



2027

FAR-AMT

Federal Aviation Regulations for Aviation Maintenance Technicians



U.S. Department of Transportation

Rules for Aviation Mechanics, Maintenance Operations, and Repair Shops
From Title 14 of the Code of Federal Regulations

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AVIATION SUPPLIES & ACADEMICS, INC.
KALAMAZOO, MICHIGAN

FAR-AMT
Federal Aviation Regulations for Aviation Maintenance Technicians
2027 Edition

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Federal Aviation Regulations for Aviation Maintenance Technicians

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Introduction

ASA 2027 FAR/AIM Series

FAR/AIM • FAR for Flight Crew • FAR for AMT

ASA has been supplying the standard reference of the industry, the FAR/AIM series, for more than 80 years. The 2027 series continues to provide information directly from the Federal Aviation Regulations and the *Aeronautical Information Manual*.

Each regulation Part is preceded by a detailed table of contents. Changes since last year's printing are identified on Page vii and in the table of contents for each regulation Part (in bold and marked with an asterisk), as well as within the text for quick reference (changed text is indicated with a bold line in the margin). In the *AIM*, changes are explained in a list at the beginning and with bold lines in the margins. It is recommended that you familiarize yourself with all the changes to identify those that affect your aviation activities.

Changes affecting the regulations can take place daily; the *AIM* changes every 6 months. ASA tracks all changes and offers you two options for free **Updates** at asa2fly.com/farupdate:

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Visit the Federal Aviation Administration (FAA) website at www.faa.gov to review Advisory Circulars (AC), Notices of Proposed Rulemaking (NPRM), current regulations, FSDO contact details, and FAA Orders and publications. Pilots operating internationally should be familiar with Customs and Border Protection regulations, which can be found at cbp.gov.

Although ASA is not a government agency, and we do not write the regulations or the *AIM*, we do work closely with the FAA. Questions or concerns can be forwarded to our attention, and we will in turn pass the comments on to the responsible office within the agency. The FAA is interested in user feedback, and your comments could foster improvements in the regulations that affect the entire industry.

FAR/AIM Comments

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Identifying Regulation Changes Since Last Year

Changes since last year's printing of the book are noted in the table of contents of each Part with an asterisk and bold title:

Example:

***61.5 Certificates and ratings issued under this part.**

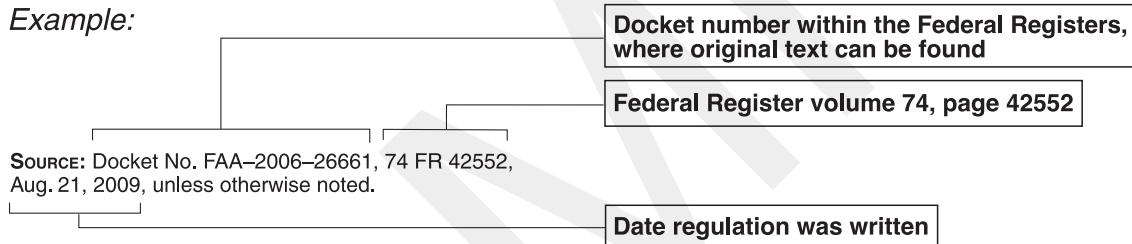
The updated text within the context of the regulation is indicated by a bold line in the margin:

- (a) The following certificates are issued under this part to an applicant who satisfactorily accomplishes the training and certification requirements for the certificate sought:
- (1) Pilot certificates—
 - (i) Student pilot.
 - (ii) Sport pilot.
 - (iii) Recreational pilot.
 - (iv) Private pilot.
 - (v) Commercial pilot.
 - (vi) Airline transport pilot.
 - (2) Flight instructor certificates.
 - (3) Ground instructor certificates.

