



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Fatigue Life of Nickel Powder
Rotating Life-Limited Parts

Date: 8/15/23

AC No: 33.70-4

Initiated By: AIR-625

1 **PURPOSE.**

This advisory circular (AC) provides guidance that may be used to demonstrate compliance with Title 14, Code of Federal Regulations (14 CFR) 33.70 for rotating life-limited engine parts made of nickel powder. Section 33.70 contains requirements applicable to the design and life management of engine life-limited parts, including high-energy nickel powder rotating parts.

2 **APPLICABILITY.**

2.1 The guidance in this AC is for aircraft engine manufacturers, modifiers, Federal Aviation Administration (FAA) engine type certification engineers, and FAA designees.

2.2 The contents of this AC do not have the force and effect of law and are not meant to bind the public in any way, and this AC is intended only to provide information to the public regarding existing requirements under the law or agency policies. Conformity with this guidance is voluntary only, and nonconformity will not affect rights and obligations under existing statutes and regulations. This AC describes an acceptable means, but not the only means, for showing compliance with § 33.70 for nickel powder rotating life-limited parts. When the method of compliance in this AC is used, terms such as “should,” “may,” and “must” are used only in the sense of ensuring applicability of this particular method of compliance when the acceptable method of compliance in this document is used. The FAA will consider other means of showing compliance that an applicant may elect to present. If, however, the FAA becomes aware of circumstances in which following this AC would not result in compliance with the applicable regulations, the agency may require additional substantiation as a basis for finding compliance.

2.3 This material in this AC does not change or create any additional regulatory requirements, nor does it authorize changes in, or permit deviations from, existing regulatory requirements.

11 CALIBRATION AND VALIDATION OF THE PROBABILISTIC SYSTEM FOR INCLUSIONS.

- 11.1 As a probabilistic system integrates a significant number of parameters (related to the size distribution and life model) that are often identified independently, applicants should verify that the probabilistic system produces sensible results once these are combined. As part of achieving this, the inclusion size distribution may be slightly adjusted in the domain that is too small to be easily characterized experimentally.
- 11.2 The confirmation of the accuracy of the probabilistic system for inclusions can be made using fatigue test results from specimens or components made from unseeded material. Although only a fraction will fracture from inclusions, applicants should ensure that these occurrences are sorted to correlate the various probabilities that the probabilistic system can calculate. For example, applicants should consider the following:
- Conditional probabilities of failure from surface, sub-surface, and internal inclusions;
 - Probabilities of failure from inclusions within a given size interval; and
 - The global failure probability distribution from inclusions as a function of cycles at a given loading condition.
- 11.3 It is important that applicants run a test campaign to show the accuracy or at least the conservatism of the probabilistic system. In addition to fatigue specimen tests, this should include tests that represent the behavior of components. Spin tests are useful in such campaigns to provide information on how to account for component characteristics, such as volume of material under stress, multiaxial loading, and residual stresses.
- 11.4 The results from the component-representative tests should fall within the population of predicted lives at the test conditions.

12 SUGGESTIONS FOR IMPROVING THIS AC.

If you have suggestions for improving this AC, you may use the [Advisory Circular Feedback Form](#) at the end of this AC.

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Advisory Circular Feedback Form

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Subject: _____

Date: _____

Please mark all appropriate line items:

An error (procedural or typographical) has been noted in paragraph _____ on page _____.

Recommend paragraph _____ on page _____ be changed as follows:

In a future change to this AC, please cover the following subject:
(*Briefly describe what you want added.*)

Other comments:

I would like to discuss the above. Please contact me.

Submitted by: _____ Date: _____