LYCOMING
A Textron Company
652 Oliver Street
Williamsport, PA 17701 U.S.A.
Tel. 570-323-6181
Fax. 570-327-7101
www.lycoming.textron.com

# MANDATORY SERVICE BULLETIN

DATE: November 22, 2004

Service Bulletin No. 369J
(Supersedes Service Bulletin No. 369I)

SUBJECT: Engine Inspection after Overspeed or Overboost

MODELS AFFECTED: All Lycoming piston engines.

TIME OF COMPLIANCE: As required by the subject bulletin.

## PART I – OVERSPEED

As shown in Chart I, every Lycoming piston engine is rated at a specified RPM value above which it may not be operated safely. Operating above the rated engine speed can accelerate wear of stressed parts, possibly resulting in their damage or failure. Momentary overspeed can occur during a landing attempt, when the prop governor lags as the throttle is suddenly opened for a go-around.

For fixed wing aircraft, momentary overspeed is defined as an increase of no more than 10% of rated engine RPM for a period not exceeding 3 seconds. For rotary wing aircraft, overspeed is defined as operating at any speed above rated engine RPM for any period of time. **No momentary overspeed is allowed for rotary wing aircraft.**

CAUTION

ENGINES MAY NOT BE CONTINUOUSLY OPERATED ABOVE SPECIFIED MAXIMUM CONTINUOUS RPM; TO DO SO WILL RESULT IN ABNORMAL WEAR ON BEARINGS, COUNTERWEIGHT ROLLERS AND OTHER ENGINE PARTS, CONCLUDING IN EVENTUAL ENGINE FAILURE.

Because inadvertent overspeed does occur, the information in this Service Bulletin is provided as an inspection procedure for an engine subjected to overspeed. Record any instance of overspeed in the engine log, along with the corrective action taken. Also note that the engine was inspected per this Service Bulletin.

NOTE

A few models have a five (5) minute take-off rating in addition to the continuous rating. On these engines, if overspeed does not exceed the take-off rating for longer than five minutes it may be disregarded. Also, for these engines the take-off rating may be considered to be the maximum rated speed when considering any momentary event of overspeed. Some engines, even though possessing parts of the same structural integrity, have different HP and RPM ratings. In these cases, when computing overspeed, the greater RPM may be used. (Reference Chart I.)

After locating the rated speed in Chart I, find the column for it in Chart II; then determine the percentage of overspeed from the values shown in the applicable column. For example, if the rated speed of the engine was found to be 2800 RPM and the overspeed was 2900 RPM, then from the 2800 column it can be determined that percentage of overspeed is less than 5%. In the lower portion of the chart, across from "2800" and down from 5% or less, locate the number "1" indicating that the instructions in Note 1 should be followed before the engine is returned to service.

CAUTION

IF OVERSPEED EXCEEDS 10% OF THE RPM VALUES IN THE COMPUTING-OVERSPEED COLUMN IN CHART I, IT IS RECOMMENDED THAT THE PROPELLER MANUFACTURER BE CONTACTED FOR POSSIBLE PROPELLER INSPECTION PROCEDURES.

**NOTES**

1. Determine the cause for overspeed and correct it.
2. Drain the lubricating system.
   a. Remove oil screens and filters and inspect for metal contamination.
   b. Perform a differential pressure check on all cylinders to determine the sealing quality of the rings and valves. See latest revision to Service Instruction No. 1191 for procedure.
   c. Using a borescope or equivalent instrument, examine the walls of each cylinder for scoring, which could be caused by stuck or broken piston rings.
   d. Disassemble magnetos and inspect all components for damage; recondition or replace parts as required. Reassemble and test in accordance with the applicable magneto overhaul instruction manual. Also inspect condition of the magneto drive gears on the engine for looseness, which would indicate the supporting idler shafts are loose due to failure of safety attachments. If applicable, inspect condition of magneto bearing recess in crankcase for excessive wear. Repair as necessary in accordance with the latest revision of Service Instruction No. 1140 or Service Instruction No. 1197.