How to Identify the Currency of the Regulations

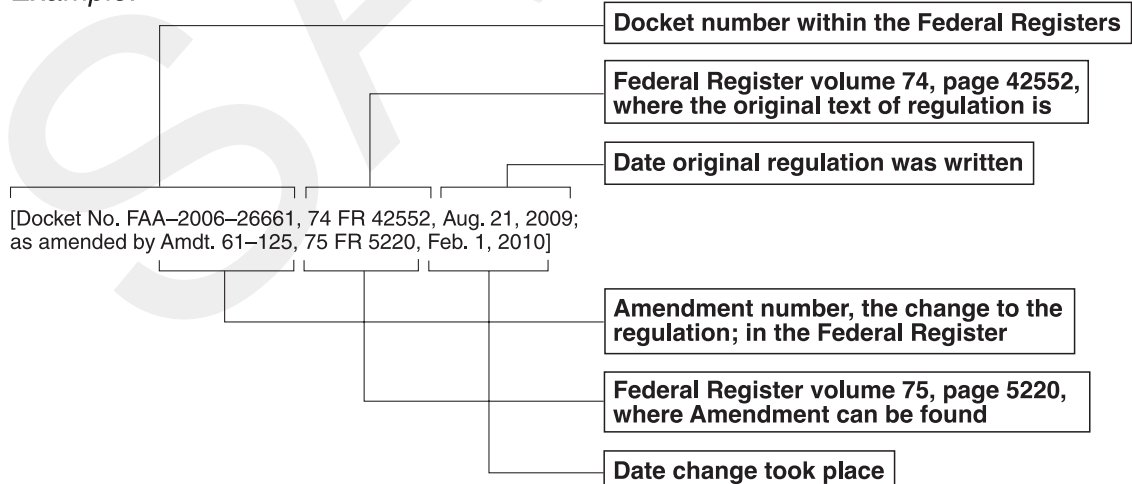
Following the table of contents at the beginning of each Part is a Source, which gives the date of origin for that regulation.

Example:



If a change has taken place since the original regulation was written, it is noted at the end of the regulation.

Example:



Summary of Major FAR Changes Since the 2026 Book Was Published

All changes are identified in the table of contents of each Part with bold Section titles and asterisks and in the regulation text with bold lines in the margins.

These regulation changes from the *Federal Register* and revisions to FAA advisory circulars affect this book as follows:

14 CFR

Parts 1, 21, 22, 43, 45, 65, 91, 119, 147

- Amends rules for the manufacture, certification, operation, maintenance, and alteration of light-sport aircraft. The amendments remove the prescriptive “light-sport aircraft” definition from 14 CFR §1.1, eliminating legacy weight-based limits and enabling a shift to a performance-based framework. This change separates aircraft certification from sport pilot privileges, allowing a broader range of aircraft to qualify under the light-sport category while maintaining distinct operational limits for sport pilots.

Parts 3, 21, 43, 65, 145

- Amends, restructures, and consolidates the falsification regulations presently located throughout 14 CFR. Regarding 14 CFR Chapter I, this rule eliminates inconsistencies among the various falsification regulations and associated sanctions; consolidates all existing falsification regulations into Part 3, Subpart D, to standardize them; and ensures that falsification-related conduct not addressed by pertinent current regulations is covered.

Part 91

- Extends the prohibition against certain flight operations in the Kabul Flight Information Region (FIR) (OAKX) from July 25, 2025, to July 25, 2028.

Parts 91, 125, 135

- Increases the recording time of cockpit voice recorders (CVRs) from the currently mandated 2 hours to 25 hours for all affected future manufactured aircraft. This action provides accident investigators, aircraft operators, and civil aviation authorities with substantially more CVR data to help determine the probable causes of incidents and accidents and prevent future incidents and accidents, and it aligns the FAA regulations more closely with existing international requirements.

Advisory Circulars

- AC 21-12, *Application for U.S. Airworthiness Certificate*, has been updated to revision D.
- AC 43-9, *Maintenance Records and FAA Form 8130-3 Return to Service*, has been updated to revision D and includes additional recent FAA editorial changes.
- AC 43.9-1G, *Instructions for Completion of FAA Form 337*, includes FAA editorial changes.

