LYCOMING OPERATOR’S MANUAL

SECTION 5
MAINTENANCE PROCEDURES

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

   b. **Timing Magnetos to Engine.**

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

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

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

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

      (5) **Dual Magnetos** – Remove the timing window plug from the most convenient side of the housing and the plug from the rotor viewing location in the center of the housing.

      (6) Turn the rotating magnet drive shaft in direction of normal rotation until the painted tooth of the distributor gear is center in the timing hole. Observe that at this time the built in pointer just ahead of the rotor viewing window aligns with either the L or R (depending on rotation).
Figure 5-1. Ignition Wiring Diagram

Figure 5-2. Timing Marks – 4 Cylinder -1200 Series
(7) Hold the magneto in this position and install gasket and magnetos. Secure with clamps, washers and nuts tightened only finger tight.

(8) Using a battery powered timing light, attach one positive lead to left switch terminal, one positive lead to right switch terminal and the ground lead to the magneto housing.

(9) Turn the entire magneto in direction of rotation 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.

(10) 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 lights just come on. Both lights should go on 2° of No. 1 engine firing position.

NOTE

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

c. Internal Timing – Dual Magneto – Check the magneto internal timing and breaker synchronization in the following manner.

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

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

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

(4) Back the engine up a few degrees and again bump forward toward number one cylinder firing position until pointer is aligned with 15° retard timing mark. See Figure 5-6. Retard breaker should just open at this position.

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

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

(7) Check action of impulse coupling (D-2000/3000 series only). With the ignition switch off observe breaker cam end of rotor while manually cranking engine through a firing sequence. Rotor should alternately stop and then (with an audible snap) be rotated rapidly through a retard firing position.
d. Generator or Alternator Output – The generator or alternator (whichever is applicable) should be checked to determine that the specified voltage and current are being obtained.

2. FUEL SYSTEM.

a. Repair of Fuel Leaks – In the event a line or fitting in the fuel system is replaced, only a fuel soluble lubricant such as clean engine oil or Loctite Hydraulic Sealant may be used on tapered threads. Do not use Teflon tape or any other form of thread compound. Do not apply sealant to the first two threads.

b. Carburetor or Fuel Injector (Except Simmonds Injectors) Fuel Inlet Screen Assembly – Remove the assembly and check the screen for distortion or openings in the strainer. Replace for either of these conditions. Clean screen assembly in solvent and dry with compressed air and reinstall. The fuel inlet screen assembly is tightened to 35-40 in.-lbs. on carburetors and 65-70 in.-lbs. on fuel injectors. The hexhead plug on pressure carburetor is tightened to 160-175 in.-lbs.

c. Fuel Grade and Limitations – The recommended aviation grade fuel for the subject engines is listed in Section 3, Item 8.

   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 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) 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 step (4) indicates that the idle adjustment is too rich or too lean, turn the idle mixture adjustment in 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 clean 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 recommended grade oil as specified in Section 3, Item 8.

   b. **Oil Suction and Oil Pressure Screens** – At each 100-hour inspection remove suction screen. Inspect for metal particles; clean and reinstall. Inspect and clean pressure screen every 25 hours.

   c. **Oil Pressure Relief Valve** – Subject engines may be equipped with either an adjustable or non-adjustable oil pressure relief valve. A brief description of both types follows:

      (1) **Non-Adjustable Oil Pressure Relief Valve** – The function of the oil pressure relief valve is to maintain engine oil pressure within specified limits. The valve, although not adjustable, may control the oil pressure with the addition of a maximum of nine (9) P/N STD-425 washers between the cap and spring to increase the pressure. Removal of the washers will decrease the oil pressure. Some early model engines use a maximum of three (3) P/N STD-425 washers to increase the oil pressure and the use of a P/N 73629 or P/N 73630 spacer between the cap and crankcase to decrease the oil pressure. Particles of metal or other foreign matter lodged between the ball and seal will result in faulty readings. It is advisable, therefore, to disassemble, inspect and clean the valve if excessive pressure fluctuations are noted.

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

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

4. **CYLINDERS.** It is recommended that as a field operation, cylinder maintenance be confined to replacement of the entire assembly. For valve replacement, consult the proper overhaul manual. This should be undertaken only as an emergency measure.
SECTION 5
MAINTENANCE PROCEDURES

a. Removal of Cylinder Assembly.

