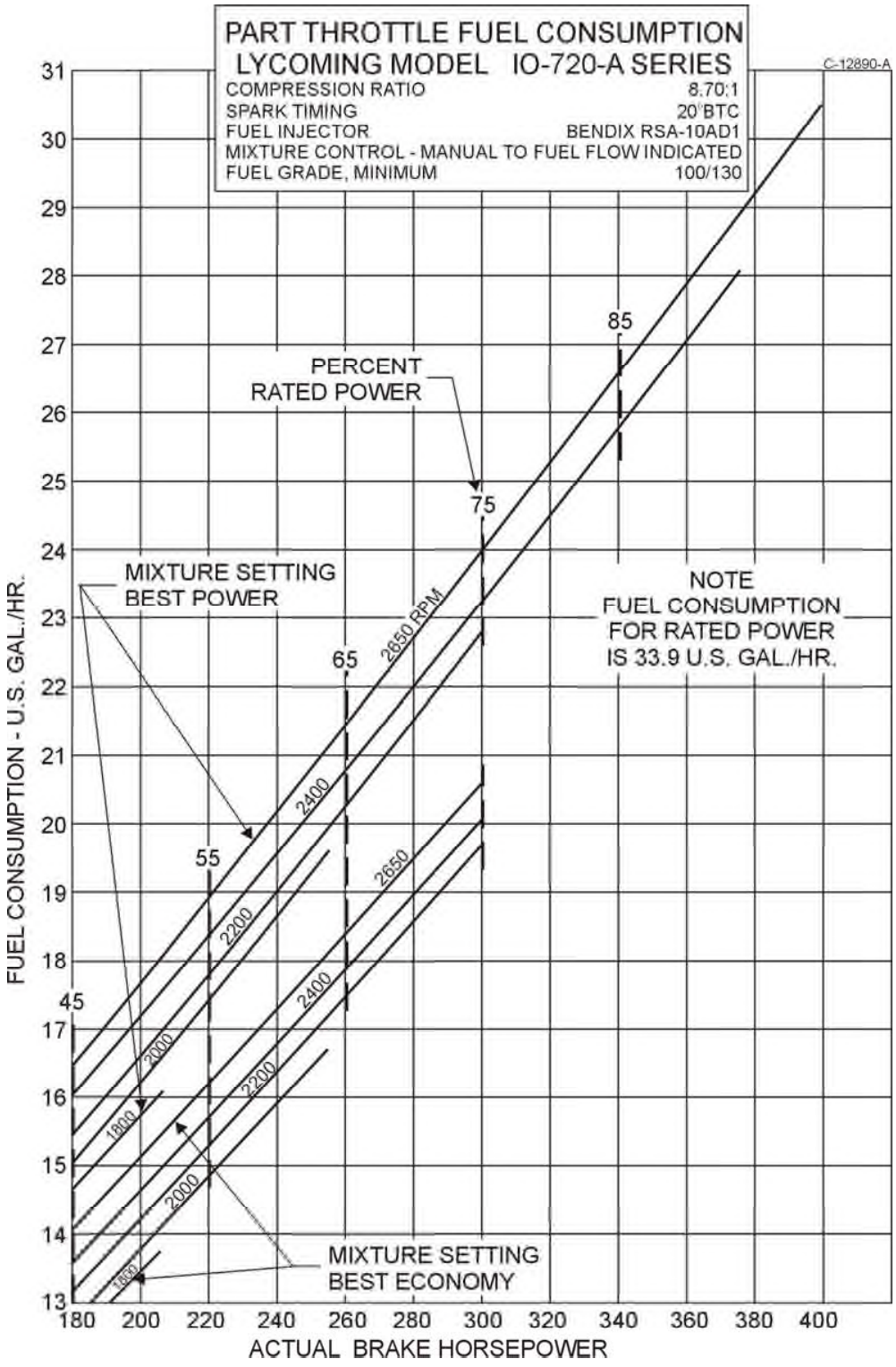

Figure 3-2. Part Throttle Fuel Consumption Curve –
IO-720-A, -C, -D Series

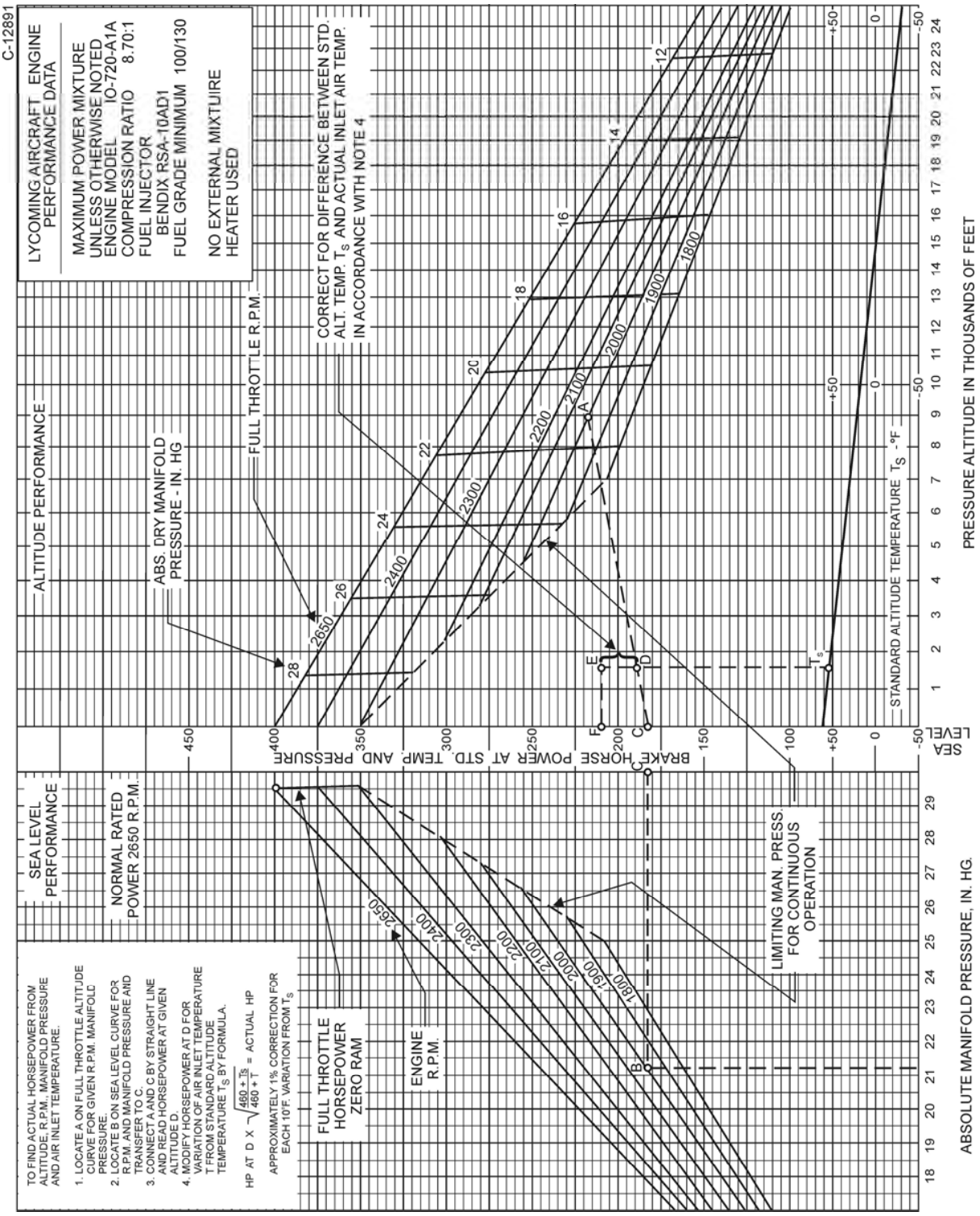

Figure 3-3. Sea Level and Altitude Performance –
IO-720-C Series