Note: Changes affecting the regulations can take place daily. ASA tracks all changes and posts them on the ASA website so you always have the most current information. To view the rules currently in effect and to have Update notices automatically emailed to you, visit asa2fly.com/farupdate.

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 Appendix D to Part 33—Mixed Phase and Ice Crystal Icing Envelope (Deep Convective Cloud)

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

Source: Docket No. 3025, 29 FR 7453, June 10, 1964, unless otherwise noted.

Editorial Note: For miscellaneous amendments to cross references in this Part 33, see Amdt. 33-2, 31 FR 9211, July 6, 1966.

Subpart A—General

§33.1 Applicability.

(a) This part prescribes airworthiness standards for the issue of type certificates and changes to those certificates, for aircraft engines.

(b) Each person who applies under part 21 for such a certificate or change must show compliance with the applicable requirements of this part and the applicable requirements of part 34 of this chapter.

[Amdt. 33–7, 41 FR 55474, Dec. 20, 1976, as amended by Amdt. 33–14, 55 FR 32861, Aug. 10, 1990]

§33.3 General.

Each applicant must show that the aircraft engine concerned meets the applicable requirements of this part.

§33.4 Instructions for Continued Airworthiness.

The applicant must prepare Instructions for Continued Airworthiness in accordance with Appendix A to this part that are acceptable to the Administrator. The instructions may be incomplete at type certification if a program exists to ensure their completion prior to delivery of the first aircraft with the engine installed, or upon issuance of a standard certificate of airworthiness for the aircraft with the engine installed, whichever occurs later.

[Amdt. 33–9, 45 FR 60181, Sept. 11, 1980]

§33.5 Instruction manual for installing and operating the engine.

Each applicant must prepare and make available to the Administrator prior to the issuance of the type certificate, and to the owner at the time of delivery of the engine, approved instructions for installing and operating the engine. The instructions must include at least the following:

(a) Installation instructions.

(1) The location of engine mounting attachments, the method of attaching the engine to the aircraft, and the maximum allowable load for the mounting attachments and related structure.

(2) The location and description of engine connections to be attached to accessories, pipes, wires, cables, ducts, and cowling.

(3) An outline drawing of the engine including overall dimensions.

(4) A definition of the physical and functional interfaces with the aircraft and aircraft equipment, including the propeller when applicable.

(5) Where an engine system relies on components that are not part of the engine type design, the interface conditions and reliability requirements for those components upon which engine type certification is based must be specified in the engine installation instructions directly or by reference to appropriate documentation.

(6) A list of the instruments necessary for control of the engine, including the overall limits of accuracy and transient response required of such instruments for control of the operation of the engine, must also be stated so that the suitability of the instruments as installed may be assessed.

(b) Operation instructions.

(1) The operating limitations established by the Administrator.

(2) The power or thrust ratings and procedures for correcting for nonstandard atmosphere.

(3) The recommended procedures, under normal and extreme ambient conditions for—

- (i) Starting;
- (ii) Operating on the ground; and
- (iii) Operating during flight.

(4) For rotorcraft engines having one or more OEI ratings, applicants must provide data on engine performance characteristics and variability to enable the aircraft manufacturer to establish aircraft power assurance procedures.

(5) A description of the primary and all alternate modes, and any back-up system, together with any associated limitations, of the engine control system and its interface with the aircraft systems, including the propeller when applicable.

(c) **Safety analysis assumptions.** The assumptions of the safety analysis as described in §33.75(d) with respect to the reliability of safety devices, instrumentation, early warning devices, maintenance checks, and similar equipment or procedures that are outside the control of the engine manufacturer.

