

Federal Aviation Regulations

Recueil des articles de la FAR

Hail diameter (m/m)	Contribution total HWC (%)
0-4.9	0
5.0-9.9	17.00
10.0-14.9	25.00
15.0-19.9	22.50
20.0-24.9	16.00
25.0-29.9	9.75
30.0-34.9	4.75
35.0-39.9	2.50
40.0-44.9	1.50
45.0-49.9	0.75
50.0-55.0	0.25
Total	100.00

Median diameter of hail is 16mm
NOTE : Source of data- Results of the Aerospace Industries Association (AIA) Propulsion Committee (PC) Study, Project PC 338-1, June 1990.]

TAB. 95.4 – Certification Standard Atmospheric Hail Size Distribution



FIG. 1 – Federal Aviation Administration

Mise en page L^AT_EX par Elodie Roux (26 septembre 2003)
D'après le site : [http ://www2.faa.gov/certification/aircraft/](http://www2.faa.gov/certification/aircraft/)

Altitude (feet)	Hail water content (HWC) (grams, water/ meter ³ air)
0	6.0
7,300	8.9
8,500	9.4
10,000	9.9
12,000	10.0
15,000	10.0
16,000	8.9
17,700	7.8
19,300	6.6
21,500	5.6
24,300	4.4
29,000	3.3
46,000	0.2

HWC values at other altitudes may be determined by linear interpolation. The hail threat below 7,300 feet and above 29,000 feet is based on linearly extrapolated data.

NOTE : Source of data—Results of the Aerospace Industries Association (AIA) Propulsion Committee (PC) Study, Project PC 338-1, June 1990.

TAB. 95.2 – Certification Standard Atmospheric Hail Concentrations

Rain droplet diameter (mm)	Contribution to total RWC (%)
0-0.49	0
0.50-0.99	2.25
1.00-1.49	8.75
1.50-1.99	16.25
2.00-2.49	19.00
2.50-2.99	17.75
3.00-3.49	13.50
3.50-3.99	9.50
4.00-4.49	6.00
4.50-4.99	3.00
5.00-5.49	2.00
5.50-5.99	1.25
6.00-6.49	0.50
6.50-7.00	0.25
Total	100.00

Median diameter of rain droplets is 2.66 m/in

NOTE : Source of data—Results of the Aerospace Industries Association (AIA) Propulsion Committee (PC) Study, Project PC 338-1, June 1990.

TAB. 95.3 – Certification Standard Atmospheric Rain Droplet Size Distribution

Amdt. 33-19, Eff. 4/30/1998

FAR 33.B1 : Certification standard atmospheric concentrations of rain and hail.

(Figure 95.1, p. 1178), (Table 95.1, p. 1178), (Table 95.2, p. 1179), (Table 95.3, p. 1179), and (Table 95.4, p. 1180) specify the atmospheric concentrations and size distributions of rain and hail for establishing certification, in accordance with the requirements of Sec. 33.78(a)(2). In conducting tests, normally by spraying liquid water to simulate rain conditions and by delivering hail fabricated from ice to simulate hail conditions, the use of water droplets and hail having shapes, sizes and distributions of sizes other than those defined in this Appendix B, or the use of a single size or shape for each water droplet or hail, can be accepted, provided the applicant shows that the substitution does not reduce the severity of the test.

FIGURE B1 - Illustration of Rain and Hail Threats. Certification concentrations are obtained using Tables B1 and B2.

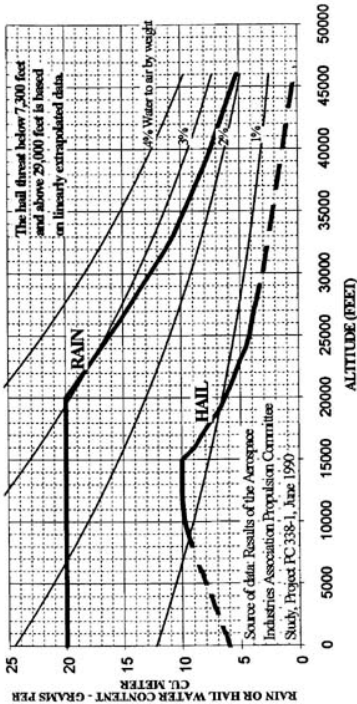


FIG. 95.1 – Illustration of Rain and Hail Threats.

Altitude (feet)	Rain water content (RWC) (grams, water/ meter ³ air)
0	20.0
20,000	20.0
26,300	15.2
32,700	10.8
39,300	7.7
46,000	5.2

RWC values at other altitudes may be determined by linear interpolation.
NOTE : Source of data-Results of the Aerospace Industries Association (AIA) Propulsion Committee Study, Project PC 338-1, June 1990.

TAB. 95.1 – Certification standard atmospheric rain concentrations

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Chapitre 95

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- of complexity requiring specialized maintenance techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross references to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the engine.
- (7) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.
- (8) Information describing the order and method of removing the engine and its parts and replacing parts, with any necessary precautions to be taken. Instructions for proper ground handling, crating, and shipping must also be included.
- (9) A list of the tools and equipment necessary for maintenance and directions as to their method of use.
- (b) *Engine Overhaul Manual or Section.*
- (1) Disassembly information including the order and method of disassembly for overhaul.
- (2) Cleaning and inspection instructions that cover the materials and apparatus to be used and methods and precautions to be taken during overhaul. Methods of overhaul inspection must also be included.
- (3) Details of all fits and clearances relevant to overhaul.
- (4) Details of repair methods for worn or otherwise substandard parts and components along with the information necessary to determine when replacement is necessary.
- (5) The order and method of assembly at overhaul.
- (6) Instructions for testing after overhaul.
- (7) Instructions for storage preparation, including any storage limits.
- (8) A list of tools needed for overhaul.]
- Amdt. 33-9, EFF. 10/14/80

FAR 33.A4 : Airworthiness Limitations section.

The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, inspection interval, and related procedure required for type certification. If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads : "The Airworthiness Limitations section is FAA approved and specifies maintenance required under Secs. 43.16 and [91.403] of the Federal Aviation Regulations unless an alternative program has been FAA approved." Amdt. 33-13, EFF. 8/18/90

FAR 33.A1 : [General.]

- (a) [This appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by Sec. 33.4.]
- (b) The Instructions for Continued Airworthiness for each engine must include the Instructions for Continued Airworthiness for all engine parts. If Instructions for Continued Airworthiness are not supplied by the engine part manufacturer for an engine part, the Instructions for Continued airworthiness for the engine must include the information essential to the continued airworthiness of the engine.
- (c) The applicant must submit to the FAA a program to show how changes to the Instructions for Continued Airworthiness made by the applicant or by the manufacturers of engine parts will be distributed.]

Amdt. 33-9, Eff. 10/14/80

FAR 33.A2 : [Format.]

- (a) [The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.]
- (b) The format of the manual or manuals must provide for a practical arrangement.]

Amdt. 33-9, Eff. 10/14/80

FAR 33.A3 : [Content.]

[The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following manuals or sections, as appropriate, and information :

(a) *Engine Maintenance Manual or Section.*

- (1) Introduction information that includes an explanation of the engine's features and data to the extent necessary for maintenance or preventive maintenance.
- (2) A detailed description of the engine and its components, systems, and installations.
- (3) Installation instructions, including proper procedures for uncrating, deinstalling, acceptance checking, lifting, and attaching accessories, with any necessary checks.
- (4) Basic control and operating information describing how the engine components, systems, and installations operate, and information describing the methods of starting, running, testing, and stopping the engine and its parts including any special procedures and limitations that apply.
- (5) Servicing information that covers details regarding servicing points, capacities of tanks, reservoirs, types of fluids to be used, pressures applicable to the various systems, locations of lubrication points, lubricants to be used, and equipment required for servicing.
- (6) Scheduling information for each part of the engine that provides the recommended periods at which it should be cleaned, inspected, adjusted, tested, and lubricated, and the degree of inspection the applicable wear tolerances, and work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree

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Appendix A : Instructions for Continued Airworthiness

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FAR 33.97 : Thrust reversers.

- (a) If the engine incorporates a reverser, the endurance, calibration, operation, and vibration tests prescribed in this subpart must be run with the reverser installed. In complying with this section, the power control lever must be moved from one extreme position to the other in not more than one second except, if regimes of control operations are incorporated necessitating scheduling of the power-control lever motion in going from one extreme position to the other, a longer period of time is acceptable but not more than three seconds. In addition, the test prescribed in paragraph (b) must be made. This test may be scheduled as part of the endurance run.
- (b) 175 reversals must be made from flight-idle forward thrust to maximum reverse thrust and 25 reversals must be made from [rated takeoff thrust] to maximum reverse thrust. After each reversal, the reverser must be operated at full reverse thrust for a period of one minute, except that, in the case of a reverser intended for use only as a braking means on the ground, the reverser need only be operated at full reverse thrust for 30 seconds.

Amdt. 33-3, Eff. 4/3/67

FAR 33.99 : General conduct of block tests.

