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Airworthiness Bulletin

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Turbine Engines – Disposition of Life Limited Parts

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

Turbine engine aircraft engaged in special-use operations.

For the purposes of this discussion, special-use operations are defined as those performing multiple take-offs and landings for each engine start/shutdown cycle.

2. Purpose

To advise operators and maintenance organisations that the fatigue lives of Life Limited Parts (LLPs) used in turbine engines may be adversely affected, including possible reductions in safety margins, when installed on aircraft engaged in special-use operations.

3. Background

A recent ATSB investigation on a turboprop engine failure attributed the event to low-cycle fatigue damage that resulted in fragments of the 3rd stage turbine wheel either penetrating the engine case or exiting the tail pipe with significant damage to the engine turbine section. ATSB Investigation Report No: AO-2022-025 refers.

Turbine engine component replacement intervals are typically based on flight hours and engine cycles. The registered operator is responsible for maintaining an accurate engine logbook that contains engine flight hours and engine cycles since new and since major inspections. Whilst accumulated flight hours are simple to calculate, engine cycles can be more complicated to establish within special-use operations.

Historically, cycle counting and life limits for LLPs used in turbine engines have been based on a “major cycle” that consists of an engine start, take-off, cruise, landing, and engine shutdown. Whilst this major cycle matches the standard flight profile for air transport operations, it has been determined to not be as suitable for special-use operations such as agricultural spraying, parachuting operations, some cargo operations, and other operations which make multiple take-offs and landings (“minor cycles”) between engine starts and shutdowns (“major cycles”).

In simple terms, a cycle refers to the stretching and relaxing of the engine rotating components imposed by centrifugal forces and thermodynamic stresses, which results in the components accruing Low-Cycle Fatigue (LCF). Whilst multiple take-off and landing cycles without engine shutdown can be categorised as a “minor cycle” it still results in LCF damage that is additive to the fatigue damage caused by a “major cycle”. This additive LCF damage can lead to the failure of the component (e.g. LLP) prior to the accumulated number of major cycles specified.

A more accurate method of tracking the life of LLPs in special-use operations is to calculate the ‘total equivalent cycles’, for example major cycles plus minor cycles. Some engine manufacturers may require a more granular calculation based on their analysis of the impact on LCF on the specific engine model, such as the application of ‘damage fraction’ factors.

4. Recommendations

Where an operator is engaged in special-use operations, such as multiple take-offs and landings within one engine start and one engine shutdown, it is recommended that they evaluate the assumptions and methodology they are using to track and calculate engine cycles, and where necessary, make adjustments to account for “minor cycles”.

The maintenance provider in partnership with the engine manufacturer should be consulted to assist in determining the proper LLP log and total equivalent cycles calculation for the specific engine model, to ensure that engine LLPs are removed from service prior to the development of a hazardous condition.

Operators engaged in special-use operations should also examine the continuing airworthiness records for those engine components subject to a life limit, to ensure that its back-to-birth history (i.e. entire service life) has been accurately and authentically documented.

If an LLP has been removed from another engine, the continuing airworthiness records for the source engine should also be examined to ensure that the component has not been subjected to a type of operation which does not accord with the adjusted component cycle count methodology.

Consideration should also be given to the incorporation of aircraft/engine STCs, modifications etc, which may affect the original fatigue life established for associated LLPs.

5. References

ATSB Investigation Report AO-2022-025

Honeywell Service Bulletin TPE331-A72-2130 (latest revision)

6. 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:

Airworthiness and Engineering Branch
National Operations and Standards
Civil Aviation Safety Authority
GPO Box 2005, Canberra, ACT, 2601