[Amdt. 33–6, 39 FR 35463, Oct. 1, 1974, as amended by Amdt. 33–9, 45 FR 60181, Sept. 11, 1980; Amdt. 33–24, 72 FR 50867, Sept. 4, 2007; Amdt. 33–25, 73 FR 48123, Aug. 18, 2008; Amdt. 33–26, 73 FR 48284, Aug. 19, 2008]

§33.7 Engine ratings and operating limitations.

(a) Engine ratings and operating limitations are established by the Administrator and included in the engine certificate data sheet specified in §21.41 of this chapter, including ratings and limitations based on the operating conditions and information specified in this section, as applicable, and any other information found necessary for safe operation of the engine.

(b) For reciprocating engines, ratings and operating limitations are established relating to the following:

(1) Horsepower or torque, r.p.m., manifold pressure, and time at critical pressure altitude and sea level pressure altitude for—

(i) Rated maximum continuous power (relating to unsupercharged operation or to operation in each supercharger mode as applicable); and

(ii) Rated takeoff power (relating to unsupercharged operation or to operation in each supercharger mode as applicable).

(2) Fuel grade or specification.

(3) Oil grade or specification.

(4) Temperature of the—

(i) Cylinder;

(ii) Oil at the oil inlet; and

(iii) Turbosupercharger turbine wheel inlet gas.

(5) Pressure of—

(i) Fuel at the fuel inlet; and

(ii) Oil at the main oil gallery.

(6) Accessory drive torque and overhang moment.

(7) Component life.

(8) Turbosupercharger turbine wheel r.p.m.

(c) For turbine engines, ratings and operating limitations are established relating to the following:

(1) Horsepower, torque, or thrust, r.p.m., gas temperature, and time for—

(i) Rated maximum continuous power or thrust (augmented);

(ii) Rated maximum continuous power or thrust (unaugmented);

(iii) Rated takeoff power or thrust (augmented);

(iv) Rated takeoff power or thrust (unaugmented);

(v) Rated 30-minute OEI power;

(vi) Rated 2-1/2 minute OEI power;

(vii) Rated continuous OEI power; and

(viii) Rated 2-minute OEI power;

- (ix) Rated 30-second OEI power; and
- (x) Auxiliary power unit (APU) mode of operation.
- (2) Fuel designation or specification.
- (3) Oil grade or specification.
- (4) Hydraulic fluid specification.
- (5) Temperature of—
 - (i) Oil at a location specified by the applicant;
 - (ii) Induction air at the inlet face of a supersonic engine, including steady state operation and transient over-temperature and time allowed;
 - (iii) Hydraulic fluid of a supersonic engine;
 - (iv) Fuel at a location specified by the applicant; and
 - (v) External surfaces of the engine, if specified by the applicant.
- (6) Pressure of—
 - (i) Fuel at the fuel inlet;
 - (ii) Oil at a location specified by the applicant;
 - (iii) Induction air at the inlet face of a supersonic engine, including steady state operation and transient overpressure and time allowed; and
 - (iv) Hydraulic fluid.
- (7) Accessory drive torque and overhang moment.
- (8) Component life.
- (9) Fuel filtration.
- (10) Oil filtration.
- (11) Bleed air.
- (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) Transient engine overtorque, and number of overtorque occurrences.
- (17) Maximum engine overtorque for turbopropeller and turboshaft engines incorporating free power turbines.
- (18) For engines to be used in supersonic aircraft, engine rotor windmilling rotational r.p.m.
- (d) In determining the engine performance and operating limitations, the overall limits of accuracy of the engine control system and of the necessary instrumentation as defined in §33.5(a) (6) must be taken into account.

[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; Amdt. 33–26, 73 FR 48284, Aug. 19, 2008; Amdt. 33–30, 74 FR 45310, Sept. 2, 2009]

§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]

§33.15 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 protection.

(a) The design and construction of the engine and the materials used must minimize the probability of the occurrence and spread of fire during normal operation and failure conditions, and must minimize the effect of such a 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 or other hazardous effects.