   CAUTION

   EARLIER SLICK MAGNETOS ARE NON-REPAIRABLE. CONSULT SLICK PUBLICATION.

3. On mechanically supercharged engines, remove the supercharger drain cover and look for presence of engine lubricating oil which, if found, is indicative of a damaged supercharger seal. To determine the extent of damage, permit the oil to drain from the supercharger for a period of 8 hours; if the quantity of oil accumulated is more than a teaspoonful, the supercharger seal should be replaced.
4. Disconnect both the inlet and outlet attaching hardware from the turbocharger and examine the compressor and turbine wheels for possible damage. Check the shaft-wheel assembly for free turning and for vertical and lateral motion, which is indicative of damaged center housing bearings. Damage in these areas must be corrected before the engine is returned to service.
5. Either repeated moments or short periods of operation in the overspeed region accelerate the rate of wear in the parts that comprise the valve train and consequently reduce the reliability of the engine. In addition to the checks normally performed on the engine during a 100-hour periodic maintenance inspection, also accomplish the following steps on page 4 and 5 before the aircraft is returned to service.

| Chart I – Specified Rated Engine RPM | | | |
|---|---|---|---|
| ENGINE MODELS | SPECIFIED ENGINE SPEED | | |
| | Continuous Rated RPM | 5 Minute Take-Off Rating | RPM For Computing Overspeed |
| O-235-C1, -C1B, -C2A, -C2B, -E, -F, -G, -J; -K2A, -L2A, -M, -N, -P | 2800 | | 2800 |
| O-235-C1C, -H2C, -L2C, -K2C | 2800 | 2800 | 2800 |
| O-290-D, -D2 | 2600 | 2800 | 2800 |
| O-320-A, -B, -C, -D, -E, -H; IO-320; LIO-320-B, -C; *AIO-320-A, -B, -C; *AEIO-320-E | 2700 | | 2700 |
| O-320-E2A; -E2C, -E2F; *AEIO-320-E2A (rated at 140 hp) | 2450 | | 2700 |
| O-340-A, -B | 2700 | | 2700 |
| O-360-A, -B, -C (except –C2D), -D, -E, -F, -G, -J; IO/LIO-360, LO-360-A, -E; *AIO-360; VO/IVO-360; HO-360-A1A, -C1A; HIO-360-G1A; *AEIO-360-A, -B, -H | 2700 | | 2700 |
| O-360-C2D | 2700 | 2900 | 2900 |
| HO-360-B; HIO-360-A, -B, -C, -E | 2900 | | 2900 |
| HIO-360-D1A | 3200 | | 3200 |
| HIO-360-F1AD | 3050 | | 3050 |
| TO-360-A, -C, -E, -F; LTO-360-A, -E; TIO-360-A, -C | 2575 | | 2575 |
| O-435-A, -C | 2550 | | 2550 |
| GO-435-C2 | 3100 | 3400 | 3400 |
| VO-435-A | 3200 | 3400 | 3400 |
| VO-435-B; TVO-435 | 3200 | | 3200 |
| GO-480-B | 3000 | 3400 | 3400 |
| GO-480-C, -D, -F, -G, -H; IGO-480 | 3100 | 3400 | 3400 |
| GSO-480; IGSO-480 | 3200 | 3400 | 3400 |
| O-540-A, -B, -D; IO-540-C, -J | 2575 | | 2700 |
| IO-540-A, -B, -E, -G, -P; HIO-540-A; TIO/LTIO-540 (except -S, -V) | 2575 | | 2575 |
| O-540-J, -L; IO-540-W, -AB1A5 | 2400 | | 2400 |
| IO-540-AA1A5 (Alt. Rating) | 2425 | | 2425 |
| O-540-E, -G, -H; IO-540-AA1B5, -AC1A5, -D, -K, -L, -M, -N, -R, -S, -T, -V; TIO-540-S; AEIO-540-D, -L | 2700 | | 2700 |
| **O-540-F1B5, **IO-540-AE1A5 | 2800 | | 2800 |
| TIO-540-AK1A | 2400 | | 2400 |
| TIO-540-AE2A, -AH1A, -AJ1A | 2500 | | 2500 |
| TIO-540-AG1A, -AF1B | 2575 | | 2575 |
| TIO/LTIO-540-V, TIO-540-W | 2600 | | 2600 |
| VO-540-A | 3200 | 3300 | 3300 |
| VO-540-B; IVO-540; TIVO-540; VO-540-C | 3200 | | 3200 |
| IGO-540 | 3000 | 3400 | 3400 |
| IGSO-540 | 3200 | 3400 | 3400 |
| TIO-541-A1A | 2575 | | 2575 |
| TIO-541-E | 2900 | | 2900 |
| TIGO-541 | 3200 | | 3200 |
| IO-720 (400 hp) | 2650 | | 2650 |
| IO-720-D1BD, -D1CD (375 hp) | 2400 | | 2650 |

