Australian Government
Civil Aviation Safety Authority

Airworthiness Bulletin

AWB 02-001 Issue 2 - 23 July 2024

On-Condition Maintenance

An Airworthiness Bulletin is an advisory document that alerts, educates, and makes recommendations about airworthiness matters. Recommendations in this bulletin are not mandatory.

1. Effectivity

The information in this Airworthiness Bulletin is relevant to owners, Registered Operators (ROs) and maintainers of all aircraft registered and operating in Australia.

2. Purpose

Issue 1 of this Airworthiness Bulletin was published to remind owners, ROs and maintainers of the expected maintenance practices in relation to “on condition maintenance”.

Issue 2 of this Airworthiness Bulletin is published subsequent to ATSB investigation reference AO-2022-049 and related ATSB Safety Action Notice 2022-049-SAN-001, to reiterate and reinforce that ‘on condition maintenance’ is reliant on active monitoring (for example via periodic inspections and/or tests) and **must not** be taken to be a ‘fit-and-forget’ philosophy.

3. Background

Some operators and maintainers, including some Licensed Aircraft Maintenance Engineers (LAMEs) have come to believe that “on condition” means fit and forget. They believe that it’s ok to not do anything until a failure occurs.

The Maintenance Steering Group -2 (MSG-2) – which is the pre-cursor to the current MSG-3, the aviation industry’s gold standard for developing scheduled maintenance programs – provides definitions for “hard time”, “on condition”, and “condition based” maintenance philosophies. “On condition” maintenance in particular is defined as:

> On Condition (OC):
> Repetitive inspections, or tests to determine the condition of units or systems or portions of structure.

Maintenance practices that mistakenly equate “on condition” to mean “fit-and-forget” and/or “fit-until-failure” will not achieve the levels of safety and reliability that are inherent in the design of the aircraft. At best, this may cause operational surprises, which could prove very costly. At worst, this may jeopardise the safety of an aircraft and its occupants. The ATSB’s investigation into a fuel leak that lead to an in-flight fire and subsequent death of the pilot serves as a stark reminder of this. Refer to investigation reference AO-2022-049 on the ATSB website for further details.

4. Understanding On condition Maintenance Practices

The majority of aircraft mechanical components do not fail abruptly but go through a period of performance degradation before failing. This means that there will be some warning signs of the fact that they are about to fail. For example, this may be a crack that is propagating; high vibrations; signs of leaking fuel or hydraulics; etc.

The point at which theses signs can first be detected is called the Potential Failure. The point at which the item fails is called the Functional Failure. See Figure 1 below. Inspections / tests done in between these two points allow for the warning signs to detect imminent functional failure and thus the item can be replaced before the functional failure actually occurs. The amount of warning given by different potential failures may vary seconds to decades. Longer warning intervals means longer task intervals.

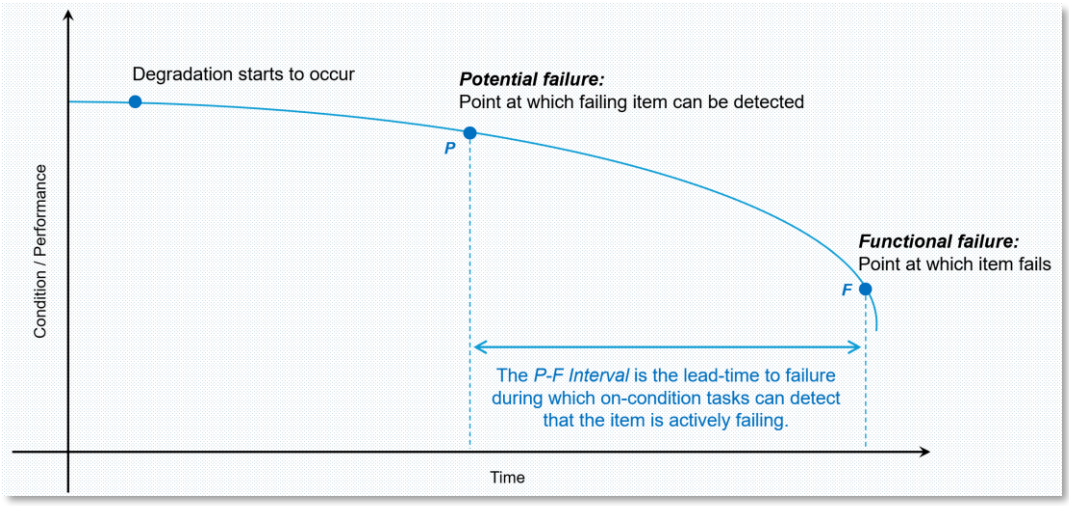

Figure 1 – The *P-F Interval* is the lead-time to failure.

On condition maintenance refers to the inspections / checks used to detect degradation in condition or performance. Items are left in service on the condition that they continue to meet a desired physical condition and performance standard.

