Australian Government
Civil Aviation Safety Authority

AIRWORTHINESS BULLETIN

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Piston Engine Low Utilisation Maintenance Practices

1. Effectivity

All installed and uninstalled aircraft piston engines.

2. Purpose

This Airworthiness Bulletin (AWB) identifies the recommended maintenance practices which effectively minimise the corrosion condition for piston engines not flown frequently.

3. Background

It is widely acknowledged that piston engines that are not flown frequently are susceptible to damage from corrosion and contamination, which may adversely affect their expected service life.

Susceptibility to corrosion is influenced by a number of factors, including but not limited to, geographical location, season, usage and storage.

When a piston engine is exposed to adverse environmental conditions such as coastal areas and areas of high relative humidity, corrosion attack can occur within a few days. Conversely, engines under more favourable environmental conditions can remain inactive for several weeks without evidence of damage by corrosion.

Experience has shown that the best course of action to reduce the likelihood of corrosion attack on engine internal surfaces is to fly the aircraft regularly. In circumstances where this action is not possible engine preservation procedures have been promulgated within engine manufacturer’s instructions for continuing airworthiness to combat and minimise the corrosion condition as a direct result of engine inactivity.

A number of other contributing factors which lead to this corrosion condition are also within the control of the operator and maintenance personnel if the appropriate preventative actions in the following recommendations are performed.

4. Recommendations

A. Engine Preservation

In general, manufacturers recommend that for engines which won't be flown for 30 days or more, a preservation regime should be instigated.

The need for engine preservation should be evaluated by the aircraft operator having regard to the prevailing environmental conditions and period of aircraft inactivity.

When an engine does not achieve flight operating temperatures for an adequate period, on a regular basis, moisture and other by-products of combustion that form, are not vaporised and eliminated through the exhaust and crankcase breather.

The mechanism by which moisture may accumulate inside the engine is by condensation. More specifically, during each heating and cooling cycle that the engine goes through water vapour may be drawn into the engine which then condenses on internal surfaces and results in increased water content of the oil.

During engine operation the oil also picks up various by-products of combustion. When these by-products mix with water, acidic compounds are formed; which are capable of etching metal and providing a point for corrosion and rust to take place on vulnerable surfaces, such as, cylinder walls, camshaft and tappets.

As the engine is subsequently run this corrosion and rust becomes a very fine abrasive causing internal engine wear. As these components wear, they make more metal which attacks the softer metals in the engine compounding the problem.

Preservative oils protect an engine from corrosion and rust in a manner that standard aviation engine oils do not. These preservative oils are specifically formulated with robust corrosion inhibitors that allow the lubricant to chemically protect metal parts, resulting in a superior barrier against the formation of corrosion and rust.

Some engine manufacturers also publish preservation procedures for periods up to 30 days without the necessity to flush the preservative oil prior to flying the aircraft. (For example; Lycoming Operators Manual No. 60297-12, Section 7).

Prior to parking the aircraft for an extended period, CASA also supports the notion that if the engine is more than 50% through the manufacturers published oil change interval, the oil should be changed and the aircraft flown to circulate the fresh oil. By parking the aircraft with fresh oil this will reduce the likelihood of corrosion that may result from contaminated or acidic used oil.

B. Engine Oil Change

Almost all engine manufacturers' maintenance schedules specify not only an hour time limit, but also a calendar time limit for oil changes. Both Lycoming and Continental Motors subscribe to a 4 month oil change threshold.

The calendar time limit is often misunderstood and is thought to be of less importance than the accumulated time in hours of operation however; both criteria are of equal importance to the continuing airworthiness of the engine.

Note: For piston engines maintained in accordance with Civil Aviation Regulation CAR 42B-CASA Maintenance Schedule; the calendar oil change interval published by the engine manufacturer is mandatory via AD/ENG/4 Amdt. 11, Appendix 'A', Requirement A3(a).

The need for the calendar based time limit is not caused by oil breakdown, but rather by the oil becoming contaminated with the by-products of combustion, and water, as previously mentioned.

Changing the oil on a calendar time basis for a low utilisation engine is an effective means of removing these contaminants thus minimising the conditions within the engine that are conducive for corrosion attack.

C. Engine Ground Runs

Engine ground running is not a substitute for regular flying, in fact, the practice of ground running will tend to aggravate rather than minimise the corrosion condition for the following reasons;

- Short duration ground running only serves to heat the engine components and actually promotes the condensation process, and
- During a ground run the engine is not operated at the necessary temperature for the proper duration to vaporize the water in the oil. Such a ground run increases the potential for water formation and corrosive attack.

Similarly, the practice of pulling engines through by hand when the aircraft is not run or flown for extended periods can also exacerbate the condition for the following reason;

- Engine lubrication systems are designed to provide either pressure or splash oil to the areas of the engine that are subjected to frictional loads. When the propeller is pulled through by hand, the rings wipe oil from the cylinder walls and the cam load created by the valve train wipes oil from the cam and followers. Repeatedly performing this action without engine start will leave these components without a protective oil film thus increasing susceptibility to corrosion attack whilst also causing excessive wear during subsequent engine starting.

5. Conclusion

When an aircraft piston engine will not be flown for an extended period;

- The use of preservation oil in accordance with the engine manufacturer's instructions is required to prevent internal engine wear due to corrosion.
- Variables such as geographic location, local temperature and humidity need to be evaluated in order to establish an appropriate engine preservation threshold and regime.
- The adverse impact of water content, acid formation and contaminants are minimized when calendar time oil changes are performed.
- Engine ground running is not a substitute for regular flying and can aggravate the corrosion condition.

Aircraft operators need to consider their individual circumstances and recognise the conditions that are conducive to corrosion and take appropriate precautions by adjusting their maintenance schedule accordingly to combat the corrosion condition as a direct result of engine inactivity.

6. References

- Lycoming - Service Letter L180B "Engine Preservation for Active and Stored Aircraft"
- Lycoming – Service Instruction 1481B, "Factory Engine Preservation" – (uninstalled engines).
- Lycoming – Service Bulletin 480E "Oil and Filter Change"
- Continental Motors –Standard Practice Maintenance Manual (SPMM) M-0;
  - Chapter 6-4 "Scheduled Inspections" and
  - Chapter 9-1 "Preserving and Storing an Engine".

7. Enquiries

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

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