* - Aerobatic engines that are engaged in flight maneuvers which cause engine overspeed are subject to abnormal wear and possible overstress of rotating parts, which will shorten the service life of the engine. The damage accumulated due to the amount of overspeed, along with the extent of repeated operation at alternating high and low power applications, must be evaluated by the operator to determine the inspection procedures required.

** - Helicopter engines.

**Chart II – Inspection Requirements in Event of Overspeed**

| Engine Overspeed in Excess of Max. Rated RPM | ENGINE RPM | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2400 | 2425 | 2500 | 2550 | 2575 | 2600 | 2650 | 2700 | 2800 | 2900 | 3050 | 3200 | 3300 | 3400 |
| * 5% | 2520 | 2456 | 2625 | 2675 | 2705 | 2730 | 2780 | 2835 | 2940 | 3045 | 3202 | 3360 | 3465 | 3570 |
| *10% | 2640 | 2668 | 2750 | 2800 | 2830 | 2860 | 2915 | 2970 | 3080 | 3190 | 3355 | 3520 | 3630 | 3740 |

* - Except as defined as "Momentary Overspeed" in 2nd paragraph of Service Bulletin.

**Category of Engine Types and Inspection Requirements**
**(Numbers Refer to Notes in Body of Text)**

| Specified Engine Speed | FIXED WING INSTALLATIONS | | | | | | | | | ROTARY WING INSTALLATIONS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DIRECT DRIVE (Normally Aspirated) | | | DIRECT DRIVE (Turbocharged) | | | GEARED DRIVE | | | | | |
| | 5% or less | between 5-10% | over 10% | 5% or less | between 5-10% | over 10% | 5% or less | between 5-10% | over 10% | 5% or less | between 5-10% | over 10% |
| 2400 | 1 | 1,2,5 | 1,6 | 1 | 1,2,4,5 | 6 | | | | | | |
| 2425 | 1 | 1,2,5 | 1,6 | | | | | | | | | |
| 2500 | | | | 1 | 1,2,4,5 | 6 | | | | | | |
| 2550 | 1 | 1,2,5 | 1,6 | | | | | | | | | |
| 2575 | 1 | 1,2,5 | 1,6 | 1 | 1,2,4,5 | 6 | | | | 1 | 1,2,5 | 6 |
| 2600 | | | | 1 | 1,2,4,5 | 6 | | | | | | |
| 2650 | 1 | 1,2,5 | 1,6 | | | | | | | | | |
| 2700 | 1 | 1,2,5 | 1,6 | | | | | | | 1 | 1,2,5 | 6 |
| 2800 | 1 | 1,2,5 | 1,6 | | | | | | | 1,2 | 1,2,5 | 6 |
| 2900 | | | | 1 | 1,2,4,5 | 6 | | | | 1,2 | 1,2,5 | 6 |
| 3050 | | | | | | | | | | 1,2 | 1,2,5 | 6 |
| 3200 | | | | | | | 1,3 | 1,3,4,5 | 6 | 1,2 | 1,2,5 | 6 |
| 3300 | | | | | | | | | | 1,2 | 1,2,5 | 6 |
| 3400 | | | | | | | 1,3 | 1,3,4,5 | 6 | | | |