On condition maintenance is applied to items on which a determination of continued airworthiness can be made by visual inspection, functional checks, measurements, tests, or other means that don’t require disassembly. The condition of an item is monitored either continuously or at specified periods. The item's performance may relate to, but are not limited to, cleanliness, cracks, deformation, corrosion, wear, pressure or temperature limits, leaks, loose or missing fasteners, and are published in the approved data of the aircraft or aircraft component.

Therefore on condition maintenance means an inspection / check that may result in the removal of an item before it fails in service. It is not a philosophy of “fit-until-failure” or “fit-an**d-forget”.**

For example, an upper or lower limit of an indicated parameter such as a fluid pressure (continuous monitoring) may indicate a component's wearing condition, etc. Failure of the item to continue to meet the specified pressure levels will indicate that further maintenance actions are necessary.

At specific periods, the condition of an item may require a sound technical judgement to determine that a malfunction or failure of the item will not occur prior to the next scheduled inspection.

According to an extensive international study conducted in the aviation industry, as much as 89 per cent of items can benefit from “on condition” maintenance tasks. That is why, at present, the majority of maintenance tasks listed in manufacturers’ maintenance schedules and the CASA maintenance schedule (Schedule 5 of the Civil Aviation Regulations (CAR) (1988)) are on condition maintenance tasks.

Compliance with on condition maintenance tasks are mandatory if listed in the manufacturer's maintenance schedules, operator’s approved system of maintenance, or Schedule 5 of the CAR (1988).

5. Manufacturers Recommended ‘Time between overhaul’ (TBO)

The MSG-2 defines “hard time” maintenance as:

> Hard Time (HT):
> A maximum interval for performing maintenance tasks. These intervals usually apply to overhaul, but also apply to total life of parts or units.

Aircraft and component manufacturers make "Hard Time" recommendations for certain items,
i.e. removal of items from service at a specified period for overhaul or replacement, indifferent of the items current performance condition. This is often referred to as Time Between Overhaul (TBO), which specifies how long the manufacturer considers their product should remain in service before disassembly and refurbishment is required in order to maintain the item’s inherent safety and reliability. These recommendations are based on the manufacturer’s engineering and design data, average utilisation, and operating conditions, and usually recommend that the item be fully stripped and returned to the original specifications. TBO’s do not normally involve a condition check being done during the item’s life.

6. Instructions for Continuing Airworthiness (ICA) for modified or repaired aircraft

As part of the design approval, the effect that a modification or repair has on the existing ICAs must be assessed. In addition, there might be a need to introduce alternate and/or additional ICAs to ensure the aircraft or aeronautical product remains airworthy throughout its lifetime. This includes but is not limited to flight deck effects, periodic inspections, operational and functional checks. In some cases, the modification approval process may determine that the aircraft's existing ICAs adequately cover the modification (e.g. through existing pre-flight checks; zonal inspections tasks etc). Regardless of the outcome, that determination should be clearly stated within the Engineering Order or equivalent document. Where in doubt, consult with the design approval holder to ensure that the requirements are clearly understood and that the modified aspects of the aircraft are not erroneously treated as "fit-and-forget". Further information can be found in CASA Advisory Circular 21-08 '*Approval of Modification and Repair Designs under Subpart 21.M*'.

7. CASA Recommendations

Owners, Registered Operators and maintainers should utilise the correct philosophy of **on condition maintenance** to detect the onset of failures of such items. Provided that a component continues to meet the documented standard, at the appropriate frequencies, it is considered satisfactory to remain in service.

In certain circumstances, alleviation may be permitted beyond the manufacturer's recommended TBO for a hard-time maintenance item. For example, TBOs that are not included in the manufacturers Airworthiness Limitations or in Airworthiness Directives issued by CASA should still be adhered to unless substantiation has been collated to show the outcome of the changed on condition inspections are appropriate for the safe operation of the aircraft or equipment.

Where **on condition maintenance** has been substantiated, maintainers should continue to pay due regard to the manufacturer's recommended TBO, particularly when the time in-service of these items has reached or exceeded the TBO interval.

Where alleviation is permitted beyond the manufacturer's TBO, an example of which would be AD/ENG/4, ROs and LAME's must ensure at the completion of the aircraft periodic inspection the **on condition maintenance** inspection requirements are included on part 1 of the aircraft's maintenance release as "maintenance required".

8. Reporting

Major defects experienced by operators must be reported to CASA under regulation 51A of the Civil Aviation Regulations (1988) or Division 42.C.4 of the Civil Aviation Safety Regulations (1998) as applicable.

For further guidance on how to submit a report, refer to CASA Advisory Circular 20-06 which is available on the CASA website. The aircraft type certificate holder should also be notified to facilitate global monitoring of the issue.

9. Enquiries

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

AirworthinessBulletin@casa.gov.au

or in writing, to:

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National Operations and Standards
Civil Aviation Safety Authority
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