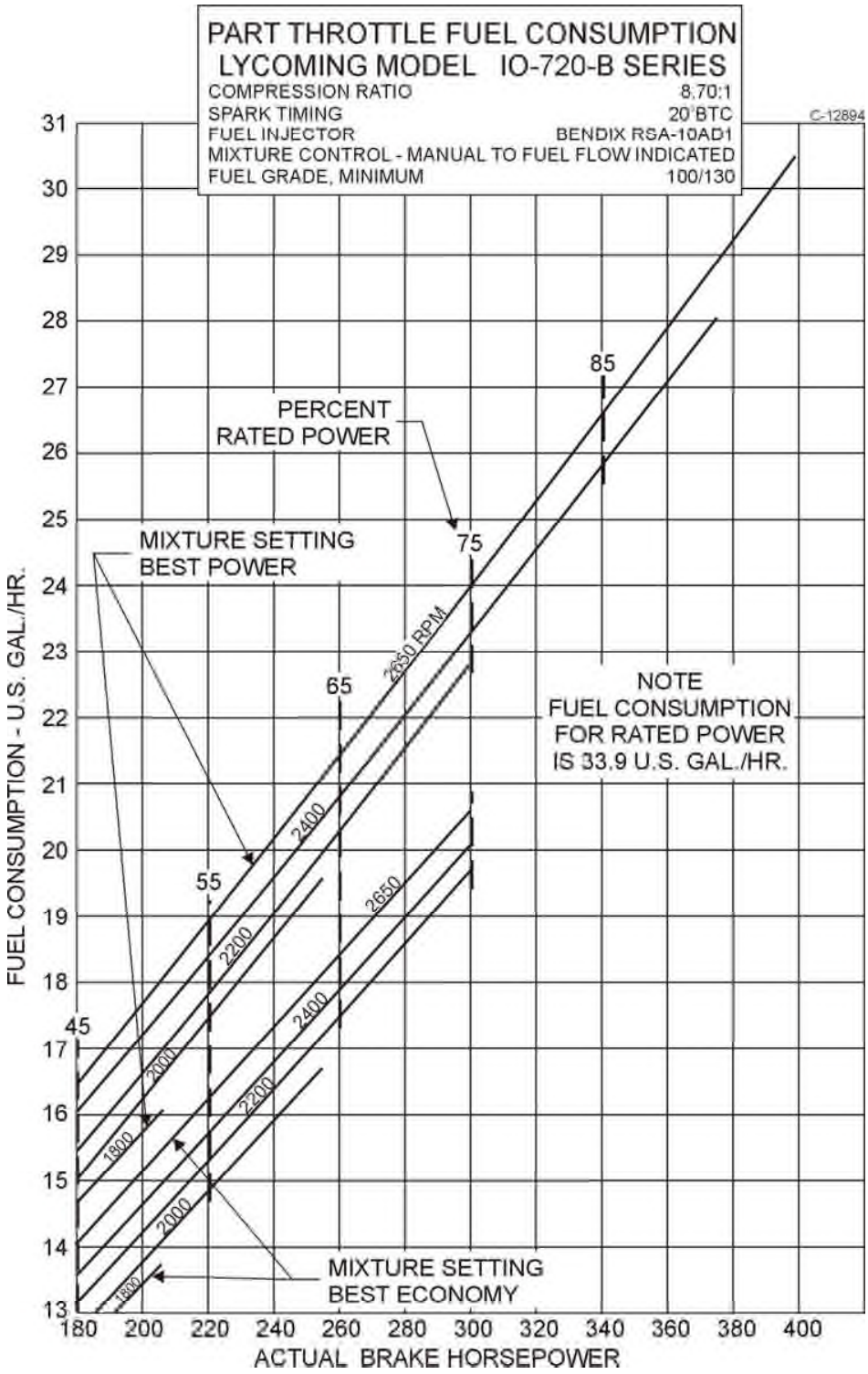

Figure 3-4. Part Throttle Fuel Consumption Curve –
IO-720-B Series

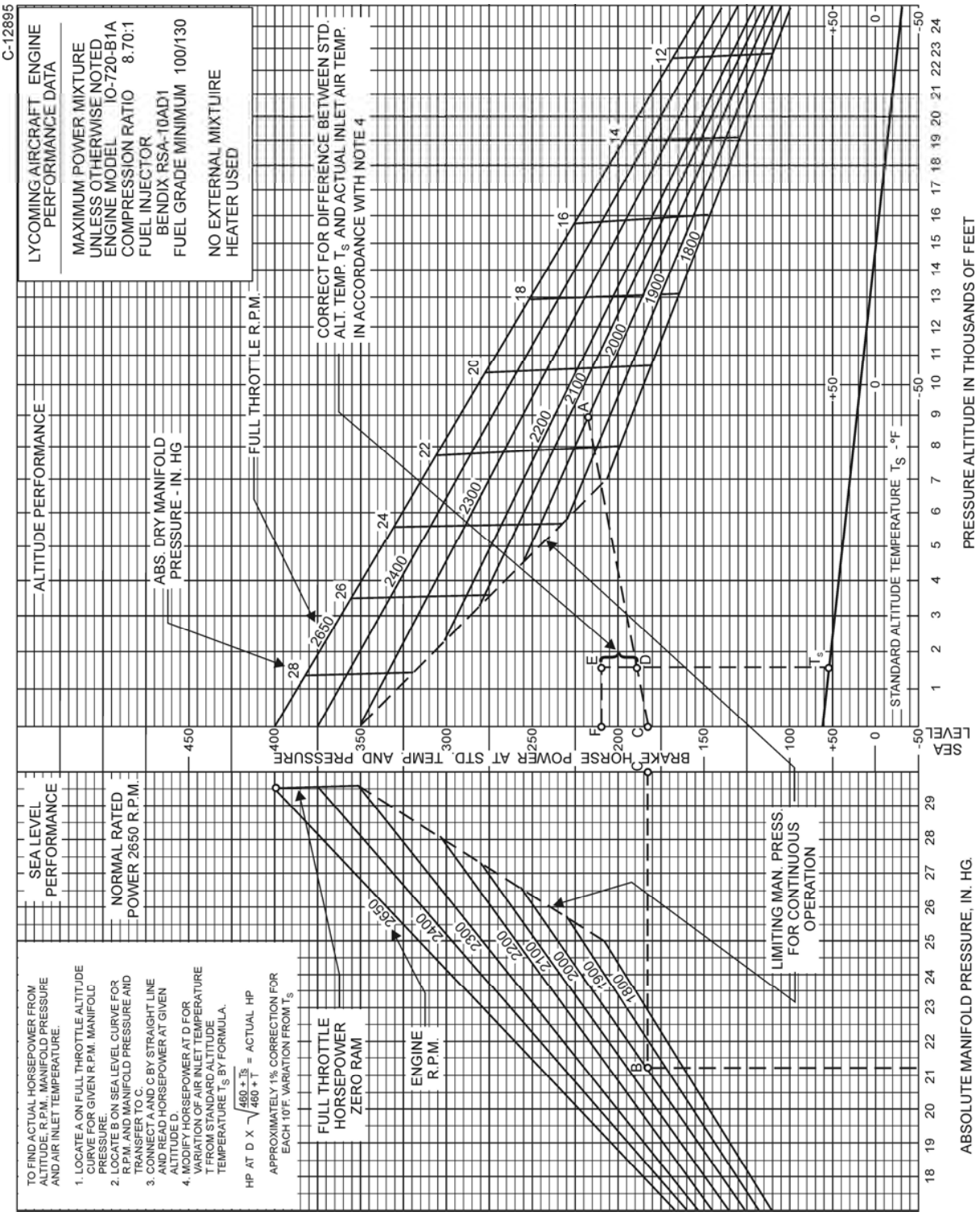

Figure 3-5. Sea Level and Altitude Performance –
IO-720-B Series