- (a) Each applicant may, in making a block test, use separate engines of identical design and construction in the vibration, calibration, endurance, and operation tests, except that, if a separate engine is used for the endurance test it must be subjected to a calibration check before starting the endurance test.
- (b) Each applicant may service and make minor repairs to the engine during the block tests in accordance with the service and maintenance instructions submitted in compliance with [Sec. 33.4]. If the frequency of the service is excessive, or the number of stops due to engine malfunction is excessive, or a major repair, or replacement of a part is found necessary during the block tests or as the result of findings from the teardown inspection, the engine or its parts must be subjected to any additional tests the Administrator finds necessary.
- (c) Each applicant must furnish all testing facilities, including equipment and competent personnel, to conduct the block tests.

Amdt. 33-9, Eff. 10/14/80

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- (1) That test, of the two prescribed, produces the least rotor imbalance ; and
 (2) The analysis is shown to be equivalent to the test.]
 Amdt. 33-10, Eff. 3/26/84

FAR 33.95 : Engine-propeller systems tests.

If the engine is designed to operate with a propeller, the following tests must be made with a representative propeller installed by either including the tests in the endurance run or otherwise performing them in a manner acceptable to the Administrator :

- (a) Feathering operation : 25 cycles.
 (b) Negative torque and thrust system operation : 25 cycles from [rated] maximum continuous power.
 (c) Automatic decoupler operation : 25 cycles from [rated] maximum continuous power (if repeated decoupling and recoupling in service is the intended function of the device).
 (d) Reverse thrust operation : 175 cycles from the flight-idle position to full reverse and 25 cycles at [rated] maximum continuous power from full forward to full reverse thrust. At the end of each cycle the propeller must be operated in reverse pitch for a period of 30 seconds at the maximum rotational speed and power specified by the applicant for reverse pitch operation.

Amdt. 33-3, Eff. 4/3/67

FAR 33.96 : [Engine tests in auxiliary power unit (APU) mode.]

[If the engine is designed with a propeller brake which will allow the propeller to be brought to a stop while the gas generator portion of the engine remains in operation, and remain stopped during operation of the engine as an auxiliary power unit ("APU mode"), in addition to the requirements of Sec. 33.87, the applicant must conduct the following tests :

- (a) Ground locking : A total of 45 hours with the propeller brake engaged in a manner which clearly demonstrates its ability to function without adverse effects on the complete engine while the engine is operating in the APU mode under the maximum conditions of engine speed, torque, temperature, air bleed, and power extraction as specified by the applicant.
 (b) Dynamic braking : A total of 400 application-release cycles of brake engagements must be made in a manner which clearly demonstrates its ability to function without adverse effects on the complete engine under the maximum conditions of engine acceleration/deceleration rate, speed, torque, and temperature as specified by the applicant. The propeller must be stopped prior to brake release.
 (c) One hundred engine starts and stops with the propeller brake engaged.
 (d) The tests required by paragraphs (a), (b), and (c) of this section must be performed on the same engine, but this engine need not be the same engine used for the tests required by Sec. 33.87.
 (e) The tests required by paragraphs (a), (b), and (c) of this section must be followed by engine disassembly to the extent necessary to show compliance with the requirements of Sec. 33.93(a) and Sec. 33.93(b).]

Amdt. 33-11, Eff. 4/24/86

- (1) Each component having an adjustment setting and a functioning characteristic that can be established independent of installation on the engine must retain each setting and functioning characteristic within the limits that were established and recorded at the beginning of the test; and
- (2) Each engine part must conform to the type design and be eligible for incorporation into an engine for continued operation, in accordance with information submitted in compliance with Sec. 33.4.
- (b) After completing the endurance testing of Sec. 33.87(f), each engine must be completely disassembled, and
- (1) Each component having an adjustment setting and a functioning characteristic that can be established independent of installation on the engine must retain each setting and functioning characteristic within the limits that were established and recorded at the beginning of the test; and
- (2) Each engine may exhibit deterioration in excess of that permitted in paragraph (a)(2) of this section including some engine parts or components that may be unsuitable for further use. The applicant must show by analysis and/or test, as found necessary by the Administrator, that structural integrity of the engine including mounts, cases, bearing supports, shafts, and rotors, is maintained; or
- (c) In lieu of compliance with paragraph (b) of this section, each engine for which the 30-second OEI and 2-minute OEI ratings are desired, may be subjected to the endurance testing of Secs. 33.87(b), (c), (d), or (e) of this part, and followed by the testing of Sec. 33.87(f), without intervening disassembly and inspection. However, the engine must comply with paragraph (a) of this section after completing the endurance testing of Sec. 33.87(f).]

Amdt. 33-18, Eff. 8/19/96

FAR 33.94 : [Blade containment and rotor unbalance tests.]

- (a) [Except as provided in paragraph (b) of this section, it must be demonstrated by engine tests that the engine is capable of containing damage without catching fire and without failure of its mounting attachments when operated for at least 15 seconds, unless the resulting engine damage induces a self shutdown, after each of the following events :
- (1) Failure of the most critical compressor or fan blade while operating at maximum permissible r.p.m. The blade failure must occur at the outermost retention groove or, for integrally-bladed rotor discs, at least 80 percent of the blade must fail.
- (2) Failure of the most critical turbine blade while operating at maximum permissible r.p.m. The blade failure must occur at the outermost retention groove or, for integrally-bladed rotor discs, at least 80 percent of the blade must fail. The most critical turbine blade must be determined by considering turbine blade weight and the strength of the adjacent turbine case at case temperatures and pressures associated with operation at maximum permissible r.p.m.
- (b) Analysis based on rig testing, component testing, or service experience may be substituted for one of the engine tests prescribed in paragraphs (a)(1) and (a)(2) of this section if—

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FAR 33.90 : [Initial maintenance inspection.]

[Each engine, except engines being type certificated through amendment of an existing type certificate or through supplemental type certification procedures, must undergo an approved test run that simulates the conditions in which the engine is expected to operate in service, including start-stop cycles, to establish when the initial maintenance inspection is required. The test run must be accomplished on an engine which substantially conforms to the final type design.]

Amdt. 33-10, Eff. 3/26/84

FAR 33.91 : Engine component tests.

- (a) For those systems that cannot be adequately substantiated by endurance testing in accordance with the provisions of Sec. 33.87, additional tests must be made to establish that components are able to function reliably in all normally anticipated flight and atmospheric conditions.
- (b) Temperature limits must be established for those components that require temperature controlling provisions in the aircraft installation to assure satisfactory functioning, reliability, and durability.
- (c) [Each impressurized hydraulic fluid tank may not fail or leak when subjected to maximum operating temperature and an internal pressure of 5 p.s.i., and each pressurized hydraulic fluid tank may not fail or leak when subjected to maximum operating temperature and an internal pressure not less than 5 p.s.i. plus the maximum operating pressure of the tank.]
- (d) For an engine type certificated for use in supersonic aircraft, the systems, safety devices, and external components that may fail because of operation at maximum and minimum operating temperatures must be identified and tested at maximum and minimum operating temperatures and while temperature and other operating conditions are cycled between maximum and minimum operating values.]

Amdt. 33-6, Eff. 10/31/74

FAR 33.92 : [Rotor locking tests.]

[If continued rotation is prevented by a means to lock the rotor(s), the engine must be subjected to a test that includes 25 operations of this means under the following conditions :

- (a) The engine must be shut down from rated maximum continuous thrust or power ; and
- (b) The means for stopping and locking the rotor(s) must be operated as specified in the engine operating instructions while being subjected to the maximum torque that could result from continued flight in this condition ; and
- (c) Following rotor locking, the rotor(s) must be held stationary under these conditions for five minutes for each of the 25 operations.]

Amdt. 33-17, Eff. 7/5/96

FAR 33.93 : Teardown inspection.

- (a) [After completing the endurance testing of Sec. 33.87(b), (c), (d), (e), or (f) of this part, each engine must be completely disassembled, and

FAR 33.88 : Engine overtemperature test.

- (a) [Each engine must run for 5 minutes at maximum permissible rpm with the gas temperature at least 75oF (42oC) higher than the maximum rating's steady-state operating limit, excluding maximum values of rpm and gas temperature associated with the 30-second OEI and 2-minute OEI ratings. Following this run, the turbine assembly must be within serviceable limits.
- (b) Each engine for which 30-second OEI and 2-minute OEI ratings are desired, that does not incorporate a means to limit temperature, must be run for a period of 5 minutes at the maximum power-on rpm with the gas temperature at least 75oF (42oC) higher than the 30-second OEI rating operating limit. Following this run, the turbine assembly may exhibit distress beyond the limits for an overtemperature condition provided the engine is shown by analysis or test, as found necessary by the Administrator, to maintain the integrity of the turbine assembly.
- (c) Each engine for which 30-second OEI and 2-minute OEI ratings are desired, that incorporates a means to limit temperature, must be run for a period of 4 minutes at the maximum power-on rpm with the gas temperature at least 35oF (20oC) higher than the maximum operating limit. Following this run, the turbine assembly may exhibit distress beyond the limits for an overtemperature condition provided the engine is shown by analysis or test, as found necessary by the Administrator, to maintain the integrity of the turbine assembly.
- (d) A separate test vehicle may be used for each test condition.]

Amdt. 33-18, Eff. 8/19/96

FAR 33.89 : Operation test.

