Australian Government
Civil Aviation Safety Authority

AIRWORTHINESS BULLETIN

Piston Engine Valve Tappet Body & Camshaft Lobe Wear

AWB 85-014 **Issue** : 1
Date : 23 November 2012

1. Applicability

All Lycoming and Continental piston engines.

2. Purpose

To alert operators and maintainers to the hazard of possible in-flight engine malfunction or loss of engine power which can result from undetected valve tappet body / lifter and camshaft lobe wear.

3. Background

There has been a recent increase in the number of reports of Lycoming engines being withdrawn from service due to ferrous metal contamination in the oil filter element.

Investigations by various Lycoming engine overhaulers have found that in the majority of cases the filter contamination was directly attributed to severe spalling of the now superseded Lycoming tappet body P/N 15B26064. These tappet bodies were supplied from late 2009 until mid 2012.

Figure 1 - Advanced spalling of Lycoming tappet body P/N 15B26064.

Figure 2 - Spalled P/N 15B26064 tappets showing the various stages of deterioration that can exist between tappet bodies in one engine.

Further research into this problem, based on related defect reports have identified a range of issues with hydraulic valve lifters, tappet bodies and cam lobes, including failures in both Lycoming and TCM Continental engines.

The inserted images are representative examples of typical deterioration which can occur. The depicted tappet body / lifter and camshaft lobe wear is not restricted to a particular engine type or component part number.

Figure 3 - Spalled TCM Continental hydraulic valve lifters P/N 653877, Note that P/N 653877 is not currently identified as a mandatory replacement in TCM MSB09-8A which states that lifter failures can present a safety of flight issue.

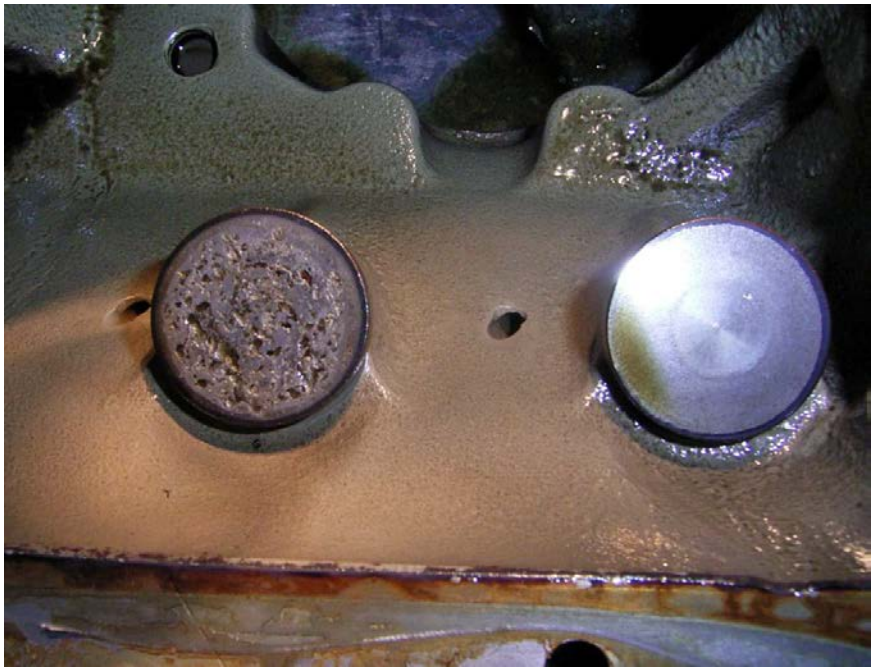

Figure 4 - Tappet Body P/N SL72877 - Variation in the condition of adjacent tappet body faces

Camshaft wear

To reduce the costs of overhaul, some maintainers have installed reground camshafts and tappets into engines. Although camshafts may be reground, there is a very strict limit on the amount of grinding which can be tolerated. If the hardened surface of the cam lobe is removed, the softer material is exposed and the rapid wear that follows provides an increasing volume of metal in the engine oil and filter.

Camshaft wear will result in loss of engine performance due to loss of volumetric efficiency and subtle changes in valve timing. Cam lobe wear may be most pronounced where two valve tappet bodies share the same cam lobe, (e.g. intake valve train).