(b) Except as provided in paragraph (c) of this section, each external line, fitting, and other component, which contains or conveys flammable fluid during normal engine operation, must be fire resistant or fireproof, as determined by the Administrator. Components must be shielded or located to safeguard against the ignition of leaking flammable fluid.

(c) A tank, which contains flammable fluids and any associated shut-off means and supports, which are part of and attached to the engine, must be fireproof either by construction or by protection unless damage by fire will not cause leakage or spillage of a hazardous quantity of flammable fluid. For a reciprocating engine having an integral oil sump of less than 23.7 liters capacity, the oil sump need not be fireproof or enclosed by a fireproof shield.

(d) An engine component designed, constructed, and installed to act as a firewall must be:

- (1) Fireproof;
- (2) Constructed so that no hazardous quantity of air, fluid or flame can pass around or through the firewall; and,
- (3) Protected against corrosion;

(e) In addition to the requirements of paragraphs (a) and (b) of this section, engine control system components that are located in a designated fire zone must be fire resistant or fireproof, as determined by the Administrator.

(f) Unintentional accumulation of hazardous quantities of flammable fluid within the engine must be prevented by draining and venting.

(g) Any components, modules, or equipment, which are susceptible to or are potential sources of static discharges or electrical fault currents must be designed and constructed to be properly grounded to the engine reference, to minimize the risk of ignition in external areas where flammable fluids or vapors could be present.

[Docket No. FAA–2007–28503, 74 FR 37930, July 30, 2009]

§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 §§35.21, 35.23, 35.42 and 35.43 of this chapter.

[Docket 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; Amdt. 33-28, 73 FR 63346, Oct. 24, 2008]

§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]

§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 rotor overspeed.

(a) For each fan, compressor, turbine, and turbosupercharger rotor, the applicant must establish by test, analysis, or a combination of both, that each rotor will not burst when operated in the engine for 5 minutes at whichever of the conditions defined in paragraph (b) of this section is the most critical with respect to the integrity of such a rotor.

(1) Test rotors used to demonstrate compliance with this section that do not have the most adverse combination of material properties and dimensional tolerances must be tested at conditions which have been adjusted to ensure the minimum specification rotor possesses the required overspeed capability. This can be accomplished by increasing test speed, temperature, and/or loads.

(2) When an engine test is being used to demonstrate compliance with the overspeed conditions listed in paragraph (b)(3) or

(b)(4) of this section and the failure of a component or system is sudden and transient, it may not be possible to operate the engine for 5 minutes after the failure. Under these circumstances, the actual overspeed duration is acceptable if the required maximum overspeed is achieved.

(b) When determining the maximum overspeed condition applicable to each rotor in order to comply with paragraphs (a) and (c) of this section, the applicant must evaluate the following rotor speeds taking into consideration the part's operating temperatures and temperature gradients throughout the engine's operating envelope:

(1) 120 percent of the maximum permissible rotor speed associated with any of the engine ratings except one-engine-inoperative (OEI) ratings of less than 2-1/2 minutes.

(2) 115 percent of the maximum permissible rotor speed associated with any OEI ratings of less than 2-1/2 minutes.

(3) 105 percent of the highest rotor speed that would result from either:

(i) The failure of the component or system which, in a representative installation of the engine, is the most critical with respect to overspeed when operating at any rating condition except OEI ratings of less than 2-1/2 minutes, or

(ii) The failure of any component or system in a representative installation of the engine, in combination with any other failure of a component or system that would not normally be detected during a routine pre-flight check or during normal flight operation, that is the most critical with respect to overspeed, except as provided by paragraph (c) of this section, when operating at any rating condition except OEI ratings of less than 2-1/2 minutes.

(4) 100 percent of the highest rotor speed that would result from the failure of the component or system which, in a representative installation of the engine, is the most critical with respect to overspeed when operating at any OEI rating of less than 2-1/2 minutes.

