***NOTE* — Metal samples for analysis can only by accepted if the engine from which the sample is taken is a new, rebuilt or overhauled engine from the Lycoming factory and it is still under warranty. Engines overhauled by other facilities may have parts that cannot be identified by analysis at Lycoming.**

POSTSCRIPT:

As an important postscript to "Suggestions if Metal is Found in the Screens or Filter," factory personnel have become concerned over unnecessary engine removals because metal was found in a replacement engine after a prior malfunctioning engine was removed. These unfortunate engine removals were largely caused by maintenance personnel failing to thoroughly flush and clean all aircraft oil system components. Because of the difficulty of removing contamination from an oil cooler, it is strongly suggested that a new oil cooler be used with the replacement engine when an engine is removed because it failed. As a reminder that it is essential to remove metal contamination from the oil system, the factory Product Support Department now sends the following tag with every service engine leaving our factory:

> IMPORTANT
>
> Before installing this replacement engine, all aircraft oil system components, oil coolers, lines and supply tanks, where used, must be thoroughly cleaned for contamination. Lycoming will not be held responsible for contamination to this newly installed engine.
>
> Product Support Department
>
> Lycoming
>
> Williamsport, PA 17701

Safety Tip — Sealant Use

The latest revision of Lycoming Service Instruction No. 1125 specifies POB No. 4 Perfect Seal and silk thread as the generally used items for sealing crankcase finished parting surfaces that do not employ gaskets. Two other products, RTV-102 or LOCTITE-515 applied as a very thin film without silk thread, may be used as alternate materials for sealing crankcase parting surfaces. Other sealants have not been tested and approved for this purpose, and NONE are approved for other uses in the assembly of Lycoming engines. Improper use of these and other sealing compounds can create serious problems. As an example, a red-colored sealant was used by a mechanic to hold the pressure-screen gasket in place. As the material solidified, pieces broke loose and eventually blocked the engine's small oil passages causing oil starvation and engine failure. The bottom line: Only use those sealant materials approved by the Lycoming Overhaul Manual and other service publications, and only use them for approved purposes.

Understanding Engine Color Codes

Hundreds of Lycoming engines leave the factory monthly and are marked with a variety of colors on each cylinder. These colors have a definite meaning and provide valuable information about the engine. Questions concerning these colors and their meanings have been asked by many owners and maintenance personnel.

In the past, color coding of cylinders was confined to colored bands around the base of each cylinder. Today, new methods of painting (enameling) engines, and a need for quick, easy engine identification were instrumental in changing color code location.

The factory color code, a large painted stripe, is now located on the cylinder head between the push rods from the spark plug boss to bottom of the cylinder head. Additional color coding has been added to identify cylinders requiring long-reach spark plugs versus short-reach spark plugs. Location of spark plug identification color code is between the spark plug boss and rocker box.

COLOR CODE FOR CYLINDER IDENTIFICATION

Location — Between push rods on cylinder head, or band around base of cylinder barrel.

Engine gray or unpainted — Standard steel cylinder barrels.

Orange stripe — Chrome-plated cylinder barrels.

Blue stripe — Nitride-hardened cylinder barrels.

*Green stripe — Steel cylinder 0.010 oversize.

*Yellow stripe — Steel cylinder 0.020 oversize.

*Color code applicable only to engines overhauled in the field. Lycoming does not sell oversize cylinders.

COLOR CODE FOR SPARK PLUG IDENTIFICATION

Location — Fin area between spark plug and rocker box.

Engine gray or unpainted — Short-reach spark plugs.

Yellow — Long-reach spark plugs.

Caution — Use only approved spark plugs for all models of Lycoming engines. See latest revision of Service Instruction No. 1042 for approved spark plugs.

Reciprocating Engine Break-in and Oil Consumption Limits

We receive many questions about engine break-in. To respond to these questions, a complete reprint of Service Instruction 1427B is included here.

This information applies to all fixed-wing and rotary-wing aircraft with horizontal installation of Lycoming reciprocating aircraft engines. The appropriate action should be taken:

1. When installing factory overhauled, rebuilt or new Lycoming engines.

2. After field overhaul (field-overhauled engine or engine with piston ring change after one or more cylinders are honed or replaced).

3. When one or more cylinders have rings replaced or cylinders are replaced (requiring new rings).

NOTE **— All engines that have had initial run-in conducted in a test cell (including all Lycoming factory new, rebuilt and overhauled) should proceed directly to the FLIGHT TEST section of this Service Instruction that is applicable to your aircraft.**

Ideally, a newly overhauled aircraft engine should be tested in a test cell where operating conditions can be closely monitored. If the engine is test-cell run, the engine must have intercylinder baffles in place, cooling shroud and club propeller to provide engine RPM requirements. Where a test cell is not available, the engine should be tested on a test stand with a club propeller and a cooling shroud. However, it is not always convenient to test an engine in this manner.