## NOTES (CONT.)

a. Inspect all screens and filters in the lubrication system for metal contamination; if any unexplainable accumulation is discovered, the cause must be determined and corrected before the engine is returned to service.

b. By means of a borescope or equivalent illuminated magnifying optical device, determine the condition of the intake and exhaust valve faces and seat faces. Evidence of excessive wear, pounding, or grooving is reason for the valve and seat replacement.

c. Inspect external condition of valve keys, rockers, and exhaust valve guides for damage; particularly check valve springs for coil strikes or severe bottoming of the coils. If damage to springs is evident, remove them and check compression load as specified in Table of Limits; replace any that are not within limits.

d. Rotate the crankshaft by hand to determine if valve lift is uniform or equal for all cylinders; also note if valve rockers are free when the valves are closed. Unequal valve lift is an indication of bent push rods; and tight rockers, when valves are closed, indicate a tuliped valve or a damaged valve lifter. Repair any suspected damage before the engine is returned to service.

**NOTES (CONT.)**

e. Comply with the latest revision of Service Bulletin No. 388 to determine exhaust valve stem to valve guide clearance condition.

6. Remove the engine from the aircraft; disassemble it and inspect the parts in accordance with the applicable overhaul manual. Replace any parts that are damaged or not within the service limits as shown in the Table of Limits. In engines equipped with dynamic counterweights, the bushings must be replaced in both counterweight and crankshaft.

## PART II – OVERBOOST

The maximum manifold pressure of turbocharged engines is controlled by various means:

1. Throttle controlled by the pilot. Here maximum rated manifold pressure is red-line and is normally reached somewhere before full-open throttle, depending upon density altitude.

2. Preset density controller. This controller senses compressor discharge density and varies the manifold pressure to ensure the engine develops rated power, up to critical altitude, regardless of the density altitude. Here take-off is at full throttle. However, the red line on the manifold pressure gage is the maximum permissible for a hot day at high field elevation. See the airframe or engine operator’s manual for standard day manifold pressure, realizing that full rated power will require a lower manifold pressure on a below standard temperature day and higher on an above standard day. This further indicates that should the density controller be improperly adjusted or malfunction, it is possible to have an overboost without exceeding red-line manifold pressure.

3. Preset absolute variable pressure controller. This controller is normally used on engines incorporating a turbo compressor air bleed to pressurize the aircraft cabin. The controller is preset at the factory resulting in red-line manifold pressure at full throttle regardless of density altitude.

4. Preset slope controller. This controller is normally used on engines that do not incorporate a turbo compressor air bleed to pressurize the aircraft cabin. The controller is preset at the factory resulting in red-line manifold pressure at full throttle regardless of density altitude.

Overboost of Lycoming supercharged or turbocharged engines is not permitted beyond the limiting manifold pressure which appears on the Sea Level and Altitude Curves of the applicable Lycoming Operator’s Manual. Any operation of an engine beyond this limit raises the possibility of serious engine damage. Because of this, any overboost, whether malfunction or inadvertent, which exceeds the allowable manifold pressure specified for the corresponding ambient pressure and temperature should be considered as shown in the following chart. It is the responsibility of the operator to monitor pressure to ensure limits are not exceeded. The continued use of an engine after momentary overboost has occurred is at the discretion and the responsibility of the operator.

NOTE

> During take-off with low oil temperature, advancing the throttle too quickly may result in manifold pressure “overshoot”. What happens is that manifold pressure advances momentarily above maximum rated by 1 or 2 inches Hg. and then returns immediately to the maximum rated. In this instance, the throttle is slightly ahead of the controller’s capacity to function normally. If overshoot does not exceed 2 inches and 3 seconds duration, it may be disregarded. However, overshoot can be prevented by interrupting the throttle advance momentarily several inches below rated manifold pressure.