- (a) The operation test must include testing found necessary by the Administrator to demonstrate—
 - (1) Starting, idling, acceleration, overspeeding, ignition, functioning of the propeller (if the engine is designated to operate with a propeller) ;
 - (2) Compliance with the engine response requirements of Sec. 33.73 ; and
 - (3) The minimum power or thrust response time to 95
 - (i) No bleed air and power extraction for aircraft use.
 - (ii) Maximum allowable bleed air and power extraction for aircraft use.
 - (iii) An intermediate value for bleed air and power extraction representative of that which might be used as a maximum for aircraft during approach to a landing.
- (4) If testing facilities are not available, the determination of power extraction required in subparagraphs (2) and (3) of paragraph (c) of this section may be accomplished through appropriate analytical means.
- (b) [The operation test must include all testing found necessary by the Administrator to demonstrate that the engine has safe operating characteristics throughout its specified operating envelope.]

Amdt. 33-10, Eff. 3/26/84

Première partie

FAR 1- Definitions and abbreviations

- (ii) One period of 5 minutes at rated takeoff thrust followed by 5 minutes at not more than 15 percent of rated takeoff thrust ;
 - (iii) One period of 10 minutes at rated takeoff augmented thrust followed by 2 minutes at idle thrust, except that if rated maximum continuous augmented thrust is lower than rated takeoff augmented thrust, 5 of the 10-minute periods must be at rated maximum continuous augmented thrust ; and
 - (iv) Six periods of 1 minute at rated takeoff augmented thrust each followed by 2 minutes, including acceleration and deceleration time, at idle thrust.
- (2) *Simulated supersonic test.* Each run of the simulated supersonic test must be preceded by changing the inlet air temperature and pressure from that attained at subsonic condition to the temperature and pressure attained at supersonic velocity, and must be followed by a return to the temperature attained at subsonic condition. Thirty runs of 4 hours each must be made, consisting of—
- (i) One period of 30 minutes at the thrust obtained with the power control lever set at the position for rated maximum continuous augmented thrust followed by 10 minutes at the thrust obtained with the power control lever set at the position for 90 percent of rated maximum continuous augmented thrust. The end of this period in the first five runs must be made with the induction air temperature at the limiting condition of transient overtemperature, but need not be repeated during the periods specified in paragraphs [(g)](2)(ii) through (iv) of this section ;
 - (ii) One period repeating the run specified in paragraph [(g)](2)(i) of this section, except that it must be followed by 10 minutes at the thrust obtained with the power control lever set at the position for 80 percent of rated maximum continuous augmented thrust ;
 - (iii) One period repeating the run specified in paragraph [(g)](2)(i) of this section, except that it must be followed by 10 minutes at the thrust obtained with the power control lever set at the position for 60 percent of rated maximum continuous augmented thrust and then 10 minutes at not more than 15 percent of rated takeoff thrust ;
 - (iv) One period repeating the runs specified in paragraphs [(g)](2)(i) and (ii) of this section ; and
 - (v) One period of 30 minutes with 25 of the runs made at the thrust obtained with the power control lever set at the position for rated maximum continuous augmented thrust, each followed by idle thrust and with the remaining 5 runs at the thrust obtained with the power control lever set at the position for rated maximum continuous augmented thrust for 25 minutes each, followed by subsonic operation at not more than 15 percent or rated takeoff thrust and accelerated to rated takeoff thrust for 5 minutes using hot fuel.
- (3) *Starts.* One hundred starts must be made, of which 25 starts must be preceded by an engine shutdown of at least 2 hours. There must be at least 10 false engine starts, pausing for the applicant's specified minimum fuel drainage time before attempting a normal start. At least 10 starts must be normal restarts, each made no later than 15 minutes after engine shutdown. The starts may be made at any time, including the period of endurance testing.

Amdt. 33-18, Eff. 8/19/96

sixth takeoff power periods, only 2 1/2 minutes need be conducted at rated takeoff power, and the remaining 2 1/2 minutes must be conducted at rated 2 1/2-minute OEI power. The developed powers at takeoff, 2 1/2-minute OEI, and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. The applicant may, during any one period, control manually the rotor speed and power while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at rated takeoff power must be at the augmented rating. In changing the power setting after or during each period, the power control lever must be moved in the manner prescribed in paragraph (d)(6) of this section.

- (2) The tests required in paragraphs (b)(2) through (b)(6), or (c)(2) through (c)(6), or (d)(2) through (d)(7) of this section, as applicable, except that in one of the 6-hour test sequences, the last 5 minutes of the 30 minutes at takeoff power test period of paragraph (b)(2) of this section, or of the 30 minutes at 30-minute OEI power test period of paragraph (c)(2) of this section, or of the 1 hour at continuous OEI power test period of paragraph (d)(3) of this section, must be run at 2 1/2-minute OEI power.

- (f) *[Rotorcraft engines for which 30-second OEI and 2-minute OEI ratings are desired.* For each rotorcraft engine for which 30-second OEI and 2-minute OEI power ratings are desired, and following completion of the tests under paragraphs (b), (c), (d), or (e) of this section, the applicant may disassemble the tested engine to the extent necessary to show compliance with the requirements of Sec. 33.93(a). The tested engine must then be reassembled using the same parts used during the test runs of paragraphs (b), (c), (d), or (e) of this section, except those parts described as consumables in the Instructions for Continued Airworthiness. The applicant must then conduct the following test sequence four times, for a total time of not less than 120 minutes :

- (1) *Takeoff power.* Three minutes at rated takeoff power.
- (2) *30-second OEI power.* Thirty seconds at rated 30-second OEI power.
- (3) *2-minute OEI power.* Two minutes at rated 2-minute OEI power.
- (4) *30-minute OEI power, continuous OEI power, or maximum continuous power.* Five minutes at rated 30-minute OEI power, rated continuous OEI power, or rated maximum continuous power, whichever is greatest, except that, during the first test sequence, this period shall be 65 minutes.
- (5) *50 percent takeoff power.* One minute at 50 percent takeoff power.
- (6) *30-second OEI power.* Thirty seconds at rated 30-second OEI power.
- (7) *2-minute OEI power.* Two minutes at rated 2-minute OEI power.
- (8) *Idle.* One minute at idle.

- (g) *[Supersonic aircraft engines.* For each engine type certificated for use on supersonic aircraft the applicant must conduct the following :

- (1) *Subsonic test under sea level ambient atmospheric conditions.* Thirty runs of one hour each must be made, consisting of—
- (i) Two periods of 5 minutes at rated takeoff augmented thrust each followed by 5 minutes at idle thrust ;

FAR 1.1 : General definitions

As used in Subchapters A through K of this chapter, unless the context requires otherwise :

Administrator means the Federal Aviation Administrator or any person to whom he has delegated his authority in the matter concerned.

Aerodynamic coefficients means non-dimensional coefficients for aerodynamic forces and moments.

Air carrier means a person who undertakes directly by lease, or other arrangement, to engage in air transportation.

Air commerce means interstate, overseas, or foreign air commerce or the transportation of mail by aircraft or any operation or navigation of aircraft within the limits of any Federal airway or any operation or navigation of aircraft which directly affects, or which may endanger safety in, interstate, overseas, or foreign air commerce.

Aircraft means a device that is used or intended to be used for flight in the air.

Aircraft engine means an engine that is used or intended to be used for propelling aircraft. It includes turbosuperchargers, appurtenances, and accessories necessary for its functioning, but does not include propellers.

Airframe means the fuselage, booms, nacelles, cowlings, fairings, airfoil surfaces (including rotors but excluding propellers and rotating airfoils of engines), and landing gear of an aircraft and their accessories and controls.

Airplane means an engine-driven fixed-wing aircraft heavier than air, that is supported in flight by the dynamic reaction of the air against its wings.

Airport means an area of land or water that is used or intended to be used for the landing and takeoff of aircraft, and includes its buildings and facilities, if any.

Airship means an engine-driven lighter-than-air aircraft that can be steered.

Air traffic means aircraft operating in the air or on an airport surface, exclusive of loading ramps and parking areas.

Air traffic clearance means an authorization by air traffic control, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace.

Air traffic control means a service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic.

Air transportation means interstate, overseas, or foreign air transportation or the transportation of mail by aircraft.

Alert Area . An alert area is established to inform pilots of a specific area wherein a high volume of pilot training or an unusual type of aeronautical activity is conducted.

Alternate airport means an airport at which an aircraft may land if a landing at the intended airport becomes inadvisable.

Altitude engine means a reciprocating aircraft engine having a rated takeoff power that is producible from sea level to an established higher altitude.

Appliance means any instrument, mechanism, equipment, part, apparatus, appurtenance, or accessory, including communications equipment, that is used or intended to be used in operating or controlling an aircraft in flight, is installed in or attached to the aircraft, and is not part of an airframe, engine, or propeller.

Approved , unless used with reference to another person, means approved by the Administrator.

Area navigation (RNAV) means a method of navigation that permits aircraft operations on any desired course within the coverage of station-referenced navigation signals or within the limits of self-contained system capability.

Area navigation low route means an area navigation route within the airspace extending upward from 1,200 feet above the surface of the earth to, but not including, 18,000 feet MSL.

Area navigation high route means an area navigation route within the airspace extending upward from, and including, 18,000 feet MSL to flight level 450.

Armed Forces means the Army, Navy, Air Force, Marine Corps, and Coast Guard, including their regular and reserve components and members serving without component status.