(1) Remove exhaust manifold.

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

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

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

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

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

**NOTE**

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

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

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

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

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

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

5-6
CAUTION

NEVER USE A MAGNET TO REMOVE HYDRAULIC PLUNGER ASSEMBLIES FROM THE CRANKCASE. THIS CAN CAUSE THE CHECK BALL TO REMAIN OFF ITS SEAT, RENDERING THE UNIT INOPERATIVE.

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

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

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

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

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

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

NOTE

Before installing cylinder hold-down nuts, lubricate crankcase thru-stud threads with any one of the following lubricants, or combination of lubricants

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

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

NOTE

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

(a) (Engines using hold-down plates) – Install shims between cylinder base hold-down plates and cylinder barrel, as directed in Figure 5-3, and tighten ½ inch hold-down nuts to 300 in.-lbs. (25 ft.-lbs.) torque, using the sequence shown in Figure 5-3.
(b) Remove shims, and using the same sequence, tighten the ½ inch cylinder base nuts to 600 in.-lvs. (50 ft.-lbs.) torque.

NOTE

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

Figure 5-3. Location of Shims Between Cylinder Barrel and Hold-Down Plates (where applicable) and Sequence of Tightening Cylinder Base Hold-Down Nuts
(c) Tighten the ¼ inch hold-down nuts to 300 in.-lbs. (25 ft.-lbs.) torque. Sequence of tightening is optional.

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

**CAUTION**

*AFTER ALL CYLINDER BASE NUTS HAVE BEEN TIGHTENED, REMOVE ANY NICKS IN THE CYLINDER FINS BY FILING OR BURRING.*

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

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

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

**NOTE**

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

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

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

Check the tension of a new belt 25 hours after installation. Refer to latest revision of Service Instruction No. 1129 and latest revision of Service Letter No. L160 for methods of checking generator or alternator drive belt tension.

6. **TURBOCHARGER CONTROLS.**

a. **Density Controller** – The density controller is adjusted at the factory to maintain a predetermined constant for desired horsepower.

    The density controller is set to the curve, see Figure 5-4, under the following conditions: Engine stabilized at operating conditions, full throttle with oil pressure at 80 psi ± 5 psi.

    If it is suspected that the manifold pressure is not within limits, it may be checked to the curve.

    **EXAMPLE**

    *Operating at the stated conditions with a compressor discharge temperature of 120°F, the manifold pressure should be 34.8 in. Hg. ± .3 in. Hg.*
If the manifold pressure is found to be out of limits, the cause might be found either in the density controller, the differential pressure controller, or the waste gate. It is recommended that an authorized overhaul facility check these controls.

**Exhaust Bypass Valve (TIO-360-A Series).**

This valve is actuated by engine oil pressure and is set to predetermined open and closed clearances. These clearances and the procedures for setting them are shown in Figure 5-5.

**Exhaust Bypass Valve (TIO-360-C1A6D).**

This valve is mechanically controlled by a flexible linkage connected to the injector throttle arm and the wastegate control arm.

Adjust linkage as follows:

1. Move injector throttle arm to full open position.
2. Insert a .005-.015 inch feeler gage between the bypass butterfly valve, in the closed position, and the bypass housing.
3. Adjust linkage until the bypass valve control arm is at the full closed stop position.
Figure 5-4. Density Control Full Throttle Setting Limits
WITH 60 - 50 PSI PRESSURE IN CYLINDER
ADJUST CLOSED POSITION OF VALVE SO
THAT CLEARANCE "B" IS .005 - .020"

AFTER ADJUSTING CLOSED POSITION AND
WITH "O" PRESSURE IN CYLINDER ADJUST
FULL OPEN STOP SCREW TO PROVIDE
.700 - .800 CLEARANCE RANGE OF "C"

VALVE IS SPRING LOADED NORMALLY OPEN

Figure 5-5. Exhaust Bypass Valve Open and Closed Setting

Figure 5-6. Timing Marks on Rotating Magnet
Figure 5-7. Ignition Wiring Diagram, Dual Magneto