(c) The highest overspeed that results from a complete loss of load on a turbine rotor, except as provided by paragraph (f) of this section, must be included in the overspeed conditions considered by paragraphs (b)(3)(i), (b)(3)(ii), and (b)(4) of this section, regardless of whether that overspeed results from a failure within the engine or external to the engine. The overspeed resulting from any other single failure must be considered when selecting the most limiting overspeed conditions applicable to each rotor. Overspeeds resulting from combinations of failures must also be considered unless the applicant can show that the probability of occurrence is not greater than extremely remote (probability range of 10⁻⁷ to 10⁻⁹ per engine flight hour).

(d) In addition, the applicant must demonstrate that each fan, compressor, turbine, and turbosupercharger rotor complies with paragraphs (d)(1) and (d)(2) of this section for the maximum overspeed achieved when subjected to the conditions specified in paragraphs (b)(3) and (b)(4) of this section. The applicant must use the approach in paragraph (a) of this section which specifies the required test conditions.

(1) Rotor Growth must not cause the engine to:

(i) Catch fire,

(ii) Release high-energy debris through the engine casing or result in a hazardous failure of the engine casing,

(iii) Generate loads greater than those ultimate loads specified in §33.23(a), or

(iv) Lose the capability of being shut down.

(2) Following an overspeed event and after continued operation, the rotor may not exhibit conditions such as cracking or distortion which preclude continued safe operation.

(e) The design and functioning of engine control systems, instruments, and other methods not covered under §33.28 must ensure that the engine operating limitations that affect turbine, compressor, fan, and turbosupercharger rotor structural integrity will not be exceeded in service.

(f) Failure of a shaft section may be excluded from consideration in determining the highest overspeed that would result from a complete loss of load on a turbine rotor if the applicant:

(1) Identifies the shaft as an engine life-limited-part and complies with §33.70.

(2) Uses material and design features that are well understood and that can be analyzed by well-established and validated stress analysis techniques.

(3) Determines, based on an assessment of the environment surrounding the shaft section, that environmental influences are unlikely to cause a shaft failure. This assessment must include complexity of design, corrosion, wear, vibration, fire, contact with adjacent components or structure, overheating, and secondary effects from other failures or combination of failures.

(4) Identifies and declares, in accordance with §33.5, any assumptions regarding the engine installation in making the assessment described above in paragraph (f)(3) of this section.

(5) Assesses, and considers as appropriate, experience with shaft sections of similar design.

(6) Does not exclude the entire shaft.

(g) If analysis is used to meet the overspeed requirements, then the analytical tool must be validated to prior overspeed test results of a similar rotor. The tool must be validated for each material. The rotor being certified must not exceed the boundaries of the rotors being used to validate the analytical tool in terms of geometric shape, operating stress, and temperature. Validation includes the ability to accurately predict rotor dimensional growth and the burst speed. The predictions must also show that the rotor being certified does not have lower burst and growth margins than rotors used to validate the tool.

[Amdt. 33–10, 49 FR 6851, Feb. 23, 1984; as amended by Amdt. 33–26, 73 FR 48284, Aug. 19, 2008; Amdt. 33–31, 76 FR 42023, July 18, 2011]

§33.28 Engine control systems.

(a) **Applicability.** These requirements are applicable to any system or device that is part of engine type design, that controls, limits, or monitors engine operation, and is necessary for the continued airworthiness of the engine.

(b) **Validation.**

(1) **Functional aspects.** The applicant must substantiate by tests, analysis, or a combination thereof, that the engine control system performs the intended functions in a manner which:

(i) Enables selected values of relevant control parameters to be maintained and the engine kept within the approved operating limits over changing atmospheric conditions in the declared flight envelope;

(ii) Complies with the operability requirements of §§33.51, 33.65 and 33.73, as appropriate, under all likely system inputs and allowable engine power or thrust demands, unless it can be demonstrated that failure of the control function results in a non-dispatchable condition in the intended application;

(iii) Allows modulation of engine power or thrust with adequate sensitivity over the declared range of engine operating conditions; and

(iv) Does not create unacceptable power or thrust oscillations.