If a test cell or a test stand is not available, an engine should be properly tested after it has been installed in the aircraft. If the engine is run in the aircraft, it should still use a club propeller for proper airflow cooling. However, the aircraft propeller may be used. In either case, the intercylinder baffles must be in place. The engine to cowling baffles must be new or in good condition to assure proper cooling airflow differential across the engine. The cylinder head temperature gage, oil temperature gage, oil pressure gage, manifold pressure gage and tachometer must be calibrated to assure accuracy.

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

NOTE **— Extended ground operation can cause excessive cylinder and oil temperatures. Prior to start of a ground run, the oil cooler system should be inspected for metal contamination and be free from air locks. When the engine oil is at operating temperature, oil goes through cooler first, then through the oil filter. If a previous engine failed, the oil cooler, propeller and governor may be contaminated and should be replaced or cleaned and inspected by an approved repair facility.**

The purpose for engine break-in is to set the piston rings and stabilize the oil consumption. There is no difference or greater difficulty in seating the piston rings of a top-overhauled engine versus a complete engine overhaul.

NOTE **— The maximum allowable oil consumption limits for all Lycoming aircraft engines can be determined by using the following formula:**

.006 X BHP X 4 7.4 = Qt/Hr.

The following procedure provides a guideline for testing a newly overhauled engine that is mounted in the aircraft. Information on the "ground run after top overhaul or cylinder change with new rings" and the "flight test after top overhaul or cylinder change with new rings" procedures are published in the applicable Lycoming Operator's Manual.

I. FIXED WING

A. PREPARATION FOR TEST WITH ENGINE INSTALLED IN AIRCRAFT

1. Pre-oil the engine in accordance with latest edition of Service Instruction No. 1241.

2. It is particularly important that the cylinder head temperature gage, oil temperature gage, oil pressure gage, manifold pressure gage, and tachometer be calibrated prior to testing.

3. Engine accessories, such as the fuel pump, fuel-metering unit, and magnetos, should be overhauled in accordance with accessory manufacturer's recommendations, or replaced with new units before testing engine. This applies to overhauled engines only.

CAUTION **— CHECK THAT ALL VENT AND BREATHER LINES ARE PROPERLY INSTALLED AND SECURED AS DESCRIBED IN THE AIRFRAME MAINTENANCE MANUAL.**

4. Install all intercylinder baffles. Install all airframe baffles and cowling.

5. For optimum cooling during ground testing, a test club should be used. Where this is not possible, the regular flight propeller can be substituted but cylinder head temperature must be monitored closely.

B. GROUND TEST

1. Face the aircraft into the wind.

2. Start the engine, and observe the oil pressure gage. If adequate pressure is not indicated within 30 seconds, shut the engine down and determine the cause. Operate the engine at 1000 RPM until the oil temperature has stabilized or reached 140° F. After warm-up, the oil pressure should not be less than the minimum pressure specified in the applicable operator's manual.

3. Check magneto drop-off as described in the latest edition of Service Instruction No. 1132.

4. Continue operation at 1000/1200 rpm for 15 minutes. Ensure that cylinder head temperature, oil temperature and oil pressure are within the limits specified in the operator's manual. Shut the engine down, and allow it to cool if necessary to complete this portion of the test. If any malfunction is noted, determine the cause and make the necessary correction before continuing with this test.

5. Start the engine again, and monitor oil pressure. Increase engine speed to 1500 RPM for a 5-minute period. Cycle propeller pitch, and perform feathering check as applicable per airframe manufacturer's recommendation.

6. Run engine to full-static, airframe-recommended power for a period of no more than 10 seconds.

7. After operating the engine at full power, allow it to cool down moderately. Check idle mixture adjustment prior to shutdown.

8. Inspect the engine for oil leaks.

9. Remove the oil suction screen and the oil pressure screen or oil filter to determine any contamination. If no contamination is evident, the aircraft is ready for flight testing.

***NOTE* — Compile a log of all pertinent data accumulated during both the ground testing and flight testing.**

C. FLIGHT TEST

***WARNING* — ENGINE TEST CLUBS MUST BE REPLACED WITH APPROVED FLIGHT PROPELLERS BEFORE FLYING AIRCRAFT.**

1. Start the engine, and perform a normal preflight run-up in accordance with the engine operator's manual.

2. Take off at airframe recommended takeoff power, while monitoring RPM, fuel flow, oil pressure, oil temperature and cylinder head temperatures.