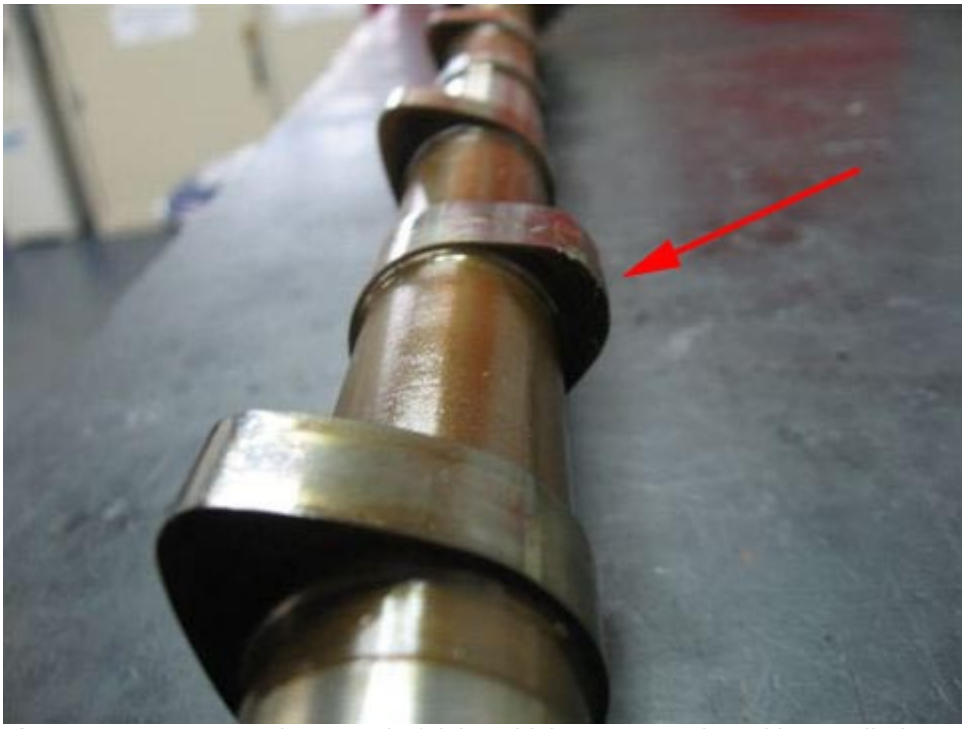

Figure 5 - Worn Lycoming camshaft lobe which was operating with a spalled tappet body P/N15B26064.

Figure 6 - Lycoming roller cam follower and worn cam lobe.

Changes in engine performance due to cam lobe wear are more difficult to detect in fixed wing than rotary wing operation. Cam lobe wear debris alone can be difficult to detect in the filter.

Causes of tappet body/ lifter and valve cam failures

It is widely recognised that the sliding contact between the cam follower and the cam and the loading encountered during operation represent one of the most highly stressed areas of the piston engine.

Corrosion

Aside from possible manufacturing problems identified in various manufacturers' service information, tappet body and hydraulic lifter contact surface failures are commonly attributed to corrosion pitting.

Corrosion pits penetrate the hardened layer and reduce the durability of cams and lifters. Such corrosion commonly results from infrequent flight activity, particularly in moisture laden environments, without adequate engine preservation.

Rapid starting

During periods of inactivity, engine oil drains away from camshaft lobe and tappet body contact surfaces. Starting the engine with the throttle set wide damages the engine because the engine RPM will quickly increase before the oil pump has had a chance to circulate oil to all parts of the engine. To minimise wear during the first few seconds of engine start-up, set and monitor the throttle during cranking so that the engine starts as close as possible to idle RPM, e.g. 650 +/- 50 RPM for the first 20 seconds and then gradually open the throttle during the engine warm up period.

Reconditioned Parts

As previously stated, re-grinding of the camshaft lobes and lifters also results in a reduction in the thickness of the wear-resisting, hardened layer of the components, which may further exacerbate the issue. Lycoming, for example, notates in service literature that if for any reason a new camshaft is to be installed in the engine, or the cam lobes are reconditioned by grinding, all of the tappet bodies must be discarded and replaced with new tappet bodies. Furthermore, Lycoming does not recommend the use of reground tappets under any circumstance.

Examine the oil filter

The first indications of abnormal tappet face wear are commonly reported to be very fine magnetic particles in the engine oil pressure filter element. Metallic contamination of the engine oil supply may result in a wide range of problems including; propeller and turbocharger control malfunction, gear tooth wear and a reduction of oil pressure due to wear in engine bearings.

Tappet body / hydraulic lifter and cam lobe wear may be difficult to detect in the early stages and the benefit of diligent inspection of the paper filter element at each oil change cannot be over-emphasised. Any fine magnetic particulate in the filter should be reason to investigate the engine further.

