AWB 85-1 Issue 4, Textron Lycoming Engine Bearings

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Applicability

All owners, operators and maintainers of Textron Lycoming piston engines.

Purpose

This AWB details some of the underlying reasons and recommends steps to minimize Lycoming engine bearing failures.

Background

CASA has received some service difficulty reports on failure of bearings installed in Lycoming engines. Following is the detail of bearing construction and probable causes of bearing failures.

Bearing design and construction

Bearings used in Lycoming engines are high-precision, low friction Plain bearings with steel backs, lined with various alloys. There are mainly two types of engine bearings based on the composition of alloys used in the bearing construction. Alloy composition determines the fatigue strength, durability, coefficient of friction and embed-ability, among others.

1. Copper-Lead based bearings were supplied by Lycoming and other PMA bearing suppliers prior to 1995. The base material for these bearings has good fatigue strength and they conform to the crankshaft journal shape with relative ease, reducing possibility of localised stresses. Copper-Lead bearings have a low coefficient of friction, good anti-scuff properties and high embed-ability. The supply of this type of bearing resumed in February 2002.
2. Aluminium-Tin based bearings were supplied by Lycoming and other PMA bearing suppliers during the period 1995-2001. These bearings have lower fatigue strength when compared to Copper-Lead bearings. The use of this bearing type requires better dimensional. Relatively higher failure rate indicate that this bearing type may have lower tolerance for operational and / or maintenance errors.

New bearings installed during the period 1995-2001 are likely to be of Aluminium-Tin type, which the facility that overhauled your engine should be able to confirm.

Engine Operation

Proper engine operation and the correct and timely maintenance actions is the key to trouble free engine life from one overhaul to another. While there are many factors that may cause engine distress, nothing is more damaging than engine detonation and pre-ignition. The conditions that cause detonation and pre-ignition including high Cylinder Head Temperatures (CHT), inappropriate Fuel-air mixture ratios and maladjusted ignition timings are found to reduce bearing durability.

Poor quality of fuel, unapproved fuel additives and contamination of the fuel system are some of the other factors that can contribute to adverse combustion conditions in the cylinders and increased bearing loads.

Oil pressures (at idle and at rated speed) and oil temperatures are all good indicators of the condition of the engine lubrication system that affects bearing durability. Unapproved oils and oil-additives can also adversely affect engine and bearings.

It is important to emphasise that any adverse indications during engine operations are to be investigated and timely corrective actions be taken to improve bearing durability.

Engine Maintenance

Plain bearings operate with a hydrodynamic lubricating film provided by oil supplied under pressure. While nominal oil pressure may vary between 60 and 90 psi, depending on the engine model and operating conditions, pressure of the hydrodynamic oil film between bearing and journal is significantly higher than oil supply pressure.

Loss of hydrodynamic oil film may lead to metal-to-metal contact, generation of excess heat and bearing disintegration.

There are a number of possible factors that may lead to bearing failure:

- Inadequate supply of oil.
- Inadequate or excessive bearing clearances.
- 'Linishing' or polishing of journals that leaves journals oval.
- High oil temperature.
- Stress concentration due to pre-existing defects.
- Propeller strike.
- Failure to pre-oil the engines before the first start, following an engine change or prolonged period of

inactivity.

Regular monitoring of the engine condition and operational details may help identify signs of an impending failure.

Engine Overhaul

Correct bearing crush is important for bearing retention and transfer of heat produced during operation. Accordingly, crankcase bearing locating diameters in relation to bearing being installed, crankshaft journal diameters and piston connecting rod internal diameters must be within manufacturer's dimensions. Lack of bearing ‘crush' may result in bearing rotation, fretting and failure.

Another factor that may hamper heat transfer from the bearing is the use of inappropriate assembly lubricant during bearing installation.

It may also be noted that any high spots, eccentricity or axial asymmetry of major diameters will result in increased bearing loads, which could result in bearing failure.

Conformance to manufacturer's recommended overhaul procedures, materials and standard practices cannot be over-emphasised.

Recommendations

For Engine Overhaul Shops:

1. Incorporate Lycoming Service Bulletins 544A, 547 supp 1, 561 and Service Instruction 1512 (or later service documents related to bearings), as applicable.
2. During overhaul, ensure a high degree of cleanliness of the bearing areas and application of approved assembly lubricant.
3. Bore diameters should meet the specification for the applicable bearing part numbers to ensure correct bearing crush.

For Maintenance personnel:

1. Change oil and filter and carry out inspection per provisions of Lycoming SB 480D. Cutting the filter open and inspecting contents may provide valuable information on bearing condition. When carrying out the engine oil and oil filter change procedure detailed in Lycoming SB 480D, drain the oil whilst the engine is still hot and strain the hot oil through a fine mesh screen filter. Draining the oil whilst it is hot will assist in flushing out bearing material flakes.

2. Pre-oil the engine per provisions of Lycoming Service Instruction SI 1241C or the latest revision, before the first start, following an engine change or prolonged period of inactivity.
3. In case of doubt, contact your overhaul facility or manufacturer.

For Pilots / Flight Operations:

1. Follow correct cold weather engine start procedures.
2. Report all instances of engine malfunction, parameter exceedances and propeller strikes, even if they are minor, to ensure appropriate and timely maintenance action.

Summary

Aluminium-Tin bearings have shown a higher failure rate in high-powered Lycoming engines. Installing bearings per the latest service documents from the manufacturer can significantly reduce the probability of bearing failure.

The next step:

1. On the next overhaul shop visit for a major repair, make sure that your Lycoming engine is reassembled with bearings as per latest Lycoming Service literature, applicable to your engine model.
2. Following the instructions in this AWB will increase bearing durability.

Service Difficulty Reporting Program

Bearing defects in piston engines should be reported to CASA on the Service Difficulty Reporting program available on the CASA website. Additional information such as details on the supplier, manufacturer and part number of the bearings fitted, details on the last OH facility, method of failure detection, location and condition of failed bearing, condition of oil & filter and the time between last oil filter inspection and bearing failure can facilitate detailed review of the bearing failure causes.

Enquiries

Enquiries with regard to the content of this Airworthiness Bulletin should be made via the direct link e-mail address: AirworthinessBulletin@casa.gov.au

Or in writing to Manufacturing, Certification and New Technologies Office, GPO Box 2005, Canberra, ACT, 2601