

(12) The number of start-stop stress cycles approved for each rotor disc and spacer.

(13) Inlet air distortion at the engine inlet.

(14) Transient rotor shaft overspeed r.p.m., and number of overspeed occurrences.

(15) Transient gas overtemperature, and number of overtemperature occurrences.

(16) For engines to be used in supersonic aircraft, engine rotor windmilling rotational r.p.m.

[Amdt. 33-6, 39 FR 35463, Oct. 1, 1974, as amended by Amdt. 33-10, 49 FR 6850, Feb. 23, 1984; Amdt. 33-11, 51 FR 10346, Mar. 25, 1986; Amdt. 33-12, 53 FR 34220, Sept. 2, 1988; Amdt. 33-18, 61 FR 31328, June 19, 1996]

### § 33.8 Selection of engine power and thrust ratings.

(a) Requested engine power and thrust ratings must be selected by the applicant.

(b) Each selected rating must be for the lowest power or thrust that all engines of the same type may be expected to produce under the conditions used to determine that rating.

[Amdt. 33-3, 32 FR 3736, Mar. 4, 1967]

## Subpart B—Design and Construction; General

### § 33.11 Applicability.

This subpart prescribes the general design and construction requirements for reciprocating and turbine aircraft engines.

### § 33.13 [Reserved]

### § 33.14 Start-stop cyclic stress (low-cycle fatigue).

By a procedure approved by the FAA, operating limitations must be established which specify the maximum allowable number of start-stop stress cycles for each rotor structural part (such as discs, spacers, hubs, and shafts of the compressors and turbines), the failure of which could produce a hazard to the aircraft. A start-stop stress cycle consists of a flight cycle profile or an equivalent representation of engine usage. It includes starting the engine, accelerating to maximum rated power or thrust, decelerating, and stop-

ping. For each cycle, the rotor structural parts must reach stabilized temperature during engine operation at a maximum rate power or thrust and after engine shutdown, unless it is shown that the parts undergo the same stress range without temperature stabilization.

[Amdt. 33-10, 49 FR 6850, Feb. 23, 1984]

### § 33.15 Materials.

The suitability and durability of materials used in the engine must—

(a) Be established on the basis of experience or tests; and

(b) Conform to approved specifications (such as industry or military specifications) that ensure their having the strength and other properties assumed in the design data.

Secs. 313(a), 601, and 603, 72 Stat. 759, 775, 49 U.S.C. 1354(a), 1421, and 1423; sec. 6(c), 49 U.S.C. 1655(c)

[Amdt. 33-8, 42 FR 15047, Mar. 17, 1977, as amended by Amdt. 33-10, 49 FR 6850, Feb. 23, 1984]

### § 33.17 Fire prevention.

(a) The design and construction of the engine and the materials used must minimize the probability of the occurrence and spread of fire. In addition, the design and construction of turbine engines must minimize the probability of the occurrence of an internal fire that could result in structural failure, overheating, or other hazardous conditions.

(b) Except as provided in paragraphs (c), (d), and (e) of this section, each external line, fitting, and other component, which contains or conveys flammable fluid must be fire resistant. Components must be shielded or located to safeguard against the ignition of leaking flammable fluid.

(c) Flammable fluid tanks and supports which are part of and attached to the engine must be fireproof or be enclosed by a fireproof shield unless damage by fire to any non-fireproof part will not cause leakage or spillage of flammable fluid. For a reciprocating engine having an integral oil sump of less than 25-quart capacity, the oil sump need not be fireproof nor be enclosed by fireproof shield.

### § 33.19

(d) For turbine engines type certificated for use in supersonic aircraft, each external component which conveys or contains flammable fluid must be fireproof.

(e) Unwanted accumulation of flammable fluid and vapor must be prevented by draining and venting.

(Secs. 313(a), 601, and 603, 72 Stat. 759, 775, 49 U.S.C. 1354(a), 1421, and 1423; sec. 6(c), 49 U.S.C. 1655(c))

[Amdt. 33-6, 39 FR 35464, Oct. 1, 1974, as amended by Amdt. 33-8, 42 FR 15047, Mar. 17, 1977; Amdt. 33-10, 49 FR 6850, Feb. 23, 1984]

### § 33.19 Durability.

(a) Engine design and construction must minimize the development of an unsafe condition of the engine between overhaul periods. The design of the compressor and turbine rotor cases must provide for the containment of damage from rotor blade failure. Energy levels and trajectories of fragments resulting from rotor blade failure that lie outside the compressor and turbine rotor cases must be defined.

(b) Each component of the propeller blade pitch control system which is a part of the engine type design must meet the requirements of § 35.42 of this chapter.

[Doc. No. 3025, 29 FR 7453, June 10, 1964, as amended by Amdt. 33-9, 45 FR 60181, Sept. 11, 1980; Amdt. 33-10, 49 FR 6851, Feb. 23, 1984]

### § 33.21 Engine cooling.

Engine design and construction must provide the necessary cooling under conditions in which the airplane is expected to operate.

### § 33.23 Engine mounting attachments and structure.

(a) The maximum allowable limit and ultimate loads for engine mounting attachments and related engine structure must be specified.

(b) The engine mounting attachments and related engine structure must be able to withstand—

(1) The specified limit loads without permanent deformation; and

(2) The specified ultimate loads without failure, but may exhibit permanent deformation.

[Amdt. 33-10, 49 FR 6851, Feb. 23, 1984]

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### § 33.25 Accessory attachments.

The engine must operate properly with the accessory drive and mounting attachments loaded. Each engine accessory drive and mounting attachment must include provisions for sealing to prevent contamination of, or unacceptable leakage from, the engine interior. A drive and mounting attachment requiring lubrication for external drive splines, or coupling by engine oil, must include provisions for sealing to prevent unacceptable loss of oil and to prevent contamination from sources outside the chamber enclosing the drive connection. The design of the engine must allow for the examination, adjustment, or removal of each accessory required for engine operation.

[Amdt. 33-10, 49 FR 6851, Feb. 23, 1984]

### § 33.27 Turbine, compressor, fan, and turbosupercharger rotors.

(a) Turbine, compressor, fan, and turbosupercharger rotors must have sufficient strength to withstand the test conditions specified in paragraph (c) of this section.

(b) The design and functioning of engine control devices, systems, and instruments must give reasonable assurance that those engine operating limitations that affect turbine, compressor, fan, and turbosupercharger rotor structural integrity will not be exceeded in service.

(c) The most critically stressed rotor component (except blades) of each turbine, compressor, and fan, including integral drum rotors and centrifugal compressors in an engine or turbosupercharger, as determined by analysis or other acceptable means, must be tested for a period of 5 minutes—

(1) At its maximum operating temperature, except as provided in paragraph (c)(2)(iv) of this section; and

(2) At the highest speed of the following, as applicable:

(i) 120 percent of its maximum permissible r.p.m. if tested on a rig and equipped with blades or blade weights.

(ii) 115 percent of its maximum permissible r.p.m. if tested on an engine.

(iii) 115 percent of its maximum permissible r.p.m. if tested on turbosupercharger driven by a hot gas supply from a special burner rig.