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SERVICE INSTRUCTION

DATE: December 29, 2010

Service Instruction No. 1427C
(Supersedes Service Instruction No. 1427B)
Engineering Aspects are
FAA (DER) Approved

SUBJECT: Lycoming Reciprocating Engine Break-In and Oil Consumption

MODELS AFFECTED: All fixed wing and rotary wing aircraft (horizontal installations only) with Lycoming reciprocating aircraft engines installed

TIME OF COMPLIANCE: After field overhaul

NOTE

Incomplete review of all the information in this document can cause errors. Read the entire Service Instruction to make sure you have a complete understanding of the requirements.

Background

This Service Instruction identifies the necessary steps for engine break-in, including engine preparation for ground operational tests, flight tests, after-flight tests, and oil consumption limits for Lycoming engines installed in fixed wing and rotary aircraft.

NOTE

Engine overhaul includes, but is not limited to, replacing applicable components such as: fuel pump, fuel metering unit, and magnetos, if applicable, with components that are overhauled, rebuilt, or new.

Ideally, this procedure is to be done in a test cell where operating conditions can be closely monitored. If the engine is operated in a test cell, the engine must have intercylinder baffles, a cooling shroud, and a test club installed for engine Revolution Per Minute (RPM) requirements. If a test cell is not available, use a test stand with a test club and a cooling shroud for the engine test.

If a test cell or a test stand is not available, do an engine test after the engine has been installed in the aircraft with the intercylinder baffles installed. If the engine is operated in the aircraft, use a test club or aircraft propeller for correct air flow cooling. The engine-to-cowling baffles must be new or in good condition for correct cooling air flow differential across the engine. The cylinder head temperature gage, oil temperature gage, oil pressure gage, manifold pressure gage and tachometer must be calibrated for accuracy.

The purpose of a test cell or ground run test if done with the engine installed in the aircraft is to make sure that the engine is in compliance with all specifications, RPM, manifold pressure, fuel flow and oil pressure. The oil cooler system must hold oil temperatures within limits shown in the applicable Lycoming Operator's Manual.

The purpose for this engine break-in procedure is for correct piston ring seating and stable oil consumption on a top overhauled engine or a newly overhauled engine that is installed in the aircraft.

NOTE

The following formula is used to calculate the maximum allowable oil consumption limits for all Lycoming aircraft engines.

$$0.006 \times BHP \times 4 \div 7.4 = Qt./Hr.$$

1. FIXED WING

A. PREPARATION FOR GROUND OPERATIONAL TEST WITH ENGINE INSTALLED IN AIRCRAFT

NOTE

Refer to the latest revision of Service Instruction 1014 for the recommended oil to be used for engine break-in on Lycoming engine models. In most cases, turbocharged engines are to use ashless dispersant oil for break-in. Non-turbocharged engines are to use aviation grade mineral oil for break-in. Follow Service Instruction 1014 to use the correct oil for break-in.

1. Do the engine pre-oil in accordance with the latest revision of Service Instruction No. 1241.
2. Calibrate the cylinder head temperature gage, oil temperature gage, oil pressure gage, manifold pressure gage, and tachometer before the ground operational test.

⚠ CAUTION

MAKE SURE THAT ALL VENT AND BREATHER LINES ARE INSTALLED CORRECTLY AND ARE SECURELY IN PLACE IN ACCORDANCE WITH THE AIRFRAME MAINTENANCE MANUAL.

3. Install all airframe baffles and cowling
4. For optimum cooling during the ground operational test, use a test club. If the test club is not available, use the regular flight propeller, however, monitor the cylinder head temperature closely.

B. GROUND OPERATIONAL TEST

NOTE

Before the ground operational test, the oil cooler system must not have any air locks.

If the engine had failed before overhaul, it is possible that the oil cooler, propeller and governor could have been contaminated. During overhaul, these parts were to either be replaced or cleaned and examined by an approved repair facility.

1. Before the start of the ground operational test, examine the oil cooler, propeller, and governor for metal contamination. These parts must be clean and free of contamination before the ground operational test can begin.
2. Put the aircraft in a position facing the wind.
3. Start the engine and look at the oil pressure gage. If sufficient oil pressure indication is not shown within 30 seconds, stop the engine. Identify and correct the cause.

4. If oil pressure is sufficient, operate the engine at 1000 RPM until the oil temperature is stable or is at 140°F (60°C). After warm-up, the oil pressure is not to be less than the minimum specified pressure in the applicable Lycoming Operator's Manual.
5. Increase engine speed to 1500 RPM and operate at that speed for 15 minutes.
6. Make sure the cylinder head temperature, oil temperature and oil pressure is within the specified limits in the Lycoming Operator's Manual.

NOTE

Extended ground operation can cause excessively high cylinder and/or oil temperatures.

NOTE

If any malfunction occurs, stop the engine and let it cool. Identify and correct the cause before continuation of the ground operational test.

a. Start the engine again and monitor oil pressure.
b. Increase engine speed to 1500 RPM for 5 minutes.