(2) **Environmental limits.** The applicant must demonstrate, when complying with §§33.53 or 33.91, that the engine control system functionality will not be adversely affected by declared environmental conditions, including electromagnetic interference (EMI), High Intensity Radiated Fields (HIRF), and lightning.

The limits to which the system has been qualified must be documented in the engine installation instructions.

(c) **Control transitions.**

(1) The applicant must demonstrate that, when fault or failure results in a change from one control mode to another, from one channel to another, or from the primary system to the back-up system, the change occurs so that:

(i) The engine does not exceed any of its operating limitations;

(ii) The engine does not surge, stall, or experience unacceptable thrust or power changes or oscillations or other unacceptable characteristics; and

(iii) There is a means to alert the flight crew if the crew is required to initiate, respond to, or be aware of the control mode change. The means to alert the crew must be described in the engine installation instructions, and the crew action must be described in the engine operating instructions;

(2) The magnitude of any change in thrust or power and the associated transition time must be identified and described in the engine installation instructions and the engine operating instructions.

(d) **Engine control system failures.** The applicant must design and construct the engine control system so that:

(1) The rate for Loss of Thrust (or Power) Control (LOTG/LOPC) events, consistent with the safety objective associated with the intended application can be achieved;

(2) In the full-up configuration, the system is single fault tolerant, as determined by the Administrator, for electrical or electronic failures with respect to LOTG/LOPC events;

(3) Single failures of engine control system components do not result in a hazardous engine effect; and

(4) Foreseeable failures or malfunctions leading to local events in the intended aircraft installation, such as fire, overheat, or failures leading to damage to engine control system components, do not result in a hazardous engine effect due to engine control system failures or malfunctions.

(e) **System safety assessment.** When complying with this section and §33.75, the applicant must complete a System Safety Assessment for the engine control system. This assessment must identify faults or failures that result in a change in thrust or power, transmission of erroneous data, or an effect on engine operability producing a surge or stall together with the predicted frequency of occurrence of these faults or failures.

(f) **Protection systems.**

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

(2) When electronic overspeed protection systems are provided, the design must include a means for testing, at least once per engine start/stop cycle, to establish the availability of the protection function. The means must be such that a complete test of the system can be achieved in the minimum number of cycles. If the test is not fully automatic, the requirement for a manual test must be contained in the engine instructions for operation.

(3) When overspeed protection is provided through hydromechanical or mechanical means, the applicant must demonstrate by test or other acceptable means that the overspeed function remains available between inspection and maintenance periods.

(g) **Software.** The applicant must design, implement, and verify all associated software to minimize the existence of errors by using a method, approved by the FAA, consistent with the criticality of the performed functions.

(h) Aircraft-supplied data. Single failures leading to loss, interruption or corruption of aircraft-supplied data (other than thrust or power command signals from the aircraft), or data shared between engines must:

- (1) Not result in a hazardous engine effect for any engine; and
- (2) Be detected and accommodated. The accommodation strategy must not result in an unacceptable change in thrust or power or an unacceptable change in engine operating and starting characteristics. The applicant must evaluate and document in the engine installation instructions the effects of these failures on engine power or thrust, engine operability, and starting characteristics throughout the flight envelope.

(i) Aircraft-supplied electrical power.

(1) The applicant must design the engine control system so that the loss, malfunction, or interruption of electrical power supplied from the aircraft to the engine control system will not result in any of the following:

- (i) A hazardous engine effect, or
- (ii) The unacceptable transmission of erroneous data.

(2) When an engine dedicated power source is required for compliance with paragraph (i)(1) of this section, its capacity should provide sufficient margin to account for engine operation below idle where the engine control system is designed and expected to recover engine operation automatically.

(3) The applicant must identify and declare the need for, and the characteristics of, any electrical power supplied from the aircraft to the engine control system for starting and operating the engine, including transient and steady state voltage limits, in the engine instructions for installation.

