Australian Government
Civil Aviation Safety Authority

AIRWORTHINESS BULLETIN

Helicopter - Effects of fatigue on life limited components

AWB 02-015 **Issue** : 1
Date : 19 May 2006

Applicability

All helicopter types and models.

Purpose

The purpose of this bulletin is to advise operators and maintenance organisations that the fatigue lives of life limited components may be adversely affected, or the safety margin reduced, depending on the type of operation and loading history that the component experiences during its service life.

Background

Fatigue becomes especially significant if a helicopter is operated outside what would be considered by the manufacturer (and specified in the Type Certificate) as the operations for which the helicopter was designed and certified. Examples of situations where fatigue lives may be affected are:

- Operation of helicopters in low level flying, agricultural, mustering or other operations where high loads may be encountered more frequently than envisaged by the designer/manufacturer.
- Operations where there are a high number of landings and takeoffs per operating hour.
- Where there is any history of design or flight manual limitations being exceeded, even if only for a short time and on an infrequent basis. Even a one time exceedance is enough to cause damage that may potentially lower the fatigue life of a component.
- Frequent operations at or near maximum all up weight, such as operations involving transport of underslung loads.

Fatigue damage may be caused to components and not be apparent during any routine inspections. The component may still be capable of taking limit loads, but may fail unexpectedly at a lower life than published. In many cases, there will be no warning of an impending fatigue failure, as progression from a small flaw to final fracture can be very fast.

Fatigue damage is accelerated when the cyclic loads in a component are of greater magnitude and frequency than that envisaged during the design of the component. These cyclic loads cause damage to the metal at the microstructural level. There is no easy way to tell the difference between two identical parts that have been subjected to differing fatigue environments, except by analysis under an electron microscope. This is what makes fatigue a hidden danger.

Recommendation

It is recommended that all operators and maintainers keep a detailed record of the operational history, beyond the normal requirement of just recording hours & cycles. The types of things to record are:

- Times, dates and durations of any flight manual limit exceedances, no matter how transient – even if they occur only once. The manufacturer should be consulted for advice if a transient overstress or flight limit exceedance occurs. Generally, **follow the manufacturers flight and maintenance manuals for what to do if this occurs**.

- Times, dates and durations of unusual operations, for example - a helicopter goes from being a private helicopter used for personal transport to an agricultural or mustering machine. This change in operations needs to be managed and the risk properly assessed. The manufacturer should be contacted for advice on how the change in operations affects component fatigue lives.

- Times, dates and circumstances of changes in the helicopter's operational environment i.e. long period of storage in hot, humid, salty environments or storage in dry, dusty environments. Long periods of storage in an aggressive environment can sometimes lead to increased corrosion, thereby exacerbating the effects of fatigue cracking if it has already begun. In some cases, corrosion can initiate fatigue cracking in an otherwise serviceable part.

- Operators of aircraft engaged in operations such as agricultural, cattle mustering or operations where more than four rotor full stops per hour are achieved should consult the manufacturer giving full details, including previous history of all operations, for possible life revision.

- Operators should notify the manufacturer if they believe that their helicopter model is experiencing an operational environment that differs from the environment that the helicopter was designed & certified to operate in. The manufacturer may be able to provide advice on how to manage the risk.

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

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