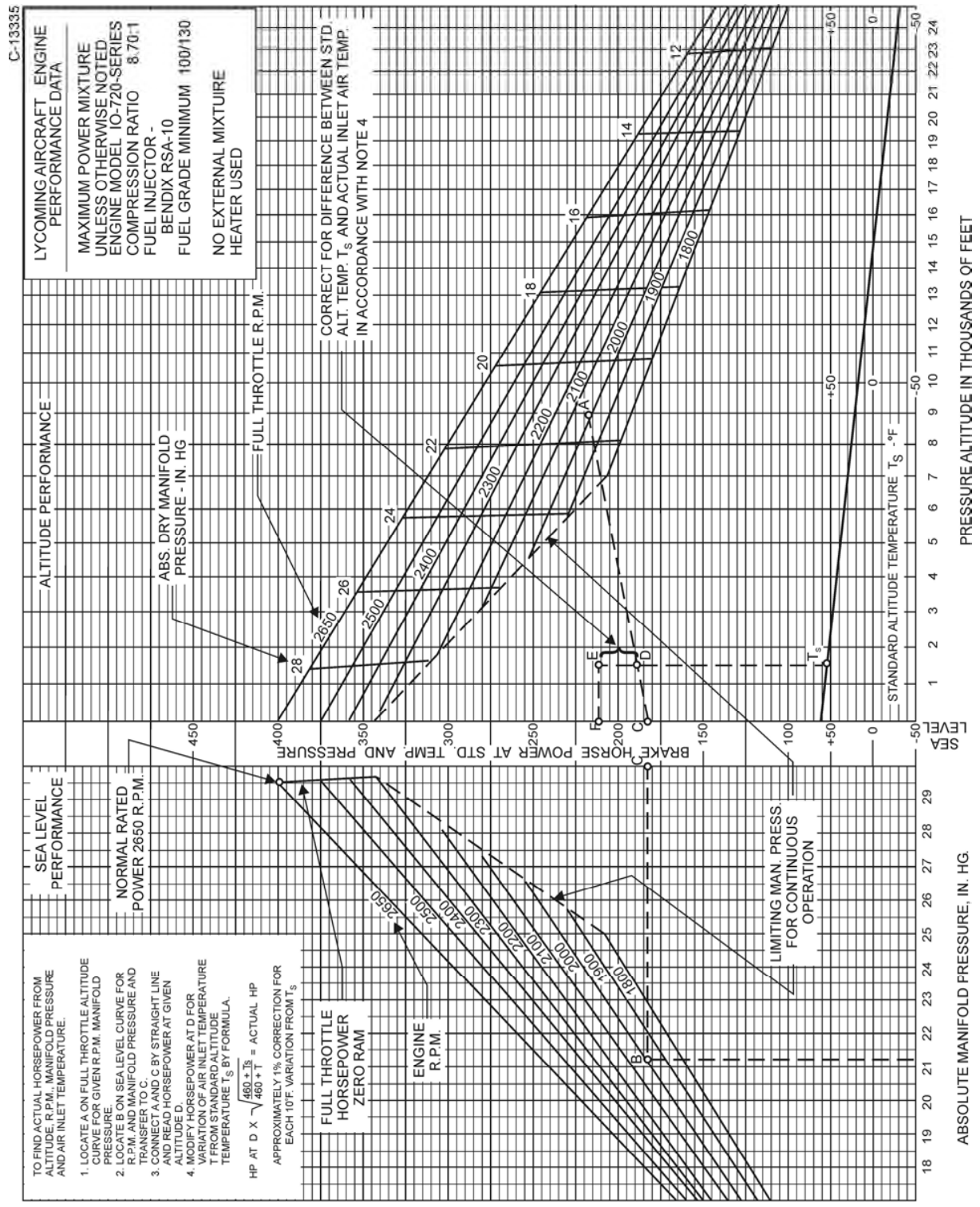

Figure 3-6. Sea Level and Altitude Performance –
IO-720-A, -D Series

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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 information.