(4) Low voltage transients outside the power supply voltage limitations declared in paragraph (i)(3) of this section must meet the requirements of paragraph (i)(1) of this section. The engine control system must be capable of resuming normal operation when aircraft-supplied power returns to within the declared limits.

(j) Air pressure signal. The applicant must consider the effects of blockage or leakage of the signal lines on the engine control system as part of the System Safety Assessment of paragraph (e) of this section and must adopt the appropriate design precautions.

(k) Automatic availability and control of engine power for 30-second OEI rating. Rotorcraft engines having a 30-second OEI rating must incorporate a means, or a provision for a means, for automatic availability and automatic control of the 30-second OEI power within its operating limitations.

(l) Engine shut down means. Means must be provided for shutting down the engine rapidly.

(m) Programmable logic devices. The development of programmable logic devices using digital logic or other complex design technologies must provide a level of assurance for the encoded logic commensurate with the hazard associated with the failure or malfunction of the systems in which the devices are located. The applicant must provide evidence that the development of these devices has been done by using a method, approved by the FAA, that is consistent with the criticality of the performed function.

[Docket No. FAA-2007-27311, 73 FR 48284, Aug. 19, 2008]

§33.29 Instrument connection.

(a) Unless it is constructed to prevent its connection to an incorrect instrument, each connection provided for powerplant instruments required by aircraft airworthiness regulations or necessary to insure operation of the engine in compliance with any engine limitation must be marked to identify it with its corresponding instrument.

(b) A connection must be provided on each turbojet engine for an indicator system to indicate rotor system unbalance.

(c) Each rotorcraft turbine engine having a 30-second OEI rating and a 2-minute OEI rating must have a means or a provision for a means to:

(1) Alert the pilot when the engine is at the 30-second OEI and the 2-minute OEI power levels, when the event begins, and when the time interval expires;

(2) Automatically record each usage and duration of power at the 30-second OEI and 2-minute OEI levels;

(3) Alert maintenance personnel in a positive manner that the engine has been operated at either or both of the 30-second and 2-minute OEI power levels, and permit retrieval of the recorded data; and

(4) Enable routine verification of the proper operation of the above means.

(d) The means, or the provision for a means, of paragraphs (c) (2) and (c)(3) of this section must not be capable of being reset in flight.

(e) The applicant must make provision for the installation of instrumentation necessary to ensure operation in compliance with engine operating limitations. Where, in presenting the safety analysis, or complying with any other requirement, dependence is placed on instrumentation that is not otherwise mandatory in the assumed aircraft installation, then the applicant must specify this instrumentation in the engine installation instructions and declare it mandatory in the engine approval documentation.

(f) As part of the System Safety Assessment of §33.28(e), the applicant must assess the possibility and subsequent effect of incorrect fit of instruments, sensors, or connectors. Where necessary, the applicant must take design precautions to prevent incorrect configuration of the system.

(g) The sensors, together with associated wiring and signal conditioning, must be segregated, electrically and physically, to the extent necessary to ensure that the probability of a fault propagating from instrumentation and monitoring functions to control functions, or vice versa, is consistent with the failure effect of the fault.

(h) The applicant must provide instrumentation enabling the flight crew to monitor the functioning of the turbine cooling system unless appropriate inspections are published in the relevant manuals and evidence shows that:

(1) Other existing instrumentation provides adequate warning of failure or impending failure;

(2) Failure of the cooling system would not lead to hazardous engine effects before detection; or

(3) The probability of failure of the cooling system is extremely remote.

[Amdt. 33-5, 39 FR 1831, Jan. 15, 1974, as amended by Amdt. 33-6, 39 FR 35465, Oct. 1, 1974; Amdt. 33-18, 61 FR 31328, June 19, 1996; Amdt. 33-25, 73 FR 48123, Aug. 18, 2008; Amdt. 33-26, 73 FR 48285, Aug. 19, 2008]

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