7. If the engine has magnetos, measure the magneto drop-off as described in the latest revision of Service Instruction No. 1132.
8. Do a cycle of the propeller pitch and a feathering check as applicable as per the airframe manufacturer's recommendations.
9. Operate the engine to full-static aircraft recommended power for up to 10 seconds.
10. After engine operation at full power, slowly decrease the RPM to idle and let the engine stabilize.
11. Do a check of the idle mixture adjustment before engine shutdown.
12. Examine the engine for oil, fuel, and hydraulic fluid leaks. Identify and correct the cause of any leaks
13. Remove the oil suction screen and the oil pressure screen or oil filter to look for any blockage or contamination. If no blockage or contamination is found, a flight test can be done. If blockage or contamination is found, change the oil. Remove the blockage and contamination. Refer to the latest revision of Service Bulletin No. 480 for instructions.

C. FLIGHT TEST.

WARNING

REPLACE ENGINE TEST CLUBS WITH APPROVED FLIGHT PROPELLERS BEFORE THE FLIGHT TEST.

1. Start the engine and do a preflight run-up in accordance with the applicable manufacturer's Pilot's Operator's Handbook (POH).
2. Do a full power take-off in accordance with the POH.
3. Monitor engine RPM, fuel flow, oil pressure, oil temperature and cylinder head temperature during takeoff.
4. As soon as possible, decrease the engine speed to climb power in accordance with the POH.

5. Do a shallow climb angle to a suitable cruise altitude.
6. Adjust the mixture per the POH.
7. At cruise altitude, decrease power to approximately 75% and continue flight for 2 hours. For the second hour, do power settings alternating between 65% and 75% power as per the applicable POH.

   NOTE

   For correct piston ring seating, in a top overhauled engine or a newly overhauled engine, operate the aircraft at 65% to 75% cruise power until oil consumption is stable.

   For a normally aspirated (non-turbocharged) engine, it will be necessary to operate at cruise power at the lower altitudes. Density altitude in excess of 8,000 feet (2438 m) will prevent the engine from reaching sufficient cruise power for an acceptable break-in; 5,000 feet (1524 m) is recommended.

   If oil consumption is not stable, look for oil leaks. Identify and correct the cause of the leak(s).

8. If the engine and aircraft are operating to correct specifications per the Lycoming Operator's Manual, increase engine power to the maximum airframer recommendations and hold for 30 minutes.

   ⚠ CAUTION

   FOR ENGINES THAT HAVE DYNAMIC COUNTERWEIGHT ASSEMBLIES, DO NOT OPERATE AT LOW MANIFOLD PRESSURE DURING HIGH ENGINE SPEEDS UNDER 15 IN. HG AND RAPID CHANGES IN ENGINE SPEEDS. THESE CONDITIONS CAN CAUSE DAMAGE TO THE COUNTERWEIGHTS, ROLLERS OR BUSHINGS, AND CAUSE DETUNING.

9. Decrease altitude at low cruise power and closely monitor the engine instruments. Do not do long descents at low manifold pressure. Do not decrease altitude too rapidly. The engine temperature could decrease too quickly.

   ⚠ CAUTION

   DO NOT DO CLOSED THROTTLE DESCENTS. CLOSED THROTTLE OPERATION DURING DESCENTS WILL CAUSE RING FLUTTER WHICH CAN CAUSE DAMAGE TO THE CYLINDERS AND RINGS.

10. After landing and shutdown, examine the engine for oil, fuel, and hydraulic fluid leaks. Identify and correct the cause of any leaks.
11. Calculate fuel and oil consumption and compare the limits given in the applicable Lycoming Operator's Manual. If the oil consumption value is above the limits in the manual, identify and correct the cause. Do this flight test again, up to and including this step before releasing the aircraft for service.
12. Remove the oil suction screen and the oil pressure screen or oil filter to look for any blockage or contamination. If no blockage or contamination is found, a flight test can be done. If blockage or

contamination is found, change the oil. Remove the blockage and contamination. Refer to the latest revision of Service Bulletin No. 480 for instructions.

13. Record compliance with this Service Instruction in the logbook.
14. Correct any problems before releasing the engine back into service.

2. ROTORY WING (HORIZONTAL INSTALLATIONS ONLY)

Break-in of helicopter engines is done by following a sequence of steps ranging from engine service of the engine on the ground to progressively increasing its power output during operation. Although this Service Instruction contains detailed information about engine break-in, it is impossible to cover all aspects of break-in for individual helicopter models. For that reason, refer to the POH for a particular helicopter model. Also, refer to the applicable Lycoming Operator's Manual for the engine.

For break-in of piston engines in helicopters:

1. Because helicopters always operate at a fixed or rated engine speed, any decrease of engine RPM necessary during break-in must be done with the helicopter on the ground and with the rotor engaged. During flight, make all power reductions by manifold pressure alone.
2. Some helicopters do not have a red line on the manifold pressure gage and use all rated power. Some gages have a red line for indication of airframer limitations but not engine performance parameters. In the case of Lycoming model HIO-360-D1A, it has graduated manifold pressure values as shown in the Lycoming Operator's Manual.
3. Because of the difference in helicopter models, refer to the helicopter POH for methods of operation for a specific helicopter regarding rotor engagement, manifold pressure ratings, the method of rotor engagement, and centrifugal clutch or manually-operated belt drive.