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 inspection.

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; 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 operation time; new, rebuilt or newly overhauled engines should undergo a 50-hour inspection including draining and renewing lubricating oil. If engine has no full-flow oil filter, change oil every 25 hours. Also, inspect and clean suction and pressure screens.

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 plugs 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. Induction System –

(1) Remove and clean the fuel inlet strainers.

(2) Check the mixture control and throttle linkage for travel, freedom of movement, security of the clamps and lubricate if necessary.

(3) 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.

(4) 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. Install new full flow oil filter, if engine is so equipped.

(3) Remove oil suction and oil pressure screens and clean thoroughly. Note carefully for presence of metal particles that are indicative of internal engine damage.

d. Exhaust System –

(1) 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.

(2) Examine exhaust manifolds for general condition.

e. Cooling System –

(1) Check cowling and baffles for damage and secure anchorage.

(2) Any damaged or missing part of the cooling system must be repaired or replaced before the aircraft resumes operation.

f. Cylinders –

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

(2) 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.

(3) 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. The 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.

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. Ignition 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.

(3) *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 system 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.

b. Induction System –

(1) Check fuel injector lines and nozzles for stains indicative of leakage. If found, repair or replace.

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

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

e. 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 letters 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.

LYCOMING OPERATOR'S MANUAL

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 Lead Assembly – In the event that an ignition harness is to be replaced, consult the ignition wiring diagram to be certain the magneto and spark plug terminals are installed at the correct location. Mark location of fastenings on individual lead assemblies to be certain the replacements are clamped at the correct locations.

b. Timing Magnetos to Engine –

(1) –700 Series Magnetos –

(a) 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 advance timing mark on the front face of the starter ring gear is in exact alignment with the small hole located at the two o'clock position on the front face of the starter housing. (Starter ring gear may be marked at 20° and 25°). Use the 20° timing mark for this series engine.

(b) Align the timing mark on the drive plate with the indent on the housing. See Figure 5-1.

(c) Hold the magneto in this position and assemble it on the engine and tighten the mounting clamps sufficiently to hold the magneto in position and yet permit it to be rotated.

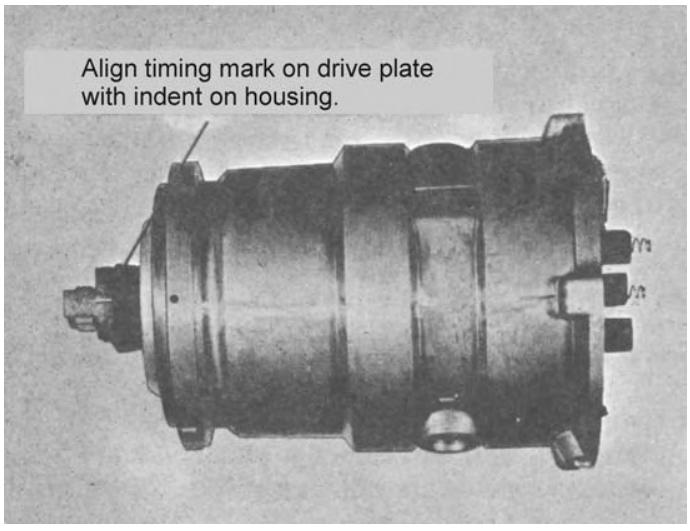

Figure 5-1. Alignment of Drive Plate and Housing Timing Marks

(d) Remove the screw, lock washer and dust shield from the opening marked "T" on the side of the magneto.

(e) Connect a timing light to the switch wire and a good ground.

(f) Insert a small screwdriver through the "T" marked opening and engage the painted rotor timing groove. (The painted lines on the distributor block and finger will be found in approximate alignment.) See Figure 5-2. With a light force depress the screwdriver, moving the rotor in a counterclockwise direction as viewed from the rear, sufficiently to remove any backlash. At the same time rotate the magneto in its mounting flange until the timing 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 and tighten the mounting clamps. Repeat this procedure with the second magneto.

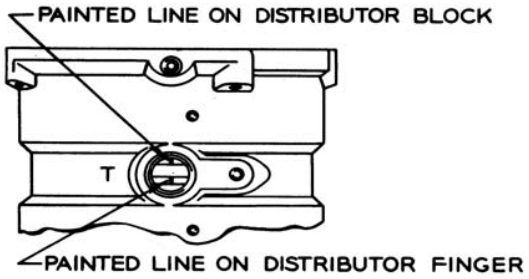

Figure 5-2. Alignment of Lines as Seen Through "T" Opening

NOTE

If inaccessibility to the "T" marked hole prevents it from being used for holding out backlash, the magneto distributor block must be removed and the magneto rotor utilized for this purpose. This is accomplished as follows:

a. Disconnect the switch, coil and (retard, if applicable) leads from the cable outlet plate.

b Remove the four screws that attach the ignition harness outlet plate to the magneto.

c Remove the switch, coil and (retard, if applicable) leads from their terminals in the distributor block.

d Loosen the two setscrews mounted radially in the rear flange of the magneto and carefully remove the distributor block from the magneto.

e Reach into the magneto and grasp the rotor. Note that when the rotor is turned counterclockwise to the point of breaker opening it will spring forward in a clockwise direction if it is released. Therefore, it must be held in the counterclockwise position while the magneto is rotated in its flange until the breaker points begin to open.

(g) Tighten the magneto mounting clamps and replace the breather plug, shield, lock washer and screw in the "T" opening or if the distributor block was removed, position the distributor block and assemble the parts in the reverse order of disassembly.