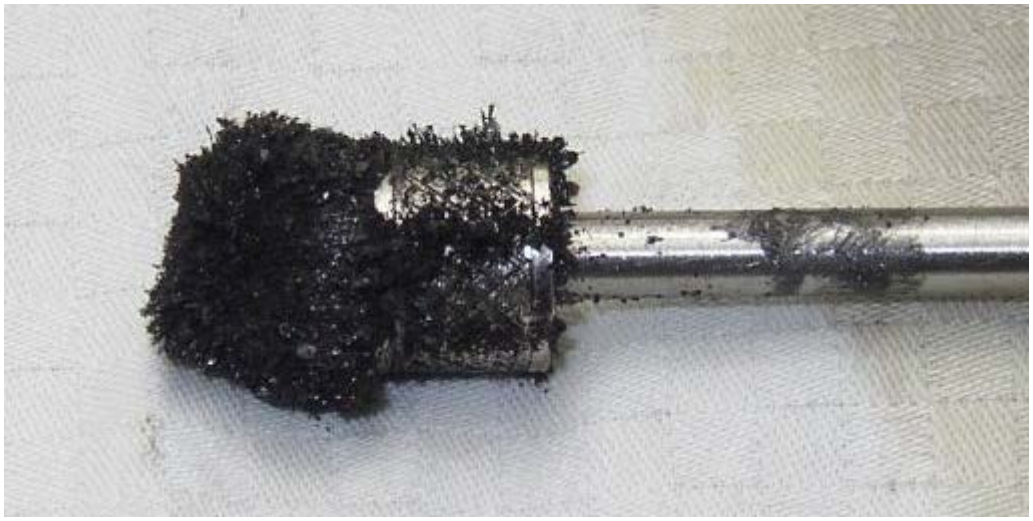

Figure 7 - Very fine magnetic particles, typically eroded from tappet bodies / lifters and camshaft lobes, extracted from an engine oil filter element.

Examine the engine.

Whenever metallic debris is detected in the filter or the volume of engine oil filter debris remains at a high level or exceeds the manufacturer's limits, the source of the debris should be identified and any problems corrected prior to further engine operation. Due to the difficulty in detecting the early stages of adverse tappet body wear, the periodic removal of a cylinder and use of a boroscope to inspect the cam and lifter faces may be a more reliable method than using oil filter debris alone to determine cam and tappet serviceability.

Introduction of new part number lifters and tappets

While there are many factors involved in adverse wear and failure of camshafts and tappet bodies, both TCM and Lycoming have sought to address any manufacturing problems by revising the design and/or manufacturing process and by introducing improved tappet bodies and hydraulic valve lifters.

For example, Lycoming Service Instruction (SI) No. 1543 Dated: February 23, 2012 - "Notification of Approved Tappet P/N 15B26262", advises that tappet P/N 15B26262 is the approved replacement for Tappet P/N 15B26064 with compliance at next overhaul, whenever tappet replacement is necessary, or earlier at owner's discretion.

The FAA have issued AD 2010-11-04 mandating TCM Continental Mandatory Service Bulletin (MSB) No. MSB09-8A, which provides similar information, and may require the replacement of certain part number hydraulic lifters before further flight.

4. References

1. CASA AWB 85-013 Issue 1
Piston Engine Oil & Filter Element - Inspection.

2. Lycoming SI 1011J Dated: February 23, 2012
Table of Current Tappet Bodies, Plunger Assemblies and Hydraulic Lifter

3. Lycoming SI 1543 Dated: February 23, 2012
Notification of Approved Tappet P/N 15B26262

4. Lycoming SI 1529 Rev. A Dated: June 30, 2010, Rev. B Dated: February 23, 2012 and Rev. C Dated July 16, 2012
Hydraulic Lifter and Tappet Body Part Numbers

5. Lycoming SB-480E Dated: April 13, 2005
I. Oil and Filter Change and Screen Cleaning
II. Oil Filter/Screen Content Inspection

6. FAA AD 2010-11-04 which mandates Teledyne Continental MSB09-8A.

7. Teledyne Continental Service Information Directive SID 05-1 Summarises information pertinent to the design, operation, maintenance and warranty for TCM camshafts and hydraulic lifters.

8. Teledyne Continental Service Information Letter SIL99-2B Dated: 17 October 2005
Current Listing of Sealants, Lubricants & Adhesives Authorized by TCM

9. Lycoming Service Letter (SL) No. L245
Withdrawal of Special Service Publication No. SSP-567 "Camshaft Regrinding"

5. Recommendation

CASA recommends that operators and maintainers:

1. Diligently inspect the oil filter element at each engine oil change and consider 25 hour / 4 month oil changes.
2. Consider using an FAA approved engine oil additive, particularly for low utilisation engines.
3. Investigate the engine technical records and determine if superseded Lycoming P/N 15B26064 tappet bodies were installed at the last overhaul.
4. Consider either not installing, or replacing superseded tappet bodies with the current part.
5. Report all instances of failed or faulty tappet bodies, hydraulic lifters and camshafts to CASA via the SDR system, via sdr@casa.gov.au.

6. Enquiries

Enquiries with regard to the content of this Airworthiness Bulletin should be made via the direct link e-mail address:

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or in writing, to:

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