A. GROUND OPERATIONAL TEST

1. Refer to the latest revision of Service Instruction No. 1014 and make sure the engine has the correct grade and quantity of oil.
2. Put the helicopter in a position facing the wind to take advantage of prevailing wind to keep the engine cool.
3. Make sure the throttle and mixture control, if applicable, are at the FULL-OFF position.

NOTE

In the following step, if sufficient oil pressure indication is not seen within 30 seconds, stop the engine, identify and correct the cause.

4. Refer to the helicopter POH for the correct start-up procedures. Start the engine and operate the engine for 5 minutes at idle RPM (1200-1450 RPM).
5. Adjust the idle mixture (if applicable) and oil pressure as necessary.
6. Do a magneto check, if applicable, per the POH.
7. Stop the engine.
8. Examine the engine for oil and fuel leaks.
9. Start the engine and operate for 5 minutes at idle speed (1200-1450 RPM).

10. Engage the rotor, if necessary, and increase the engine RPM to 50% to 60% of rated engine speed for 5 minutes with rotor blades at flat pitch (collective full down).

NOTE

For correct break-in, do not let the cylinder head temperature go above 420°F (216°C).

11. If the oil pressure is at the correct operating pressure and the oil temperature is between 180°F and 200°F (82°C and 93°C), with the cylinder head temperatures between 350°F and 400°F (177°C and 204°C), increase the engine RPM to 80% of rated engine speed for 5 minutes, followed by 100% airframe manufacturer's rated engine speed for another 5 minutes.
12. After operating the engine for the last 5-minute segment, let the engine cool as recommended in the POH and then stop the engine.
13. Drain the oil from the engine and change the oil. Refer to the latest revision of Service Instruction No. 1014.
14. Remove and clean the suction screen in the oil sump.
15. Clean the oil pressure screen and/or replace the oil filter.
16. Make any necessary oil pressure adjustments.
17. Install the suction screen and oil pressure screen (or new oil filter); torque per the Table of Limits.
18. Add the correct grade and quantity of oil. (Refer to latest revision of Service Instruction No. 1014.)
19. Start the engine and let it operate at 1450 RPM idle.
20. Engage the rotor, if necessary, and increase the engine RPM to 2000 RPM.
21. Warm the engine to do a ground operational check as described in the helicopter's POH.

B. FLIGHT TEST

1. Start the engine and operate it at 1450 RPM.
2. Engage the rotor, if necessary, and increase the engine speed to 75% RPM.
3. With the engine warm, do a ground operational test in accordance with the helicopter manufacturer's POH, including the magneto check.

NOTE

Use two crew members to control and monitor the engine instruments, including the aircraft and engine operating temperatures and pressures. If any parameters are out of tolerance with the helicopter POH or engine and aircraft operating manual limitations, stop the break-in procedure. Identify and correct the problem. Do any necessary maintenance. Then continue with the break-in procedure.

4. Put the helicopter into a hover mode for 10 minutes while monitoring the manifold pressure, fuel pressure, oil temperature, oil pressure and cylinder head temperature, etc.
5. If engine instruments are satisfactory, go to cruise altitude.
6. Operate at cruise power at 70% to 75% of rated power for 30 minutes to keep a constant safe altitude.

7. At the end of the 30-minute flight at 70% to 75% power, record the manifold pressure and engine temperature.
8. Increase engine RPM and manifold pressure to maximum specified limits in the helicopter manufacturer's POH. Hold this power setting for 45 minutes at a constant safe altitude.
9. At the end of 45 minutes, again record the manifold pressure and engine temperature.
10. After the flight test and before engine shutdown, operate the aircraft either in a hover mode for 10 minutes or for the time recommended in the helicopter POH.
11. Record the manifold pressure and engine temperatures.
12. After landing, refer to the POH for cool-down and shutdown procedures.
13. Examine the engine for oil and fuel leaks. Identify and correct the cause of any leaks.
14. Calculate the fuel and oil consumption.
15. If the calculated consumption values are above the specified limits, identify and correct the cause(s). Do the flight test again before releasing the aircraft for service.
16. Remove the oil suction screen and pressure screen (or oil filter). Examine for contamination. Remove contamination. If contamination is found, identify and correct the cause of the contamination.
17. Clean the screen and, if necessary, replace the oil filter.
18. Install the suction screen and oil pressure screen (or new oil filter); torque per the Table of Limits.
19. Add the correct grade and quantity of oil. (Refer to the latest revision of Service Instruction No. 1014.)
20. After the helicopter has been released for service, operate the engine on mineral oil until oil consumption is stable. (Refer to the latest revision of Service Instruction No. 1014.) During this time, keep the engine power above 65% and monitor. Make sure that all aircraft and engine operating temperatures and pressures are kept within limits.