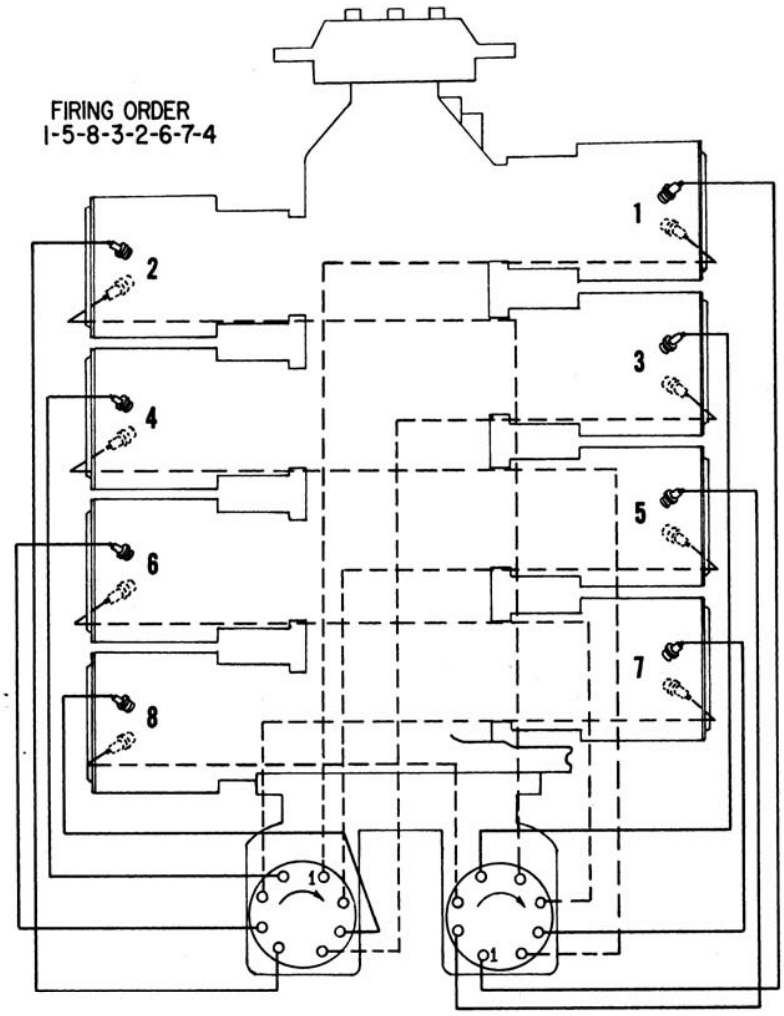

Figure 5-3. Ignition Wiring Diagram

(2) –1200 Series Magnetos –

(a) Turn the engine to number one full advance firing position as instructed in paragraph b (1) (a).

(b) Remove the inspection plug from the magneto and turn the drive shaft in direction of normal rotation until the applicable timing mark on the distributor gear is approximately aligned with the mark on the distributor block. Install the gasket and magneto adapter on the engine. Being sure that the gear does not move from the above position assemble the gasket and magneto on the engine. Secure with clamps only tight enough to hold the magneto while allowing it to be revolved in its mounting flange. Accomplish the same procedure with the second magneto.

(c) 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 a good ground. 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.

(d) Back off the crankshaft a few degrees until the timing lights 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.

(3) Dual Magneto –

(a) Place the engine in the No. 1 advance firing position as directed in paragraph 1 b (1a).

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

WARNING

DO NOT ATTACH HARNESS SPARK PLUG ENDS TO THE SPARK PLUGS UNTIL ALL MAGNETO-TO-ENGINE TIMING PROCEDURES AND MAGNETO-TO-SWITCH CONNECTIONS ARE ENTIRELY COMPLETED.

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

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

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

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

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

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

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

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

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

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

(m) Repeat steps (i) thru (k) until the condition described in paragraph (l) is obtained.

(n) Complete tightening of the magneto securing clamps by torqueing to 150 in.-lbs.

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

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

NOTE

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

(4) Internal Timing – Dual Magneto –

(a) Check the magneto terminal timing and breaker synchronization in the following manner.

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

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

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

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

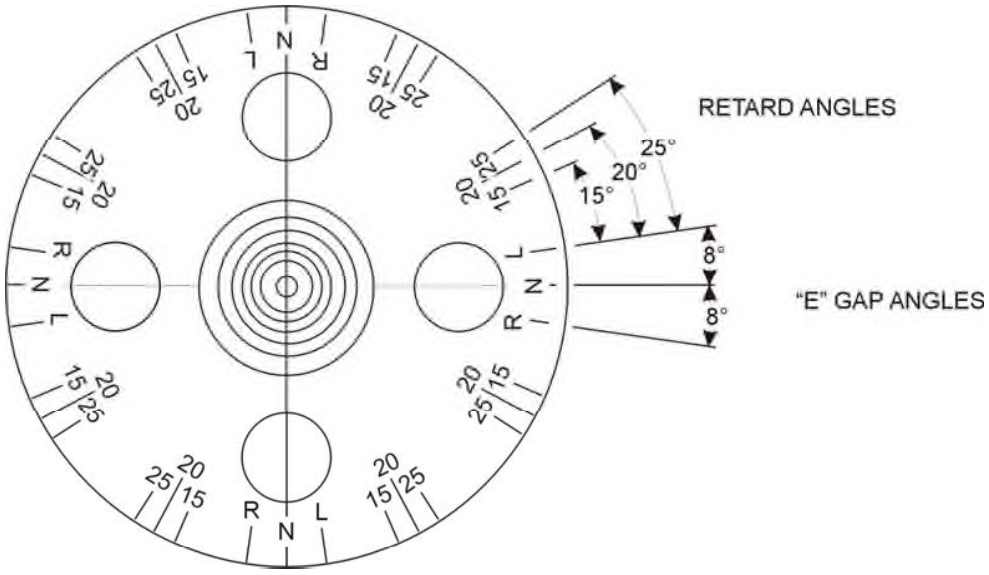

Figure 5-4. Timing Marks on Rotating Magneto

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

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

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

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, use only clean engine oil or Loctite Hydraulic sealant on the threads of all tapered pipe fittings. 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 if either of these conditions exist. Clean 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 100/130 octane, minimum is recommended for the IO-720 series engines.

In the event that the specified fuel is not available at some locations, it is permissible to use a 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 inlet ducts for dirt or restrictions. Inspect and service air filters as directed in the airframe manufacturer's handbook.

e. Idle Speed and Mixture Adjustment –

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

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

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

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

If the above indicates that the idle mixture 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 recommendations shown in Section 3.

b. Oil Suction and Oil Pressure Screens – At each 50-hour inspection remove, inspect for metal particles, clean and install. For engines without a full-flow oil filter, change oil and inspect and clean screens every 25 hours.

c. Oil Pressure Relief Valve – The function of the oil relief valve is to maintain engine oil pressure within specified limits. Consult Engine Flight Chart, Section 3, paragraph 7. Subject engines may be equipped with either an adjustable or a non-adjustable oil pressure relief valve located between the upper right engine mount and no. 7 cylinder.

