RA 5602 - Propulsion System Part Lifing and Critical Parts

Rationale

Propulsion Systems are complex, have multiple failure modes and contain a significant number of critical parts whose failure could hazard the Air System and pose a Risk to Life. In order to assure the integrity of critical parts within a Propulsion System, the manufacture, identification, configuration and usage of such parts must be controlled and managed.

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Regulation 5602(1)

Identification of Critical Parts

5602 (1) The Propulsion System Design Organization (DO) shall identify the critical parts contained within the Propulsion System.

Acceptable Means of Compliance 5602(1)

Identification of Critical Parts

1. As part of the certification process for Propulsion Systems, DOs should conduct safety analyses in order to identify critical parts whose failure has the potential to cause hazardous propulsion system effects, or where failure would have unacceptable consequences.
2. Critical parts should be clearly identified in the Configuration Status Record (CSR).
3. Where life marking is deemed necessary, the marking system, location and means of marking should be detailed in the Air System Document Set (ADS) and authorized by the Type Airworthiness Authority (TAA).

Guidance Material 5602(1)

Identification of Critical Parts

4. The recognized standards for Propulsion Systems describe critical parts as those that are required to achieve and maintain a high degree of integrity, because failure has been identified as having the potential to result in a hazardous effect at the system level. Hazardous effects are defined by the European Aviation Safety Agency (EASA) within the Certification Specification for Engines (CS-E), Propellers (CS-P) and Auxiliary Power Units (CS-APU) which may be used as guidance; however, military design features may introduce hazardous effects not captured by civil regulation.
5. In order to provide an indelible record of usage, specified critical parts can be life marked, whereby the usage at each exposure is etched onto the part. The process must be closely controlled to ensure that the markings do not compromise the integrity of the part. Further guidance on the management of critical engine parts is at RA 5722.

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1 RA 5885 - Identification of products, parts and appliances (MRP 21 subpart Q).
2 Other specifications may be used such as 14 CFR Part 33 for US-certified Propulsion Systems.
3 RA5722 - Propulsion Integrity Management.
Determination of Critical Part Life

5602 (2) The Propulsion System DO shall determine critical part lives and exchange rates using a recognized process and shall present the lives to the TAA.

Acceptable Means of Compliance 5602(2)

Determination of Critical Part Life

6. Critical part lives should be formulated using processes consistent with the Type Certification Basis of the Propulsion System.

7. Where critical part lives and exchange rates have been determined using a process other than that described in Def Stan 00-970 Part 11, the DO should ensure that the military flight/usage profiles have been assessed against the usage profiles used in certification in order to identify whether any factoring of life or exchange rate is required.

Guidance Material 5602(2)

Determination of Critical Part Life

8. Def Stan 00-970 Pt 11 provides a procedure for determining critical part lives and civil codes, including CS-E and 14 CFR Part 33, specifying that the life will be formulated to an approved process. Unless executive lifing is used, part lives are quoted in cycles, which are translated into directly measurable units, such as hours or missions, through exchange rates or usage factors. Executive lifing systems may be used to calculate part lives directly.

9. In the early stages of a project, part life may be released proportionately in-line with greater operational experience and sample testing. The proportional release of life is not considered a life extension as discussed in RA 57245.

10. The DO may also propose lives for non-critical parts whose failure or reduced reliability would erode safety margins. Non-critical lives include overhaul, inspection and recondition lives. Through Reliability Centred Maintenance (RCM) analysis the DO, or the service provider (for performance-based support contracts, eg availability or power-by-the-hour), may propose maintenance lives such as overhaul, inspection and recondition. Whilst these lives may be formulated to optimise maintenance and availability of Propulsion Systems, they may also guard against specific non-critical failures. The rationale behind the life may be recorded in order to ensure that any extension of such life does not compromise safety or availability. Consideration may also be given to shelf, storage and inhibited lives.

Control of Critical Parts

5602 (3) The Propulsion System DO shall control the manufacture of critical parts and shall record the manufacturing history.

Acceptable Means of Compliance 5602(3)

Control of Critical Parts

11. The DO should demonstrate, to the satisfaction of the TAA, the processes for the control and validation of critical parts, including those from alternative methods or sources of manufacture.

12. Decisions on introducing alternative methods or sources of manufacture, or making a significant design configuration change, should be recorded in a Local Technical Committee (LTC) and Configuration Control Board (CCB).

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1 Def Stan 00-970 Pt 11 - Design and Airworthiness Requirements for Service Aircraft.
2 RA 5724 - Life Extension Programme.
3 RA 5320 - Aircraft Maintenance Programme – Design Guidelines.
4 RA 5303 - Local Technical Committee.
5 RA 5304 - Configuration Control Board.
Control of Critical Parts

13. An alternative method of manufacture is a method other than that previously used to produce the critical part and requiring a change to the information recorded on the relevant drawings and supporting documentation.

14. An alternative manufacturing source is a manufacturer or sub-contractor other than that which has previously produced the critical part, or a change in location of manufacture by an existing manufacturer.

15. Where alternative methods or sources of manufacture lead to a requirement for modification action, the relevant procedures in the RA 5300\(^9\) series are to be followed.

16. Propulsion Systems certified under civil codes are required to have a Manufacturing Plan for the critical parts. This document must contain the approved manufacturing processes to meet certification requirements. However, it must also contain the process used by the DO to validate a change in manufacturing source in order to satisfy the requirements of this RA and to be considered for acceptance by the TAA.

17. Where these procedures are applied to sub-contractors, any submissions must be made through the contracting agencies.

18. Critical parts from alternative methods or sources of manufacture which require validation testing may be included in engines on test for other purposes. Such validation tests are additional to any Quality Verification Tests to which the parts may be subjected.

Regulation 5602(4)

Build and Installation Records

5602 (4) The identity (part number and serial number) of critical parts shall be recorded in the build documentation by the Production and Maintenance Organization.

Acceptable Means of Compliance 5602(4)

Build and Installation Records


Guidance Material 5602(4)

Build and Installation Records

20. Refer to RA 5502\(^10\) and RA 5810(18)\(^11\) for further information.

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\(^9\) RA 5300 Series - Control of Design and Design Records.

\(^10\) RA 5502 - Air System Maintenance Documentation, Forms and Certificates.

\(^11\) RA 5810 - Military Type Certificate (MRP 21 Subpart B).