Autorotation means a rotorcraft flight condition in which the lifting rotor is driven entirely by action of the air when the rotorcraft is in motion.

Auxiliary rotor means a rotor that serves either to counteract the effect of the main rotor torque on a rotorcraft or to maneuver the rotorcraft about one or more of its three principal axes.

Balloon means a lighter-than-air aircraft that is not engine driven, and that sustains flight through the use of either gas buoyancy or an airborne heater.

Brake horsepower means the power delivered at the propeller shaft (main drive or main output) of an aircraft engine.

Calibrated airspeed means the indicated airspeed of an aircraft, corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.

Canard means the forward wing of a canard configuration and may be a fixed, movable, or variable geometry surface, with or without control surfaces.

Canard configuration means a configuration in which the span of the forward wing is substantially less than that of the main wing.

Category : (1) As used with respect to the certification, ratings, privileges, and limitations of airmen, means a broad classification of aircraft. Examples include : airplane; rotorcraft; glider; and lighter-than-air; and

(2) As used with respect to the certification of aircraft, means a grouping of aircraft based upon intended use or operating limitations. Examples include : transport, normal, utility, acrobatic, limited, restricted, and provisional.

Category A , with respect to transport category rotorcraft, means multiengine rotorcraft designed with engine and system isolation features specified in Part 29 and utilizing scheduled takeoff and landing operations under a critical engine failure concept which assures adequate designated surface area and adequate performance capability for continued safe flight in the event of engine failure.

Category B , with respect to transport category rotorcraft, means single-engine or multiengine rotorcraft which do not fully meet all Category A standards. Category B rotorcraft have no guaranteed stay-up ability in the event of engine failure and unscheduled landing is assumed.

Category II operations , with respect to the operation of aircraft, means a straight-in ILS approach to the runway of an airport under a Category II ILS instrument approach procedure issued by the Administrator or other appropriate authority.

(1) *Takeoff and idling.* One hour of alternate 5-minute periods at rated takeoff power and at idling power. The developed powers at takeoff and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. During any one period the rotor speed and power may be controlled manually while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at rated takeoff power must be at the augmented power rating. In changing the power setting after each period, the power control lever must be moved in the manner prescribed in paragraph (c)(5) of this section.

(2) *Rated maximum continuous and takeoff power.* Thirty minutes at—
(i) Rated maximum continuous power during fifteen of the twenty-five 6-hour endurance test cycles; and
(ii) Rated takeoff power during ten of the twenty-five 6-hour endurance test cycles.

(3) *Rated continuous OEL power.* One hour at rated continuous OEL power.

(4) *Rated maximum continuous power.* One hour at rated maximum continuous power.

(5) *Incremental cruise power.* Two hours at the successive power lever positions corresponding with not less than 12 approximately equal speed and time increments between maximum continuous engine rotational speed and ground or minimum idle rotational speed. For engines operating at constant speed, power may be varied in place of speed. If there are significant peak vibrations anywhere between ground idle and maximum continuous conditions, the number of increments chosen must be changed to increase the amount of running conducted while being subjected to the peak vibrations up to not more than 50 percent of the total time spent in incremental running.

(6) *Acceleration and deceleration runs.* Thirty minutes of accelerations and decelerations, consisting of six cycles from idling power to rated takeoff power and maintained at the takeoff power lever position for 30 seconds and at the idling power lever position for approximately 4 1/2 minutes. In complying with this paragraph, the power control lever must be moved from one extreme position to the other in not more than 1 second, except that if different regimes of control operations are incorporated necessitating scheduling of the power control lever motion in going from one extreme position to the other, a longer period of time is acceptable, but not more than 2 seconds.

(7) *Starts.* One hundred starts, of which 25 starts must be preceded by at least a 2-hour engine shutdown. There must be at least 10 false engine starts, pausing for the applicant's specified minimum fuel drainage time, before attempting a normal start. There must be at least 10 normal restarts with not longer than 15 minutes since engine shutdown. The remaining starts may be made after completing the 150 hours of endurance testing.

(e) *Rotorcraft engines for which a 2 1/2-minute OEL power rating is desired.* For each rotorcraft engine for which a 2 1/2-minute OEL power rating is desired, the applicant must conduct the following series of tests :

(1) *Takeoff, 2 1/2-minute OEL, and idling.* One hour of alternate 5-minute periods at rated takeoff power and at idling power except that, during the third and

starts, pausing for the applicant's specified minimum fuel drainage time, before attempting a normal start. There must be at least 10 normal restarts with not longer than 15 minutes since engine shutdown. The remaining starts may be made after completing the 150 hours of endurance testing.

- (c) *Rotorcraft engines for which a 30-minute OEI power rating is desired.* For each rotorcraft engine for which a 30-minute OEI power rating is desired, the applicant must conduct the following series of tests :

- (1) *Takeoff and idling.* One hour of alternate 5-minute periods at rated takeoff power and at idling power. The developed powers at takeoff and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. During any one period, the rotor speed and power may be controlled manually while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at rated takeoff power must be at the augmented power rating. In changing the power setting after each period, the power control lever must be moved in the manner prescribed in paragraph (c)(5) of this section.
- (2) *Rated 30-minute OEI power.* Thirty minutes at rated 30-minute OEI power.
- (3) *Rated maximum continuous power.* Two hours at rated maximum continuous power.
- (4) *Incremental cruise power.* Two hours at the successive power lever positions corresponding with not less than 12 approximately equal speed and time increments between maximum continuous engine rotational speed and ground or minimum idle rotational speed. For engines operating at constant speed, power may be varied in place of speed. If there are significant peak vibrations anywhere between ground idle and maximum continuous conditions, the number of increments chosen must be changed to increase the amount of running conducted while being subjected to the peak vibrations up to not more than 50 percent of the total time spent in incremental running.
- (5) *Acceleration and deceleration runs.* Thirty minutes of accelerations and decelerations, consisting of six cycles from idling power to rated takeoff power and maintained at the takeoff power lever position for 30 seconds and at the idling power lever position for approximately 4 1/2 minutes. In complying with this paragraph, the power control lever must be moved from one extreme position to the other in not more than 1 second, except that if different regimes of control operations are incorporated necessitating scheduling of the power control lever motion in going from one extreme position to the other, a longer period of time is acceptable, but not more than 2 seconds.
- (6) *Starts.* One hundred starts, of which 25 starts must be preceded by at least a two-hour engine shutdown. There must be at least 10 false engine starts, pausing for the applicant's specified minimum fuel drainage time, before attempting a normal start. There must be at least 10 normal restarts with not longer than 15 minutes since engine shutdown. The remaining starts may be made after completing the 150 hours of endurance testing.
- (d) *Rotorcraft engines for which a continuous OEI rating is desired.* For each rotorcraft engine for which a continuous OEI power rating is desired, the applicant must conduct the following series of tests :

Category III operations , with respect to the operation of aircraft, means an ILS approach to, and landing on, the runway of an airport using a Category III ILS instrument approach procedure issued by the Administrator or other appropriate authority.

Category IIIa operations , an ILS approach and landing with no decision height (DH), or a DH below 100 feet (30 meters), and controlling runway visual range not less than 700 feet (200 meters).

Category IIIb operations , an ILS approach and landing with no DH, or with a DH below 50 feet (15 meters), and controlling runway visual range less than 700 feet (200 meters), but not less than 150 feet (30 meters).

Category IIIc operations , an ILS approach and landing with no DH and no runway visual range limitation.

Ceiling means the height above the earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as "broken", "overcast", or "obscuration", and not classified as "thin" or "partial".

Civil aircraft means aircraft other than public aircraft.

Class :

- (1) As used with respect to the certification, ratings, privileges, and limitations of airmen, means a classification of aircraft within a category having similar operating characteristics. Examples include : single engine ; multiengine ; land ; water ; gyroplane ; helicopter ; airship ; and free balloon ; and

- (2) As used with respect to the certification of aircraft, means a broad grouping of aircraft having similar characteristics of propulsion, flight, or landing. Examples include : airplane ; rotorcraft ; glider ; balloon ; landplane ; and sea-plane.

Clearway means :

- (1) For turbine engine powered airplanes certificated after August 29, 1959, an area beyond the runway, not less than 500 feet wide, centrally located about the extended centerline of the runway, and under the control of the airport authorities. The clearway is expressed in terms of a clearway plane, extending from the end of the runway with an upward slope not exceeding 1.25 percent, above which no object nor any terrain protrudes. However, threshold lights may protrude above the plane if their height above the end of the runway is 26 inches or less and if they are located to each side of the runway.

- (2) For turbine engine powered airplanes certificated after September 30, 1958, but before August 30, 1959, an area beyond the takeoff runway extending no less than 300 feet on either side of the extended centerline of the runway, at an elevation no higher than the elevation of the end of the runway, clear of all fixed obstacles, and under the control of the airport authorities.

Climbout speed , with respect to rotorcraft, means a referenced airspeed which results in a flight path clear of the height-velocity envelope during initial climbout.

Commercial operator means a person who, for compensation or hire, engages in the carriage by aircraft in air commerce of persons or property, other than as an air carrier or foreign air carrier or under the authority of Part 375 of this title. Where it is doubtful that an operation is for "compensation or hire", the test applied is whether the carriage by air is merely incidental to the person's other business or is, in itself, a major enterprise for profit.