(1) Adjustable – If the oil pressure under normal operating conditions should exceed either the maximum or minimum specified limits, stop engine and screw the adjusting screw out to decrease pressure and in to increase pressure. Depending on installation, the adjusting screw may have only a screw driver slot and must be turned with a screw driver; or may have the screw driver slot plus a pinned .375-24 installed nut and may be turned with either a screw driver or a box wrench.

(2) Non-adjustable – The valve, although not adjustable, may be adapted to control the oil pressure. The original assembly used up to a maximum of three STD-425 washers under the cap to increase pressure or a spacer (P/N 73629 or 73630) to reduce pressure. The later modification uses only the STD-425 washers to increase or decrease the pressure. A maximum of nine washers may be used. Particles of metal or other foreign matter lodged between the ball and seat will result in faulty readings. It is advisable, therefore, to disassemble, inspect and clean the valve if excessive pressure fluctuations are noted.

4. CYLINDERS. Although the complete procedure for disassembly and reassembly is given here, it is recommended that as a field operation, cylinder maintenance be confined to replacement of the entire assembly. Valve replacement 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 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 also watching the valve action.

(5) Remove rocker shaft covers from cylinder head.

(6) Slide valve rocker shafts from cylinder head far enough so that the valve rockers can be removed. Valve rocker shafts can be removed when the cylinder is removed from the engine.

(7) Remove push rods by grasping ball end and pulling out of shroud tube. Remove shroud tubes 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 seal retainer in crankcase. Remove shroud tube seal sleeves and seals from outer end of shroud tubes, also remove seals from crankcase. Discard all seals. Place washers, springs and seal sleeves in proper compartment of cleaning basket.

NOTE

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

(8) Remove cylinder base nuts and hold down plates; 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 Valves and Valve Springs from Cylinder – Place the cylinder over a block of wood so as to hold the valves in a closed position. Compress the valve springs using the valve spring compressor. Remove the split keys from the end of the valve stem. The valve springs and valve spring seats may now be removed from the cylinder head. Hold the valve stems so that the valves will not fall out and remove the cylinder from the holding block. The valves may now be removed from the inside of the cylinder.

c. 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 pad of the crankcase. Support with heavy rubber bands, discarded cylinder base oil seal rings or any other method.

d. Removal of Hydraulic Tappet Socket and Plunger Assembly – 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. The socket will usually stick to the finger firmly enough to be pulled out of the tappet body. 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 lock wire, inserting the lock wire around the edge of the plunger assembly and turning 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.

e. Assembly of Valves in Cylinder – Prelubricate valve stems with Molytex Grease O or equivalent and insert each valve stem in its respective valve guide. Place cylinder over a block of wood so that the valves are held against the seats and assemble the lower valve spring seat, auxiliary valve spring and outer valve spring over the valve stem and guide. Place the upper valve spring seat on the top of the springs.

NOTE

When installing valve springs, place the dampener end of spring (close wound coils marked with dye or lacquer) toward the cylinder.

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 – Rotate the crankshaft so that the connecting rod of the cylinder being assembled is at the top center position that corresponds with both valves closed.

(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 cylinder 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.

NOTE

Insert valve rocker shafts in cylinder before assembling cylinder to engine.

(4) Using a piston ring compressor, assemble the cylinder over the piston. Push the cylinder all 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 and cylinder base hold-down nuts and tighten as directed in the following steps:

NOTE

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

(a) Install shims between cylinder base hold-down plates and cylinder barrels as directed in Figure 5-5 and tighten ½ inch hold-down nuts to 300 in.-lbs. (25 ft.-lbs.) torque, using the sequence shown in Figure 5-5.

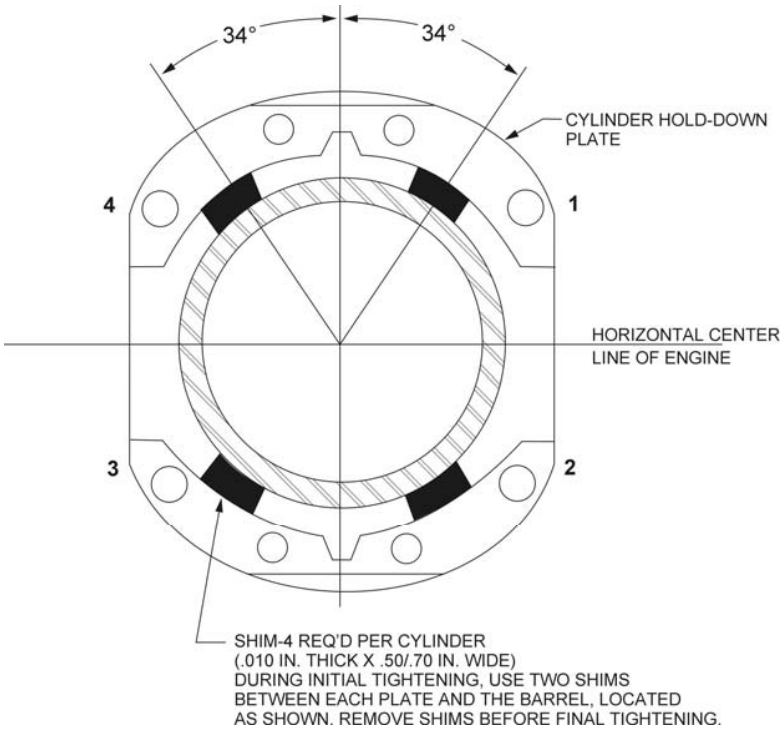

Figure 5-5. Location of Shims Between Cylinder Barrel and Hold-Down Plate

(b) Remove shims, and using the same sequence, tighten the ½ inch cylinder base nuts to 600 in.-lbs. (50 ft.-lbs.) torque.

(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) Assemble each push rod in its respective shroud tube, and install springs, cups, washers and seals to each pair of shroud tubes. Place this assembly in its respective position. Lock shroud tube in place by turning tube in place ¼ turn. This places the ears in the shroud tube in the vertical indentation position of the spring.

