CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

Advisory Circular

Subject: **On condition maintenance**

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AC43-4

Author: **David Pattie**

Authorised: Peter Blackler
Assistant Director
Rules & Standards

1. GENERAL. Civil Aviation Authority advisory circulars (AC) contain information about standards, practices and procedures that the Authority has found to be acceptable for compliance with the associated rule.

Consideration will be given to other methods of compliance which may be presented to the Authority.

When new standards, practices or procedures are found to be acceptable they will be added to the appropriate advisory circular.

In addressing a subject the use of the imperative *must* or *is to*, terms not normally welcome in an AC, is because it is associated with mandatory provisions of the Rule itself.

Each reference to a number in this AC, such as 43.15, is a reference to a specific rule within Part 43.

2. PURPOSE. This Advisory Circular (AC) provides methods acceptable to the Authority for showing compliance with the general maintenance rules set out in Part 43.

3. CANCELLATION. The data in this advisory circular supersedes that information in AC43.4 of AC43-1A. AC43-1A – Aircraft Maintenance is hereby cancelled.

4. FOCUS. This material is intended for persons responsible for maintenance on New Zealand registered aircraft. It provides acceptable techniques, methods, and practices in relation to on condition maintenance.

5. RELATED CAR. This AC relates specifically to Part 43 - General Maintenance Rules.

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Introduction

The objective of Part 43 is to establish, for all aircraft, the minimum standard of maintenance considered necessary to ensure the continued validity of their Airworthiness Certificate. The rule will also ensure that all aircraft are maintained to a standard that assures safe operation.

This is achieved by prescribing—

- the minimum standard of maintenance required for aircraft
- the minimum standards for the performance of maintenance
- the persons who may certify maintenance
- the manner in which maintenance is to be recorded and certified

This advisory circular provides acceptable methods, techniques, and practices for the on condition maintenance of New Zealand registered aircraft.

On condition maintenance is a preventative process that allows deterioration of components by monitoring those components for their continued compliance with a required standard. The continued satisfactory operation of the structure or component may be determined by inspection, operation, or examination in-situ without detailed dismantling. The necessity to bay service, recondition, overhaul, or repair is made dependent on the condition.

On condition maintenance should include the assessment of pilot monitored performance, functional checks, and scheduled maintenance, and use circumstantial servicings to carry out opportunity assessments of components. The circumstantial assessments result from other component failures, routine component replacement due to life limitations, and from accidents.

On condition is not fit until failure or fit and forget.

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General

This Advisory Circular provides information to industry to more clearly define the different terms that cover aircraft maintenance as carried out by the general aviation industry.

Confidence in continued airworthiness has traditionally been based on maintaining safety margins by the prescription of fixed component lives and aircraft and component *overhaul* periods. Fixed lives have been applied to items that are safety critical or where fatigue is known to be a limiting factor. Overhaul lives have been applied where deterioration occurs which may not be discovered during routine inspection.

In recent years maintenance practices have been influenced by changes in aircraft design philosophy and improvements in engineering technology. Advances in manufacturing techniques and material specifications have made it less necessary to carry out frequent disassembly of aircraft and components to establish confidence. The need to be competitive and to reduce costs has meant that the industry has sought to gain advantage from these improvements by moving to a philosophy of maintenance on condition.

On condition maintenance
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As this change occurs it is necessary that the terms used should be fully understood. There are a number of maintenance processes that are used in the maintenance of general aviation aircraft, either together or separately. These processes which aimed at preventing aircraft or components failing in service and include—

- Airworthiness Limitations
- Hard-time maintenance
- On-condition maintenance

Definitions

Airworthiness Limitations

Airworthiness Limitations are periods at which specific components must be removed from service. These periods are set by the manufacturer of the aircraft or component. Airworthiness Limitations take into consideration such things as—

- the criticality of the functions performed
- the in-service loading of parts
- the exposure of parts to fatigue or wear

These airworthiness limitations are required to be published in the Airworthiness Limitations section of the aircraft maintenance manual and are considered to be mandatory. They may also be published as Inspections for Continued Airworthiness. Airworthiness Authorities may also set component life limitations, in the form of Airworthiness Directives, where such limits are not prescribed by the manufacturer.

Hard-time maintenance

Hard-time maintenance is a process where the known deterioration of an item is limited to an acceptable level by maintenance actions at given periods of time. These periods are usually set in relation to—

- calendar time
- number of cycles
- number of landings
- aircraft hours in service

The maintenance actions would include overhaul, partial overhaul, and parts replacement in accordance with the relevant manuals. These actions allow the aircraft or component to be released to service for a further specified period.