| Chart III - Overboost Recommendations (No Manifold Pressure Relief Valve) | |
|---|---|
| IN ALL CONDITIONS LISTED BELOW, INVESTIGATE REASON FOR OVERBOOST AND CORRECT BEFORE NEXT FLIGHT | |
| Overboost Conditions | Recommendations |
| Momentary overboost not exceeding 3 inches Hg. for 5 seconds. | Enter in logbook. Include maximum manifold pressure reached, duration of overboost, cylinder head temperature, ambient air temperature, pressure altitude. |
| Not exceeding 5 inches Hg. or 10 seconds. | Normal 50-hour inspection plus particular attention to items 1, 2 and 3 in the following list. |
| Not exceeding 10 inches Hg. | Remove engine from aircraft; completely disassemble and inspect. Replace all parts that do not come within maximum service limits as shown in latest revision of Lycoming Service Table of Limits. |
| Over 10 inches Hg. | Complete engine overhaul required, plus replacement of crankshaft. |

1. Inspect cylinder assemblies for signs of cracked heads, particularly around the lower spark plug holes; and for cracks around the hold-down flange of cylinder barrels. Also check barrels for burned paint and for oil leaks around cylinder base flanges.

2. Remove oil screens and inspect for metal particles using care to insure the particles are metal and not hard carbon.

3. Remove all spark plugs and inspect them closely for physical and structural defects. Spark plugs removed may be reused providing that each plug checks out satisfactorily in a spark plug test unit and exhibits none of the following defects:

   a. Fine wire plugs with loose center or ground electrodes.

   b. Electrodes show signs of metal or impact damage.

   c. Massive electrode plugs with copper run-out of center electrode.

   d. Ceramic core nose with a cracked or crazed surface.

## PART III – ENGINES EQUIPPED WITH ABSOLUTE PRESSURE RELIEF VALVE

Some Lycoming turbocharged engines are equipped with an absolute pressure relief valve (often referred to as a “pop-off” valve). This valve is installed between the compressor outlet and the fuel injector/carburetor to protect the engine from surges of excessive manifold pressure. Even though manifold pressure may continue to rise above its normal rated value, power output will not increase appreciably. In fact, as the valve lifts off its seat, at approximately 2 inches above normal-rated, power may decrease even if manifold pressure continues to rise above normal-rated pressure.

Action required with manifold pressure overboost:

1. Determine the cause for overboost and correct it.

2. Remove the absolute pressure relief valve (pop-off valve).

3. Place the valve assembly, mounting flange down, on a calibrated scale. The valve head should protrude approximately 0.2 inch below the mounting flange. Ensuring that the mounting flange remains parallel to the scale surface, apply pressure to the top of the valve housing. If the valve head depresses flush with the mounting flange surface, without exceeding the maximum pounds of force listed below, the valve is functioning.

In the following chart, pressure relief valves are divided into three categories, according to manifold pressure requirements.

| Categories – Manifold Pressure Required to Develop Rated Power | Maximum Pounds to Depress Valve |
|---|---|
| 30.00 to 40.00 inches Hg. | *43 lbs. |
| 40.00 to 50.00 inches Hg. | *58 lbs. |
| 50.25 to 60.00 inches Hg. | *72 lbs. |
| * - Any lesser pressure is acceptable as long as the valve, when in service, does not lift off its seat prior to attaining manifold pressure. | |

NOTE

After complying with items 1 thru 3 and making appropriate logbook entry, return engine to service. Should the relief valve fail to lift off its seat within prescribed limits, the valve has malfunctioned. If so, refer to and comply with the Chart III overboost recommendations. Also, either reset or replace the pressure-relief valve.

CAUTION

ON ENGINES WHERE MANIFOLD PRESSURE IS THROTTLE-CONTROLLED BY THE PILOT, IN NO CASE ADVANCE THE THROTTLE BOOSTING MANIFOLD PRESSURE BEYOND RED-LINE TO DETERMINE IF THE ABSOLUTE PRESSURE RELIEF CONTROLLER IS FUNCTIONING. THIS IS AN EMERGENCY CONTROLLER. DELIBERATE MANIFOLD PRESSURE OVERBOOST MUST BE AVOIDED.

NOTE: Revision “J” revises Chart I and Chart II.