Controlled airspace means an airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification. Note—Controlled airspace is a generic term that covers Class A, Class B, Class C, Class D, and Class E airspace.

Controlled Firing Area . A controlled firing area is established to contain activities, which if not conducted in a controlled environment, would be hazardous to non-participating aircraft.

Crewmember means a person assigned to perform duty in an aircraft during flight time.

Critical altitude means the maximum altitude at which, in standard atmosphere, it is possible to maintain, at a specified rotational speed, a specified power or a specified manifold pressure. Unless otherwise stated, the critical altitude is the maximum altitude at which it is possible to maintain, at the maximum continuous rotational speed, one of the following :

- (1) The maximum continuous power, in the case of engines for which this power rating is the same at sea level and at the rated altitude.
- (2) The maximum continuous rated manifold pressure, in the case of engines, the maximum continuous power of which is governed by a constant manifold pressure.

Critical engine means the engine whose failure would most adversely affect the performance or handling qualities of an aircraft.

Decision height , with respect to the operation of aircraft, means the height at which a decision must be made, during an ILS or PAR instrument approach, to either continue the approach or to execute a missed approach.

Equivalent airspeed means the calibrated airspeed of an aircraft corrected for adiabatic compressible flow for the particular altitude. Equivalent airspeed is equal to calibrated airspeed in standard atmosphere at sea level.

Extended over-water operation means-

- (1) With respect to aircraft other than helicopters, an operation over water at a horizontal distance of more than 50 nautical miles from the nearest shoreline; and
- (2) With respect to helicopters, an operation over water at a horizontal distance of more than 50 nautical miles from the nearest shoreline and more than 50 nautical miles from an off-shore heliport structure.

External load means a load that is carried, or extends, outside of the aircraft fuselage.

External-load attaching means the structural components used to attach an external load to an aircraft, including external-load containers, the backup structure at the attachment points, and any quick-release device used to jettison the external load.

[Final takeoff speed means the speed of the airplane that exists at the end of the takeoff path in the en route configuration with one engine inoperative.]

Fireproof –

- (1) With respect to materials and parts used to confine fire in a designated fire zone, means the capacity to withstand at least as well as steel in dimensions appropriate for the purpose for which they are used, the heat produced when there is a severe fire of extended duration in that zone; and

- (v) During the runs at thrust settings for maximum continuous thrust and percentages thereof, the engine must be operated with the inlet air distortion at the limit for those thrust settings.

(b) *Engines other than certain rotorcraft engines.* For each engine except a rotorcraft engine for which a rating is desired under paragraph (c), (d), or (e) of this section, the applicant must conduct the following runs :

- (1) *Takeoff and idling.* One hour of alternate five-minute periods at rated takeoff power and thrust and at idling power and thrust. The developed powers and thrusts at takeoff and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. The applicant may, during any one period, manually control the rotor speed, power, and thrust while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at takeoff must be at the augmented rating. For engines with augmented takeoff power ratings that do not materially increase operating severity, the amount of running conducted at the augmented rating is determined by the Administrator. In changing the power setting after each period, the power-control lever must be moved in the manner prescribed in paragraph (b)(5) of this section.

(2) *Rated maximum continuous and takeoff power and thrust.* Thirty minutes at—

- (i) Rated maximum continuous power and thrust during fifteen of the twenty-five 6-hour endurance test cycles; and
- (ii) Rated takeoff power and thrust during ten of the twenty-five 6-hour endurance test cycles.

(3) *Rated maximum continuous power and thrust.* One hour and 30 minutes at rated maximum continuous power and thrust.

(4) *Incremental cruise power and thrust.* Two hours and 30 minutes at the successive power lever positions corresponding to at least 15 approximately equal speed and time increments between maximum continuous engine rotational speed and ground or minimum idle rotational speed. For engines operating at constant speed, the thrust and power may be varied in place of speed. If there is significant peak vibration anywhere between ground idle and maximum continuous conditions, the number of increments chosen may be changed to increase the amount of running made while subject to the peak vibrations up to not more than 50 percent of the total time spent in incremental running.

(5) *Acceleration and deceleration runs.* 30 minutes of accelerations and decelerations, consisting of six cycles from idling power and thrust to rated takeoff power and thrust and maintained at the takeoff power lever position for 30 seconds and at the idling power lever position for approximately four and one-half minutes. In complying with this paragraph, the power-control lever must be moved from one extreme position to the other in not more than one second, except that, if different regimes of control operations are incorporated necessitating scheduling of the power-control lever motion in going from one extreme position to the other, a longer period of time is acceptable, but not more than two seconds.

(6) *Starts.* One hundred starts must be made, of which 25 starts must be preceded by at least a two-hour engine shutdown. There must be at least 10 false engine

- (3) Except as provided in paragraph (a)(5) of this section, power or thrust, gas temperature, rotor shaft rotational speed, and, if limited, temperature of external surfaces of the engine must be at least 100 percent of the value associated with the particular engine operation being tested. More than one test may be run if all parameters cannot be held at the 100 percent level simultaneously.
- (4) The runs must be made using fuel, lubricants and hydraulic fluid which conform to the specifications specified in complying with Sec. 33.7(c).
- (5) Maximum air bleed for engine and aircraft services must be used during at least one-fifth of the runs. However, for these runs, the power or thrust or the rotor shaft rotational speed may be less than 100 percent of the value associated with the particular operation being tested if the Administrator finds that the validity of the endurance test is not compromised.
- (6) Each accessory drive and mounting attachment must be loaded. The load imposed by each accessory used only for aircraft service must be the limit load specified by the applicant for the engine drive and attachment point during rated maximum continuous power or thrust and higher output. The endurance test of any accessory drive and mounting attachment under load may be accomplished on a separate rig if the validity of the test is confirmed by an approved analysis.
- (7) During the runs at any rated power or thrust the gas temperature and the oil inlet temperature must be maintained at the limiting temperature except where the test periods are not longer than 5 minutes and do not allow stabilization. At least one run must be made with fuel, oil, and hydraulic fluid at the minimum pressure limit and at least one run must be made with fuel, oil, and hydraulic fluid at the maximum pressure limit with fluid temperature reduced as necessary to allow maximum pressure to be attained.
- (8) If the number of occurrences of either transient rotor shaft overspeed or transient gas overtemperature is limited, that number of the accelerations required by paragraph (b) through (g) of this section must be made at the limiting overspeed or overtemperature. If the number of occurrences is not limited, half the required accelerations must be made at the limiting overspeed or overtemperature.]
- (9) For each engine type certificated for use on supersonic aircraft the following additional test requirements apply :
- (i) To change the thrust setting, the power control lever must be moved from the initial position to the final position in not more than one second except for movements into the fuel burning thrust augmentor augmentation position if additional time to confirm ignition is necessary.
- (ii) During the runs at any rated augmented thrust the hydraulic fluid temperature must be maintained at the limiting temperature except where the test periods are not long enough to allow stabilization.
- (iii) During the simulated supersonic runs the fuel temperature and induction air temperature may not be less than the limiting temperature.
- (iv) The endurance test must be conducted with the fuel burning thrust augmentor installed, with the primary and secondary exhaust nozzles installed, and with the variable area exhaust nozzles operated during each run according to the methods specified in complying with Sec. 33.5(b).

- (2) With respect to other materials and parts, means the capacity to withstand the heat associated with fire at least as well as steel in dimensions appropriate for the purpose for which they are used.

Fire resistant— (1) With respect to sheet or structural members means the capacity to withstand the heat associated with fire at least as well as aluminum alloy in dimensions appropriate for the purpose for which they are used ; and

- (2) With respect to fluid-carrying lines, fluid system parts, wiring, air ducts, fittings, and powerplant controls, means the capacity to perform the intended functions under the heat and other conditions likely to occur when there is a fire at the place concerned.

Flame resistant means not susceptible to combustion to the point of propagating a flame, beyond safe limits, after the ignition source is removed.

Flammable , with respect to a fluid or gas, means susceptible to igniting readily or to exploding.

Flap extended speed means the highest speed permissible with wing flaps in a prescribed extended position.

Flash resistant means not susceptible to burning violently when ignited.

Flightcrew member means a pilot, flight engineer, or flight navigator assigned to duty in an aircraft during flight time.

Flight level means a level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet. For example, flight level 250 represents a barometric altimeter indication of 25,000 feet ; flight level 255, an indication of 25,500 feet.

Flight plan means specified information, relating to the intended flight of an aircraft, that is filed orally or in writing with air traffic control.

Flight time means :

- (1) Pilot time that commences when an aircraft moves under its own power for the purpose of flight and ends when the aircraft comes to rest after landing ; or
- (2) For a glider without self-launch capability, pilot time that commences when the glider is towed for the purpose of flight and ends when the glider comes to rest after landing.

Flight visibility means the average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

Foreign air carrier means any person other than a citizen of the United States, who undertakes directly, by lease or other arrangement, to engage in air transportation.

Foreign air commerce means the carriage by aircraft of persons or property for compensation or hire, or the carriage of mail by aircraft, or the operation or navigation of aircraft in the conduct or furtherance of a business or vocation, in commerce between a place in the United States and any place outside thereof ; whether such commerce moves wholly by aircraft or partly by aircraft and partly by other forms of transportation.