Examples of this type of action could include removal of radio or navigation equipment for bench calibration at prescribed periods or removal of an engine for overhaul and testing to specification.

On-condition maintenance

On-condition Maintenance is a preventative process in which an item is monitored either continuously or at specified periods. The item's performance is compared to an appropriate standard in order to determine if it can continue in service. The standard may be—

- an upper or lower limit of an indicated parameter such as a fluid-pressure instrument reading

- a simple go or no go indicator such as a fuel-filter pressure-drop warning light

On condition maintenance should include the assessment of pilot monitored performance, functional checks, and scheduled maintenance, and use circumstantial servicings to carry out opportunity assessments of components. The circumstantial assessments result from other component failures, routine component replacement due to life limitations, and from accidents.

Other examples of the types of maintenance that provide condition inspections are—

- the precession check of an instrument gyro which may indicate that bench testing is required
- a *run down* check on a turbine which may indicate a need to check for turbine rub
- the spectrometric examination of lubricant which may indicate imminent component failure

The continued satisfactory operation of the structure or component may be determined by inspection, operation, or examination in-situ without detailed dismantling. The necessity to bay service, recondition, overhaul, or repair is made dependent on the condition.

Failure of the item to continue to meet the documented standard will indicate that further maintenance actions are necessary. The fundamental purpose of On-condition maintenance is to remove an item before it fails in service. It is not a philosophy of *fit until failure* or *fit and forget*.

Application

Most routine maintenance programmes contain elements of Airworthiness Limitations, Hard-time maintenance and On-condition maintenance.

General aviation aeroplanes tend to have few *Airworthiness Limitations***,** whereas rotorcraft may have many.

Most Airworthiness Authorities are of the opinion that only those items that the manufacturer can substantiate as necessary for inclusion in the Life Limitations at Type Certification should have a mandated life or removal time. These are usually fatigue critical items. Other items may be made mandatory in Airworthiness Directives issued by the controlling Airworthiness Authority.

Aircraft and component manufacturers usually make *Hard-time* recommendations, usually referred to as Time Between Overhaul (TBO), which specify how long they consider their products should remain in service. These recommendations are based on average utilisation and conditions and usually recommend that the item is fully stripped and returned to the original specification. These recommendations are not considered mandatory by various responsible Airworthiness Authorities.

Without the substantiation necessary for inclusion in the Airworthiness Limitations it is not considered possible to make a generalisation as to how long a component should remain in service. This will be affected by the type of utilisation and operating conditions to which the component is subjected. This can only be determined on a case-by-case basis by assessing the operational history and condition of the component.

Provided that a component continues to meet the documented standard either continuously or at the appropriate frequencies it is considered satisfactory to remain in service. This is the way in which routine maintenance inspections are carried out on the airframe and airframe components of most aircraft used in general aviation. This approach is *On-condition* maintenance and can be extended to engines and propellers.

Summary

New Zealand Civil Airworthiness Requirements have been amended over time to allow a greater degree of On-condition maintenance compared to Hard-time maintenance. The mandated 50 hour inspections recommended by the manufacturer have been changed to a more rationalised programme based around the 100 hour cycle. The requirement for instrument and radio equipment to be removed from the aircraft for bench checking has been changed to a system where on-board monitoring and ramp testing is an acceptable alternative.

These changes are intended to encourage operators to monitor the performance of their equipment and to allow licensed aircraft maintenance engineers (LAME) greater discretion in deciding whether an aircraft or aircraft component can safely continue in service.

This philosophy has now been applied to engines and propellers that are fitted to aircraft not used on air transport operations. An on-condition inspection and test schedule, which must be applied to an engine or propeller when it reaches the manufacturer’s recommended TBO, is detailed in advisory circular AC43-5.

The LAME can use this inspection and test schedule to decide whether the engine or propeller can continue in service. The inspection and test is repeated each 100 hours in service after the manufacturer’s recommended TBO is reached. If the engine or propeller fails the inspection or test then it will be withdrawn from service and the necessary rectification action taken to bring it back within the parameters of the required inspection.

It is a LAME's decision whether they carry out any required work and release a component to service. If the LAME is unable to satisfy him or herself, with the tools, equipment, and expertise available, that the engine or propeller is fit for return to service then the LAME should recommend to the operator that appropriate remedial action is taken by a person or organisation properly competent to do so. It is the operator's decision, using the advice of their maintainer, whether the component is overhauled or repaired.