U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Guidance for Pressurized Engine Static Parts

Date: 9/13/10 **AC No:** 33.64-1
Initiated By: ANE-111

1. Purpose. This advisory circular (AC) provides definitions and guidance regarding compliance with the strength requirements for pressurized engine static parts in § 33.64 of Title 14 of the Code of Federal Regulations (14 CFR part 33). Section 33.64 establishes strength requirements for pressurized static engine parts that operate at significant pressure levels.

2. Applicability.

a. The guidance is directed to engine manufacturers, modifiers, foreign regulatory authorities, and part manufacturers who operate under Parts Manufacturer Approval (PMA) authority.

b. This material is neither mandatory nor regulatory in nature and does not constitute a regulation. It describes acceptable means, but not the only means, for demonstrating compliance with the applicable regulations. The FAA will consider other methods of demonstrating compliance that an applicant may elect to present. Terms such as "should," "shall," "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. While these guidelines are not mandatory, they are derived from extensive FAA and industry experience in determining compliance with the relevant regulations. On the other hand, if the FAA becomes aware of circumstances that convince us that following this AC would not result in compliance with the applicable regulations, we will not be bound by the terms of this AC, and we may require additional substantiation as the basis for finding compliance.

c. This material does not change, create any additional, authorize changes in, or permit deviations from existing regulatory requirements.

3. Related 14 CFR Part 33 Regulations.

a. Section 33.19, Durability.

b. Section 33.62, Stress analysis.

c. Section 33.70, Engine life-limited parts.

d. Section 33.75, Safety analysis.

4. Related Guidance. AC 33-3, Turbine and Compressor Rotors Type Certification Substantiation Procedures, September 9, 1968.

5. Definitions. For the purpose of this AC, the following definitions apply and should be related to an engine operating in a typical installation:

a. Burst. Failure or fracture of a part which involves the sudden release of pressurized fluid (gaseous or liquid).

b. Failure. A change in the condition of the part such that it is no longer able to perform its expected function (in this case contain pressurized fluid).

c. Fracture. Separation of the part into two or more pieces or into a condition so that it is no longer whole or complete.

d. Hazardous condition. Any of the conditions listed in § 33.75.

e. Normal working pressure. The maximum pressure differential likely to occur during most flights, including pressure fluctuations (surges) from the normal operation of valves and orifices.

f. Maximum working pressure. The maximum pressure differential that could occur under the most adverse operational conditions (for example, forward speed, altitude, ambient temperature, engine speed, and use of OEI ratings). This includes any pressure fluctuations, including significant surge pressures, resulting from the normal operation of valves or orifices.

g. Maximum possible pressure. The maximum pressure differential that could occur under the most adverse combination of operational conditions (for example, forward speed, altitude, ambient temperature, engine speed, and use of OEI ratings) likely to occur in service in combination with failure of any relevant part(s) of the engine or control system, or combinations of failures that are more likely than extremely remote. All pressure fluctuations which result from the normal or emergency use of controls and valves should be considered including significant surge pressures.

h. Most critically stressed engine condition. The condition with the lowest margin associated with the conditions specified by § 33.64(a)(1) and (a)(2).

i. Static parts subject to significant gas or liquid pressure loads. Those static parts subject to high-pressure loads, or whose design is influenced by the gas or liquid pressure loads the part is designed to contain. Examples might include the compressor, combustor and turbine casings, heat exchangers, bleed valve solenoids, starter motors or fuel, oil and hydraulic system components. Special attention should be given to any filler cap.

6. Guidance. Compliance with § 33.64 can be based on a test demonstration or analysis or a combination of both.

a. Strength Requirements.

(1) Section 33.64(a)(1) requires that pressure loaded static parts not exhibit excessive permanent distortion or leakage that could create a hazardous condition when subjected to the pressure loads specified by § 33.64(a)(1) and (b) for a stabilized period of one minute.

(2) Section 33.64(a)(2) requires that pressure loaded static parts not fracture or burst when subjected to the pressure loads specified by § 33.64(a)(2) and (b) for a stabilized period of one minute.

(3) The serviceable limits contained in the engine manual should be used to determine the acceptable amount of permanent distortion.

b. Tests.

(1) If the part is subject to loads in addition to those resulting from differential pressure (for example, flight maneuver loads or engine mounting loads), an analysis should be made to examine the effect of these additional loads. If these loads have a minor effect, it may be possible to simulate the additional loads by increasing the test pressure differential. However, if the loads are significant or cannot be adequately represented by a pressure increment, the test should include these loads as well as the pressure loads.

(2) If during actual engine operation the part contains thermal stresses, the test pressure level may be adjusted to include these effects. If the pressure level cannot be adjusted to include these effects, then the capability of the part may be demonstrated by correcting the test results analytically.

(3) If a part is subjected to pressure levels which vary by part location (internal or external pressure gradient) in service, the test pressures and loads which simulate service conditions may also vary by location.

(4) The part should be tested at the temperature associated with the most critically stressed engine condition(s). An acceptable alternate approach would increase the test pressure differential and/or loads to simulate the loss of strength associated with operating temperature. The applicant has the option to simulate separate test temperatures if needed, i.e., a temperature

to simulate the permanent distortion conditions specified by § 33.64(a)(1) and a temperature to simulate the fracture conditions specified by § 33.64(a)(2).

(5) Component pressure tests should simulate the actual mounting and restraint conditions consistent with engine operation at the critical part location.

(6) Component pressure tests must take into account the minimum properties representative of both the material and the processes used in the construction of the part and any adverse geometry conditions allowed by the type design, as required by § 33.64(b)(3) and (b)(4).

c. Analytical Methods. Analytical techniques may be used to meet the strength requirements as defined by § 33.64, providing the model is validated by tests or the method has been used on parts of similar design and the field experience has been successful.

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