Foreign air transportation means the carriage by aircraft of persons or property as a common carrier for compensation or hire, or the carriage of mail by aircraft, in

commerce between a place in the United States and any place outside of the United States, whether that commerce moves wholly by aircraft or partly by aircraft and partly by other forms of transportation.

Forward wing means a forward lifting surface of a canard configuration or tandem-wing configuration airplane. The surface may be a fixed, movable, or variable geometry surface, with or without control surfaces.

Glider means a heavier-than-air aircraft, that is supported in flight by the dynamic reaction of the air against its lifting surfaces and whose free flight does not depend principally on an engine.

Go-around power or thrust setting means the maximum allowable in-flight power or thrust setting identified in the performance data.

Ground visibility means prevailing horizontal visibility near the earth's surface as reported by the United States National Weather Service or an accredited observer.

Gyrodyne means a rotorcraft whose rotors are normally engine-driven for takeoff, hovering, and landing, and for forward flight through part of its speed range, and whose means of propulsion, consisting usually of conventional propellers, is independent of the rotor system.

Gyroplane means a rotorcraft whose rotors are not engine-driven, except for initial starting, but are made to rotate by action of the air when the rotorcraft is moving; and whose means of propulsion, consisting usually of conventional propellers, is independent of the rotor system.

Helicopter means a rotorcraft that, for its horizontal motion, depends principally on its engine-driven rotors.

Heliport means an area of land, water, or structure used or intended to be used for the landing and takeoff of helicopters.

Idle thrust means the jet thrust obtained with the engine power control level set at the stop for the least thrust position at which it can be placed.

IFR conditions means weather conditions below the minimum for flight under visual flight rules.

IFR over-the-top , with respect to the operation of aircraft, means the operation of an aircraft over-the-top on an IFR flight plan when cleared by air traffic control to maintain "VFR conditions" or "VFR conditions on top".

Indicated airspeed means the speed of an aircraft as shown on its pilot static airspeed indicator calibrated to reflect standard atmosphere adiabatic compressible flow at sea level uncorrected for airspeed system errors.

Instrument means a device using an internal mechanism to show visually or aurally the attitude, altitude, or operation of an aircraft or aircraft part. It includes electronic devices for automatically controlling an aircraft in flight.

Interstate air commerce means the carriage by aircraft of persons or property for compensation or hire, or the carriage of mail by aircraft, or the operation or navigation of aircraft in the conduct or furtherance of a business or vocation, in commerce between a place in any State of the United States, or the District of Columbia, and a place in any other State of the United States, or the District of Columbia; or between places in the same State of the United States through the airspace over any place outside thereof; or between places in the same territory or possession of the United States, or the District of Columbia.

vane passages, fuel nozzle blockage, incorrectly schedule compressor variables, etc.) shall be evaluated by test or analysis, or by reference to previous experience and shall be shown not to create a hazardous condition.

- (f) Compliance with this section shall be substantiated for each specific installation configuration that can affect the vibration characteristics of the engine. If these vibration effects cannot be fully investigated during engine certification, the methods by which they can be evaluated and methods by which compliance can be shown shall be substantiated and defined in the installation instructions required by Sec. 33.5.]

Amdt. 33-17, Eff. 7/5/96

FAR 33.85 : Calibration tests.

- (a) Each engine must be subjected to those calibration tests necessary to establish its power characteristics and the conditions for the endurance test specified Sec. 33.87. The results of the power characteristics calibration tests form the basis for establishing the characteristics of the engine over its entire operating range of speeds, pressures, temperatures, and altitudes. Power ratings are based upon standard atmospheric conditions with no airbleed for aircraft services and with only those accessories installed which are essential for engine functioning.

- (b) A power check at sea level conditions must be accomplished on the endurance test engine after the endurance test and any change in power characteristics which occurs during the endurance test must be determined. Measurements taken during the final portion of the endurance test may be used in showing compliance with the requirement of this paragraph.

- (c) [In showing compliance with this section, each condition must stabilize before measurements are taken, except as permitted by paragraph (d) of this section.

- (d) In the case of engines having 30-second OEI, and 2-minute OEI ratings, measurements taken during the applicable endurance test prescribed in Sec. 33.87(f)(1) through (8) may be used in showing compliance with the requirements of this section for these OEI ratings.]

Amdt. 33-18, Eff. 8/19/96

FAR 33.87 : Endurance test.

- (a) *General.* [Each engine must be subjected to an endurance test that includes a total of at least 150 hours of operation and, depending upon the type and contemplated use of the engine, consists of one of the series of runs specified in paragraphs (b) through (g) of this section, as applicable. For engines tested under paragraphs (b), (c), (d), (e) or (g) of this section, the prescribed 6-hour test sequence must be conducted 25 times to complete the required 150 hours of operation. Engines for which the 30-second OEI and 2-minute OEI ratings are desired must be further tested under paragraph (f) of this section. The following test requirements apply:]
- (1) The runs must be made in the order found appropriate by the Administrator for the particular engine being tested.
- (2) Any automatic engine control that is part of the engine must control the engine during the endurance test except for operations where automatic control is normally overridden by manual control or where manual control is otherwise specified for a particular test run.

FAR 33.81 : Applicability.

[This subpart prescribes the block tests and inspections for turbine engines.]
Amdt. 33-6, Eff. 10/31/74

FAR 33.82 : [General.]

[Before each endurance test required by this subpart, the adjustment setting and functioning characteristic of each component having an adjustment setting and a functioning characteristic that can be established independent of installation on the engine must be established and recorded.]
Amdt. 33-6, Eff. 10/31/74

FAR 33.83 : Vibration test.

- (a) [Each engine must undergo vibration surveys to establish that the vibration characteristics of those components that may be subject to mechanically or aerodynamically induced vibratory excitations are acceptable throughout the declared flight envelope. The engine surveys shall be based upon an appropriate combination of experience, analysis, and component test and shall address, as a minimum, blades, vanes, rotor discs, spacers, and rotor shafts.
- (b) The surveys shall cover the ranges of power or thrust, and both the physical and corrected rotational speeds for each rotor system, corresponding to operations throughout the range of ambient conditions in the declared flight envelope, from the minimum rotational speed up to 103 percent of the maximum physical and corrected rotational speed permitted for rating periods of two minutes or longer, and up to 100 percent of all other permitted physical and corrected rotational speeds, including those that are overspeeds. If there is any indication of a stress peak arising at the highest of those required physical or corrected rotational speeds, the surveys shall be extended sufficiently to reveal the maximum stress values present, except that the extension need not cover more than a further 2 percentage points increase beyond those speeds.
- (c) Evaluations shall be made of the following :
 - (1) The effects on vibration characteristics of operating with scheduled changes (including tolerances) to variable vane angles, compressor bleeds, accessory loading, the most adverse inlet air flow distortion pattern declared by the manufacturer, and the most adverse conditions in the exhaust duct(s) ; and
 - (2) The aerodynamic and aeromechanical factors which might induce or influence flutter in those systems susceptible to that form of vibration.
- (d) Except as provided by paragraph (e) of this section, the vibration stresses associated with the vibration characteristics determined under this section, when combined with the appropriate steady stresses, must be less than the endurance limits of the materials concerned, after making due allowances for operating conditions for the permitted variations in properties of the materials. The suitability of these stress margins must be justified for each part evaluated. If it is determined that certain operating conditions, or ranges, need to be limited, operating and installation limitations shall be established.
- (e) The effects on vibration characteristics of excitation forces caused by fault conditions (such as, but not limited to, out-of-balance, local blockage or enlargement of stator

Interstate air transportation means the carriage by aircraft of persons or property as a common carrier for compensation or hire, or the carriage of mail by aircraft in commerce :

- (1) Between a place in a State or the District of Columbia and another place in another State or the District of Columbia ;
- (2) Between places in the same State through the airspace over any place outside that State ; or
- (3) Between places in the same possession of the United States ; Whether that commerce moves wholly by aircraft or partly by aircraft and partly by other forms of transportation.

Intrastate air transportation means the carriage of persons or property as a common carrier for compensation or hire, by turbojet-powered aircraft capable of carrying thirty or more persons, wholly within the same State of the United States.

Kite means a framework, covered with paper, cloth, metal, or other material, intended to be flown at the end of a rope or cable, and having as its only support the force of the wind moving past its surfaces.

Landing gear extended speed means the maximum speed at which an aircraft can be safely flown with the landing gear extended.

Landing gear operating speed means the maximum speed at which the landing gear can be safely extended or retracted.

Large aircraft means aircraft of more than 12,500 pounds, maximum certificated takeoff weight.

Lighter-than-air aircraft means aircraft that can rise and remain suspended by using contained gas weighing less than the air that is displaced by the gas.

Load factor means the ratio of a specified load to the total weight of the aircraft. The specified load is expressed in terms of any of the following : aerodynamic forces, inertia forces, or ground or water reactions.

Long-range communication system (LRCS) . A system that uses satellite relay, data link, high frequency, or another approved communication system which extends beyond line of sight.

Long-range navigation system (LRNS) . An electronic navigation unit that is approved for use under instrument flight rules as a primary means of navigation, and has at least one source of navigational input, such as inertial navigation system, global positioning system, Omega/very low frequency, or Loran C.

Mach number means the ratio of true airspeed to the speed of sound.

Main rotor means the rotor that supplies the principal lift to a rotorcraft.