3. As soon as possible, reduce to climb power specified in operator's manual. Assume a shallow climb angle to a suitable cruise altitude. Adjust mixture per Pilot's Operating Handbook.

4. After establishing cruise altitude, reduce power to approximately 75% and continue flight for 2 hours. For the second hour, alternate power settings between 65% and 75% power per operator's manual.

***NOTE* — If engine is normally aspirated (non-turbocharged), it will be necessary to cruise at the lower altitudes to obtain the required power levels. Density altitude in excess of 8,000 feet (5,000 feet is recommended) will not allow the engine to develop sufficient cruise power for a good break-in.**

5. Increase engine power to maximum airframe recommendation and maintain for 30 minutes, provided engine and aircraft are performing within operating manual specifications.

***CAUTION* — AVOID LOW MANIFOLD PRESSURE DURING HIGH ENGINE SPEEDS (UNDER 15" HG) AND RAPID CHANGES IN ENGINE SPEEDS WITH ENGINES THAT HAVE DYNAMIC COUNTERWEIGHT ASSEMBLIES. THESE CONDITIONS CAN DAMAGE THE COUNTERWEIGHTS, ROLLERS OR BUSHINGS, THEREBY CAUSING DETUNING.**

6. Descend at low cruise power, while closely monitoring the engine instruments. Avoid long descents at low manifold pressure. Do not reduce altitude too rapidly, or engine temperature may drop too quickly.

***CAUTION* — AVOID ANY CLOSED-THROTTLE DESCENTS. CLOSED-THROTTLE OPERATION DURING DESCENTS WILL CAUSE RING FLUTTER CAUSING DAMAGE TO THE CYLINDERS AND RINGS.**

7. After landing and shutdown, check for leaks at fuel and oil fittings and at engine and accessory parting surfaces. Compute fuel and oil consumption and compare to the limits given in operator's manual. If consumption exceeds figures shown in manual, determine the cause before releasing aircraft for service.

8. Remove oil suction screen and oil pressure screen or oil filter to check again for contamination.

***NOTE* — To seat the piston rings in a newly overhauled engine, cruise the aircraft at 65% to 75% power for the first 50 hours, or until oil consumption stabilizes.**

II. ROTARY WING (HORIZONTAL INSTALLATIONS ONLY)

Proper break-in of helicopter engines is accomplished by following a sequence of steps ranging from servicing the engine on the ground to progressively increasing its power output during operation. Although this Service Instruction contains detailed information pertaining to break-in, it is impossible to cover all aspects of break-in for individual helicopter models. For that reason, consult the Pilot's Operating Handbook (POH) for a particular helicopter model. Also, refer to the Lycoming Operator's Manual for the engine.

Some facts should be kept in mind regarding break-in of piston engines employed in helicopters. They are as follows:

Because helicopters always operate at a fixed or rated engine speed, any reduced RPM required during break-in must be undertaken with the helicopter on-ground and with the rotor engaged. During flight, all power reductions must be made by manifold pressure alone.

Manifold Pressure Values. Some helicopters do not have red-line on the manifold pressure gage, and therefore use all rated power. Some are red-lined to airframe limitations and not to engine performance parameters. In the case of Lycoming model HIO-360-D1A, it has graduated manifold pressure values that can be obtained from the Lycoming Operator's Manual.

The method of rotor engagement, centrifugal clutch or manually operated belt drive, must also be considered.

***NOTE* — Because of the difference in helicopter models, refer to the helicopter pilot's operating handbook (POH) for specific methods of operation for a particular helicopter concerning rotor engagement and manifold pressure ratings.**

A. GROUND TEST

1. Check that engine is serviced with proper grade and quantity of oil.

2. Review the appropriate starting procedure detailed in the helicopter Pilot's Operating Handbook (POH).

3. Position the helicopter to take advantage of prevailing wind to assist in engine cooling.

4. Ensure that throttle and mixture control are at the full-off position.

***NOTE* — In following step, if adequate oil pressure is not indicated within 30 seconds, shut the engine down and determine the cause.**

5. Refer to helicopter Pilot's Operating Handbook (POH) for proper starting procedures. Start engine, and run 5 minutes at idle RPM (1200 - 1450 RPM).

6. Adjust idle mixture and oil pressure as required.

7. Shut engine off.

8. Inspect the engine for oil and fuel leaks.

9. If plug fouling is noted on magneto check, remove, inspect and test spark plugs. Clean oil and lead from plug. Reinstall spark