(7) Assemble cap on end of exhaust valve stem and assemble each rocker in its respective position by sliding the rocker shaft outward far enough to enable the rocker to be placed between the bosses and rocker thrust washer to be placed between the rocker and center boss and then slide the valve rocker shaft in place to retain the rocker.

(8) Assemble rocker shaft covers with gaskets to secure rocker shafts. Tighten cover nuts to recommended torque.

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

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

5. *GENERATOR OR ALTERNATOR DRIVE BELT TENSIONS.* Check the tension of a new belt 25 hours after installation. Refer to latest revision of Service Instruction No. 1129 and Service Letter No. L160 for methods of checking generator or alternator drive belt tension.

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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 magneto.
	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.
	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.
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.
	Leak in induction system.	Tighten all connections. Replace defective parts.
	Defective spark plugs.	Clean and gap or replace spark plugs.
	Improper fuel.	Fill tank with fuel of recommended grade.
	Magneto breaker points not working.	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.

TROUBLE	PROBABLE CAUSE	REMEDY
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, gage and flow at fuel line.
	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.
Rough Engine	Cracked engine mount.	Replace mount.
	Defective mounting bushings.	Install new mounting bushings.
	Uneven compression	Check compression.
Low Oil Pressure	Insufficient oil.	Fill sump to proper level with recommended oil.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	Leak in suction line or pressure line.	Check gasket between accessory housing and crankcase.
	High oil temperature.	See "High Oil Temperature" in "Trouble" column.
	Defective pressure gage.	Replace gage.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.

TROUBLE	PROBABLE CAUSE	REMEDY
High Oil Temperature	Insufficient air cooling.	Check air inlet and outlet for deformation or obstruction.
	Insufficient oil supply.	Fill oil sump to proper level with specified oil.
	Low grade of oil.	Replace with oil conforming to specifications.
	Clogged oil lines or strainers.	Remove and clean oil strainers.
	Excessive blow-by.	Usually caused by worn or stuck rings.
	Failing or failed bearings.	Examine sump for metal particles. If found, overhaul of engine is indicated.
	Defective temperature gage.	Replace gage.
Excessive Oil Consumption	Low grade of oil.	Fill tank with oil conforming to specifications.
	Failing or failed bearings.	Check sump for metal particles.
	Worn piston rings.	Install new rings.
	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.

SECTION 7
INSTALLATION AND PRESERVATION

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SECTION 7

INSTALLATION AND PRESERVATION

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 sump 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.

Engine Accessories – Considerable time and effort can be saved if the accessories are installed on the engine before the engine is mounted in the airframe. The locations of the various accessory mounting pads are shown on the accompanying installation drawings.

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.

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

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.

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 nozzles 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-C-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.