Maintenance means inspection, overhaul, repair, preservation, and the replacement of parts, but excludes preventive maintenance.

Major alteration means an alteration not listed in the aircraft, aircraft engine, or propeller specifications—

- (1) That might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness ; or
- (2) That is not done according to accepted practices or cannot be done by elementary operations.

Major repair means a repair :

- (1) That, if improperly done, might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness ; or
- (2) That is not done according to accepted practices or cannot be done by elementary operations.

Manifold pressure means absolute pressure as measured at the appropriate point in the induction system and usually expressed in inches of mercury.

Maximum speed for stability characteristics , V_{FC}/M_{FC} means a speed that may not be less than a speed midway between maximum operating limit speed (V_{MO}/M_{MO}) and demonstrated flight diving speed (V_{DF}/M_{DF}), except that, for altitudes where the Mach number is the limiting factor, M_{FC} need not exceed the Mach number at which effective speed warning occurs.

Medical certificate means acceptable evidence of physical fitness on a form prescribed by the Administrator.

Military operations area . A military operations area (MOA) is airspace established outside Class A airspace to separate or segregate certain nonhazardous military activities from IFR Traffic and to identify for VFR traffic where these activities are conducted.

Minimum descent altitude means the lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure, where no electronic glide slope is provided.

Minor alteration means an alteration other than a major alteration.

Minor repair means a repair other than a major repair.

Navigable airspace means airspace at and above the minimum flight altitudes prescribed by or under this chapter, including airspace needed for safe takeoff and landing.

Night means the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.

Nonprecision approach procedure means a standard instrument approach procedure in which no electronic glide slope is provided.

Operate , with respect to aircraft, means use, cause to use or authorize to use aircraft, for the purpose (except as provided in Sec. 91.13 of this chapter) of air navigation including the piloting of aircraft, with or without the right of legal control (as owner, lessee, or otherwise).

Operational control , with respect to a flight, means the exercise of authority over initiating, conducting or terminating a flight.

Overs eas air commerce means the carriage by aircraft of persons or property for compensation or hire, or the carriage of mail by aircraft, or the operation or navigation of aircraft in the conduct or furtherance of a business or vocation, in commerce between a place in any State of the United States, or the District of Columbia, and any place in a territory or possession of the United States ; or between a place in a territory or possession of the United States, and a place in any other territory or possession of the United States.

Chapitre 93

Subpart F : Block Tests ;

Turbine Aircraft Engines

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- (2) Continuation of the rain ingestion during subsequent rapid deceleration to minimum idle, then
- (3) Continuation of the rain ingestion during three minutes at minimum idle power to be certified for flight operation, then
- (4) Continuation of the rain ingestion during subsequent rapid acceleration to takeoff power.
- (c) Engines for supersonic airplanes. In addition to complying with paragraphs (a)(1) and (a)(2) of this section, a separate test for supersonic airplane engines only, shall be conducted with three hailstones ingested at supersonic cruise velocity. These hailstones shall be aimed at the engine's critical face area, and their ingestion must not cause unacceptable mechanical damage or unacceptable power or thrust loss after the ingestion or require the engine to be shut down. The size of these hailstones shall be determined from the linear variation in diameter from 1-inch (25 millimeters) at 35,000 feet (10,500 meters) to 1/4-inch (6 millimeters) at 60,000 feet (18,000 meters) using the diameter corresponding to the lowest expected supersonic cruise altitude. Alternatively, three larger hailstones may be ingested at subsonic velocities such that the kinetic energy of these larger hailstones is equivalent to the applicable supersonic ingestion conditions.
- (d) For an engine that incorporates or requires the use of a protection device, demonstration of the rain and hail ingestion capabilities of the engine, as required in paragraphs (a), (b), and (c) of this section, may be waived wholly or in part by the Administrator if the applicant shows that :
 - (1) The subject rain and hail constituents are of a size that will not pass through the protection device ;
 - (2) The protection device will withstand the impact of the subject rain and hail constituents ; and
 - (3) The subject of rain and hail constituents, stopped by the protection device, will not obstruct the flow of induction air into the engine, resulting in damage, power or thrust loss, or other adverse engine anomalies in excess of what would be accepted in paragraphs (a), (b), and (c) of this section.]

Amdt. 33-19, Eff. 4/30/1998

FAR 33.79 : Fuel burning thrust augmentor.

[Each fuel burning thrust augmentor, including the nozzle, must—

- (a) Provide cutoff of the fuel burning thrust augmentor ;
- (b) Permit on-off cycling ;
- (c) Be controllable within the intended range of operation ;
- (d) Upon a failure or malfunction of augmentor combustion, not cause the engine to lose thrust other than that provided by the augmentor ; and
- (e) Have controls that function compatibly with the other engine controls and automatically shut off augmentor fuel flow if the engine rotor speed drops below the minimum rotational speed at which the augmentor is intended to function.]

Amdt. 33-6, Eff. 10/31/74

Overseas air transportation means the carriage by aircraft of persons or property as a common carrier for compensation or hire, or the carriage of mail by aircraft, in commerce :

- (1) Between a place in a State or the District of Columbia and a place in a possession of the United States ; or
- (2) Between a place in a possession of the United States and a place in another possession of the United States ; whether that commerce moves wholly by aircraft or partly by aircraft and partly by other forms of transportation.

Over-the-top means above the layer of clouds or other obscuring phenomena forming the ceiling.

Parachute means a device used or intended to be used to retard the fall of a body or object through the air.

Person means an individual, firm, partnership, corporation, company, association, joint-stock association, or governmental entity. It includes a trustee, receiver, assignee, or similar representative of any of them.

Pilotage means navigation by visual reference to landmarks.

Pilot in command means the person who :

- (1) Has final authority and responsibility for the operation and safety of the flight ;
- (2) Has been designated as pilot in command before or during the flight ; and
- (3) Holds the appropriate category, class, and type rating, if appropriate, for the conduct of the flight.

Pitch setting means the propeller blade setting as determined by the blade angle measured in a manner, and at a radius, specified by the instruction manual for the propeller.

Positive control means control of all air traffic, within designated airspace, by air traffic control.

Powered-lift means a heavier-than-air aircraft capable of vertical takeoff, vertical landing, and low speed flight that depends principally on engine-driven lift devices or engine thrust for lift during these flight regimes and on nonrotating airfoil(s) for lift during horizontal flight.

Precision approach procedure means a standard instrument approach procedure in which an electronic glide slope is provided, such as ILS and PAR.

Preventive maintenance means simple or minor preservation operations and the replacement of small standard parts not involving complex assembly operations.

Prohibited area . A prohibited area is airspace designated under part 73 within which no person may operate an aircraft without the permission of the using agency.

Propeller means a device for propelling an aircraft that has blades on an engine-driven shaft and that, when rotated, produces by its action on the air, a thrust approximately perpendicular to its plane of rotation. It includes control components normally supplied by its manufacturer, but does not include main and auxiliary rotors or rotating airfoils of engines.

Public aircraft means an aircraft used only for the United States Government, or owned and operated (except for commercial purposes), or exclusively leased for at least 90 continuous days, by a government (except the United States Government), including a State, the District of Columbia, or a territory or possession of the

United States, or political subdivision of that government; but does not include a government-owned aircraft transporting property for commercial purposes, or transporting passengers other than transporting (for other than commercial purposes) crewmembers or other persons aboard the aircraft whose presence is required to perform, or is associated with the performance of, a governmental function such as firefighting, search and rescue, law enforcement, aeronautical research, or biological or geological resource management; or transporting (for other than commercial purposes) persons aboard the aircraft if the aircraft is operated by the Armed Forces or an intelligence agency of the United States. An aircraft described in the preceding sentence shall, notwithstanding any limitation relating to use of the aircraft for commercial purposes, be considered to be a public aircraft for the purposes of this Chapter without regard to whether the aircraft is operated by a unit of government on behalf of another unit of government, pursuant to a cost reimbursement agreement between such units of government, if the unit of government on whose behalf the operation is conducted certifies to the Administrator of the Federal Aviation Administration that the operation was necessary to respond to a significant and imminent threat to life or property (including natural resources) and that no service by a private operator was reasonably available to meet the threat.

Rated 30-second OEI power , with respect to rotorcraft turbine engines, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine under part 33 of this chapter, for continued one-flight operation after the failure of one engine in multiengine rotorcraft, limited to three periods of use no longer than 30 seconds each in any one flight, and followed by mandatory inspection and prescribed maintenance action.

Rated 2-minute OEI power , with respect to rotorcraft turbine engines, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine under part 33 of this chapter, for continued one-flight operation after the failure of one engine in multiengine rotorcraft, limited to three periods of use no longer than 2 minutes each in any one flight, and followed by mandatory inspection and prescribed maintenance action.

Rated continuous OEI power , with respect to rotorcraft turbine engines, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine under Part 33 of this chapter, and limited in use to the time required to complete the flight after the failure of one engine of a multiengine rotorcraft.

Rated maximum continuous augmented thrust , with respect to turbojet engine type certification, means the approved jet thrust that is developed statically or in flight, in standard atmosphere at a specified altitude, with fluid injection or with the burning of fuel in a separate combustion chamber, within the engine operating limitations established under Part 33 of this chapter, and approved for unrestricted periods of use.