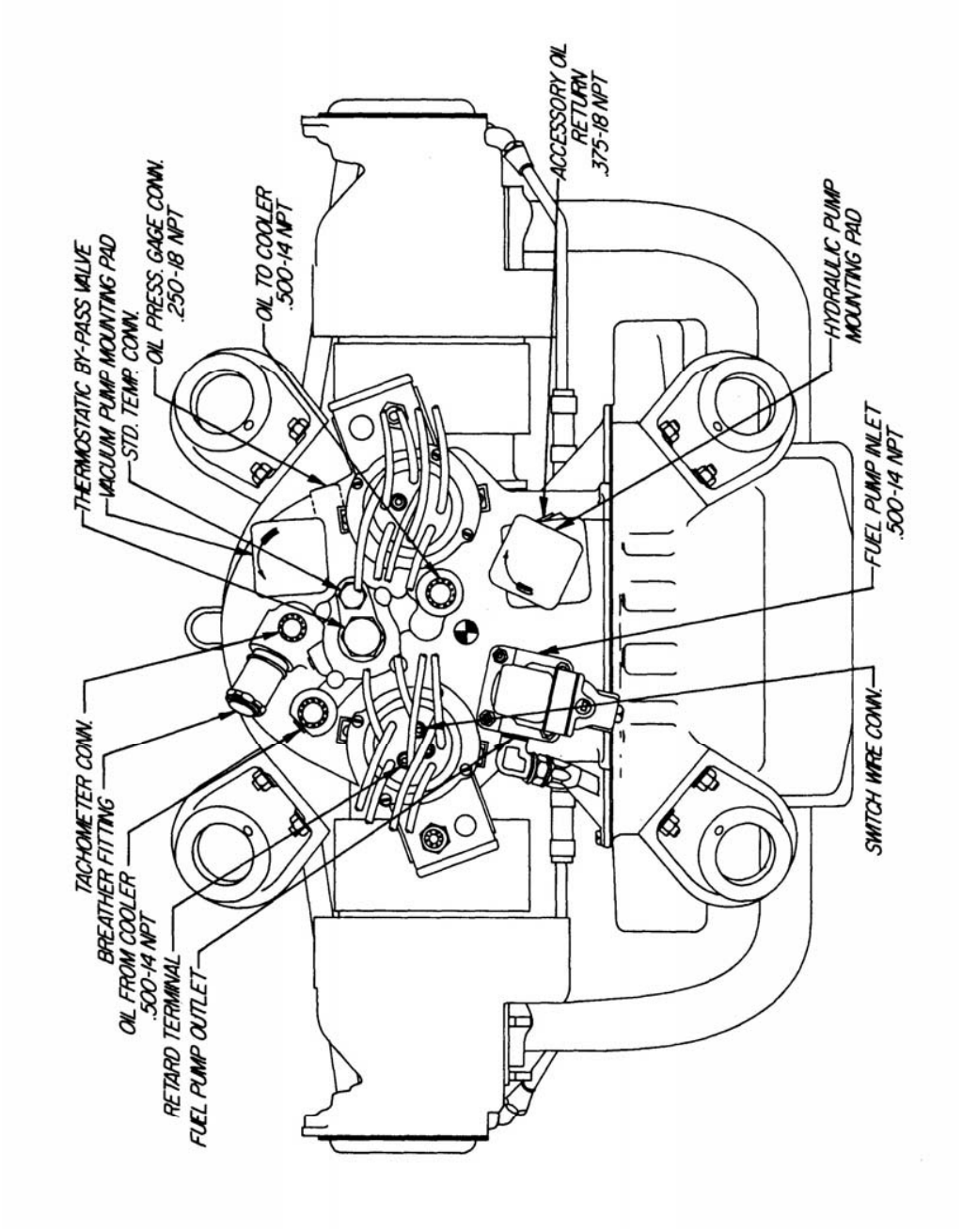

Figure 7-1. Rear View – Typical IO-720

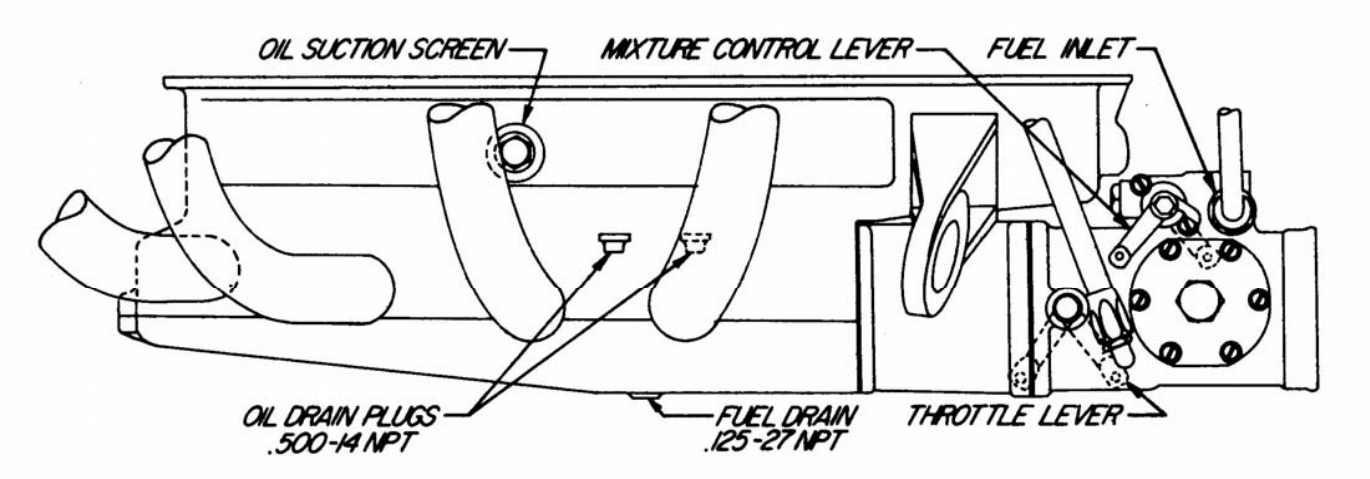

Figure 7-2. Lower Right Side View – Typical IO-720 – Rear Inlet

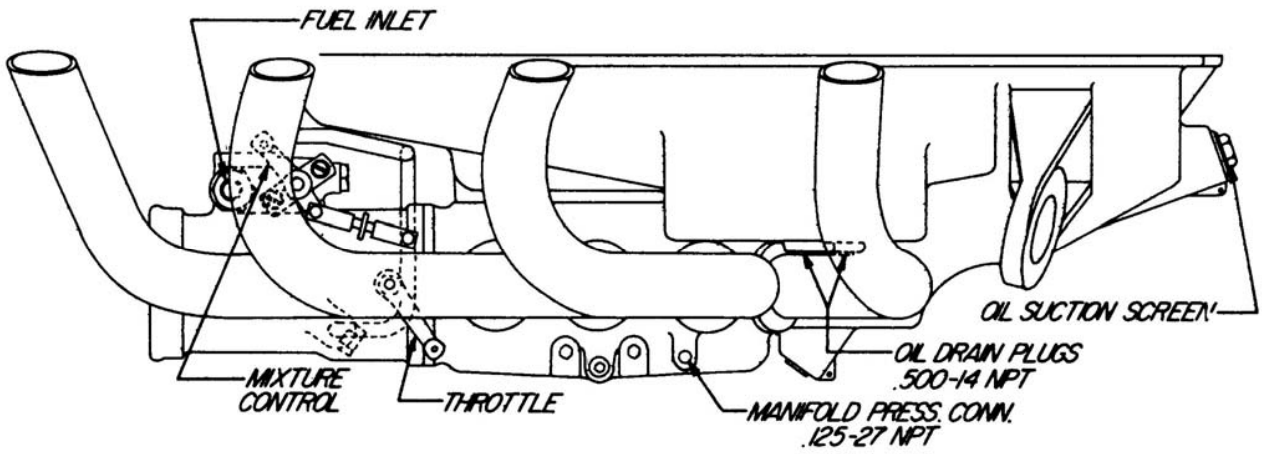

Figure 7-3. Lower Right Side View – Typical IO-720 – Front Inlet

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 SERVICE INSTRUCTION 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
10 min	1000														
20 min	1200														
20 min	1300														
15 min	1500														
10 min	1600														
10 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.

FULL THROTTLE HP AT ALTITUDE
(Normally Aspirated Engines)

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

TABLE OF SPEED EQUIVALENTS

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

CENTIGRADE – FAHRENHEIT CONVERSION TABLE

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

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

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	.0032	1.587	9/16	.5625	.2485	14.288
3/32	.0937	.0069	2.381	19/32	.5937	.2769	15.081
7/64	.1094	.0094	2.778	39/64	.6094	.2916	15.478
1/8	.125	.0123	3.175	5/8	.625	.3068	15.875
5/32	. 1562	.0192	3.969	21/32	.6562	.3382	16.669
11/64	.1719	.0232	4.366	43/64	.6719	.3545	17.065
3/16	.1875	.0276	4.762	11/16	.6875	.3712	17.462
7/32	.2187	.0376	5.556	23/32	.7187	.4057	18.256
15/64	.2344	.0431	5.593	47/64	.7344	.4235	18.653
1/4	.25	.0491	6.350	3/4	.75	.4418	19.050
9/32	.2812	.0621	7.144	25/32	.7812	.4794	19.844
19/64	.2969	.0692	7.540	51/64	.7969	.4987	20.241
5/16	.3125	.0767	7.937	13/16	.8125	.5185	20.637
11/32	.3437	.0928	8.731	27/32	.8437	.5591	21.431
23/64	.3594	.1014	9.128	55/64	.8594	.5800	21.828
3/8	.375	.1105	9.525	7/8	.875	.6013	22.225
13/32	.4062	.1296	10.319	29/32	.9062	.6450	23.019
27/64	.4219	.1398	10.716	59/64	.9219	.6675	23.416
7/16	.4375	.1503	11.112	15/16	.9375	.6903	23.812
15/32	.4687	.1725	11.906	31/32	.9687	.7371	24.606
31/64	.4844	.1842	12.303	63/64	.9844	.7610	25.003