Rated maximum continuous power , with respect to reciprocating, turbopropeller, and turboshaft engines, means the approved brake horsepower that is developed statically or in flight, in standard atmosphere at a specified altitude, within the engine operating limitations established under Part 33, and approved for unrestricted periods of use.

- (2) The ingestion velocity will simulate ice being sucked into the engine inlet.
 - (3) Engine operation will be Maximum Cruise power or thrust.
 - (4) The ingestion will simulate a continuous maximum icing encounter at 25 degrees Fahrenheit.]
- Amtd. 33-20, EFF. 12/13/2000

FAR 33.78 : [Rain and hail ingestion.]

- (a) [All engines.
 - (1) The ingestion of large hailstones (0.8 to 0.9 specific gravity) at the maximum true air speed, up to 15,000 feet (4,500 meters), associated with a representative aircraft operating in rough air, with the engine at maximum continuous power, may not cause unacceptable mechanical damage or unacceptable power or thrust loss after the ingestion, or require the engine to be shut down. One-half the number of hailstones shall be aimed randomly over the inlet face area and the other half aimed at the critical inlet face area. The hailstones shall be ingested in a rapid sequence to simulate a hailstone encounter and the number and size of the hailstones shall be determined as follows :
 - (i) One 1-inch (25 millimeters) diameter hailstone for engines with inlet areas of not more than 100 square inches (0.0645 square meters).
 - (ii) One 1-inch (25 millimeters) diameter and one 2-inch (50 millimeters) diameter hailstone for each 150 square inches (0.0908 square meters) of inlet area, or fraction thereof, for engines with inlet areas of more than 100 square inches (0.0645 square meters).
 - (2) In addition to complying with paragraph (a)(1) of this section and except as provided in paragraph (b) of this section, it must be shown that each engine is capable of acceptable operation throughout its specified operating envelope when subjected to sudden encounters with the certification standard concentrations of rain and hail, as defined in Appendix B to this part. Acceptable engine operation precludes flameout, run down, continued or non-recoverable surge or stall, or loss of acceleration and deceleration capability, during any three minute continuous period in rain and during any 30 second continuous period in hail. It must also be shown after the ingestion that there is no unacceptable mechanical damage, unacceptable power or thrust loss, or other adverse engine anomalies.
- (b) Engines for rotorcraft. As an alternative to the requirements specified in paragraph (a)(2) of this section, for rotorcraft turbine engines only, it must be shown that each engine is capable of acceptable operation during and after the ingestion of rain with an overall ratio of water droplet flow to airflow, by weight, with a uniform distribution at the inlet plane, of at least four percent. Acceptable engine operation precludes flameout, run down, continued or non-recoverable surge or stall, or loss of acceleration and deceleration capability. It must also be shown after the ingestion that there is no unacceptable mechanical damage, unacceptable power loss, or other adverse engine anomalies. The rain ingestion must occur under the following static ground level conditions :
 - (1) A normal stabilization period at take-off power without rain ingestion, followed immediately by the suddenly commencing ingestion of rain for three minutes at takeoff power, then

Engine Inlet Throat Area (A) – Square-meters (square-inches)	Bird quantity	Bird weight kg. (lb.)
0.05 (77.5) i A	none	
.05 (77.5) ≤ A i 0.10 (155)	1	0.35 (0.77)
0.10 (155) ≤ A i 0.20 (310)	1	0.45 (0.99)
0.20 (310) ≤ A i 0.40 (620)	2	0.45 (0.99)
0.40 (620) ≤ A i 0.60 (930)	2	0.70 (1.54)
0.60 (930) ≤ A i 1.00 (1,550)	3	0.70 (1.54)
1.00 (1,550) ≤ A i 1.35 (2,092)	4	0.70 (1.54)
1.35 (2,092) ≤ A i 1.70 (2,635)	1	1.15 (2.53)
	plus 3	0.70 (1.54)
1.70 (2,635) ≤ A i 2.10 (3,255)	1	1.15 (2.53)
	plus 4	0.70 (1.54)
2.10 (3,255) ≤ A i 2.50 (3,875)	1	1.15 (2.53)
	plus 5	0.70 (1.54)
2.50 (3,875) ≤ A i 3.90 (6,045)	1	1.15 (2.53)
	plus 6	0.70 (1.54)
3.90 (6,045) ≤ A i 4.50 (6,975)	3	1.15 (2.53)
4.50 (6,975) ≤ A	4	1.15 (2.53)

TAB. 92.2 – (Table of §33.76) : Medium Flocking Bird Weight and Quantity Requirements

Engine Area (A) – square-meters (square-inches)	Inlet	Throat	Bird quantity	Bird weight kg.(lb.)
1.35 (2,092) i A	None			
1.35 (2,092) i A i 2.90 (4,495)	A	2.90	1	1.15 (2.53)
2.90 (4,495) i A i 3.90 (6,045).	A	3.90	2	1.15 (2.53)
3.90 (6,045) i A			1	1.15 (2.53)
			plus 6	0.70 (1.54)

TAB. 92.3 – (Table of §33.76) : Additional Integrity Assessment

- (1) Such foreign objects are of a size that will not pass through the protective device;
- (2) The protective device will withstand the impact of the foreign objects and
- (3) The foreign object, or objects, stopped by the protective device will not obstruct the flow of induction air into the engine with a resultant sustained reduction in power or thrust greater than those values required by paragraph (c) of this section.
- (e) Compliance with paragraph (c) of this section must be shown by engine test under the following ingestion conditions :
- (1) Ice quantity will be the maximum accumulation on a typical inlet cowl and engine face resulting from a 2-minute delay in actuating the anti-icing system ; or a slab of ice which is comparable in weight or thickness for that size engine.

Rated maximum continuous thrust , with respect to turbojet engine type certification, means the approved jet thrust that is developed statically or in flight, in standard atmosphere at a specified altitude, without fluid injection and without the burning of fuel in a separate combustion chamber, within the engine operating limitations established under Part 33 of this chapter, and approved for unrestricted periods of use.

Rated takeoff augmented thrust , with respect to turbojet engine type certification, means the approved jet thrust that is developed statically under standard sea level conditions, with fluid injection or with the burning of fuel in a separate combustion chamber, within the engine operating limitations established under Part 33 of this chapter, and limited in use to periods of not over 5 minutes for takeoff operation.

Rated takeoff power , with respect to reciprocating, turbopropeller, and turboshaft engine type certification, means the approved brake horsepower that is developed statically under standard sea level conditions, within the engine operating limitations established under Part 33, and limited in use to periods of not over 5 minutes for takeoff operation.

Rated takeoff thrust , with respect to turbojet engine type certification, means the approved jet thrust that is developed statically under standard sea level conditions, without fluid injection and without the burning of fuel in a separate combustion chamber, within the engine operating limitations established under Part 33 of this chapter, and limited in use to periods of not over 5 minutes for takeoff operation.

Rated 30-minute OEI power , with respect to rotorcraft turbine engines, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine under Part 33 of this chapter, and limited in use to a period of not more than 30 minutes after the failure of one engine of a multiengine rotorcraft.

Rated 2½ -minute OEI power , with respect to rotorcraft turbine engines, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine under Part 33 of this chapter, and limited in use to a period of not more than 2½ minutes after the failure of one engine of a multiengine rotorcraft.

Rating means a statement that, as a part of a certificate, sets forth special conditions, privileges, or limitations.

Reference landing speed [means the speed of the airplane, in a specified landing configuration, at the point where it descends through the 50 foot height in the determination of the landing distance.]

Reporting point means a geographical location in relation to which the position of an aircraft is reported.

Restricted area . A restricted area is airspace designated under Part 73 within which the flight of aircraft, while not wholly prohibited, is subject to restriction.

RNAV way point (W/P) means a predetermined geographical position used for route or instrument approach definition or progress reporting purposes that is defined relative to a VORTAC station position.

Rocket means an aircraft propelled by ejected expanding gases generated in the engine from self-contained propellants and not dependent on the intake of outside substances. It includes any part which becomes separated during the operation.

Rotorcraft means a heavier-than-air aircraft that depends principally for its support in flight on the lift generated by one or more rotors.

Rotorcraft-load combination means the combination of a rotorcraft and an external-load, including the external-load attaching means. Rotorcraft-load combinations are designated as Class A, Class B, Class C, and Class D, as follows :

- (1) *Class A rotorcraft-load combination* means one in which the external load cannot move freely, cannot be jettisoned, and does not extend below the landing gear.
- (2) *Class B rotorcraft-load combination* means one in which the external load is jettisonable and is lifted free of land or water during the rotorcraft operation.
- (3) *Class C rotorcraft-load combination* means one in which the external load is jettisonable and remains in contact with land or water during the rotorcraft operation.
- (4) *Class D rotorcraft-load combination* means one in which the external-load is other than a Class A, B, or C and has been specifically approved by the Administrator for that operation.

Route segment means a part of a route. Each end of that part is identified by :

- (1) A continental or insular geographical location ; or
- (2) A point at which a definite radio fix can be established.

Sea level engine means a reciprocating aircraft engine having a rated takeoff power that is producible only at sea level.

Second in command means a pilot who is designated to be second in command of an aircraft during flight time.

Show , unless the context otherwise requires, means to show to the satisfaction of the Administrator.

Small aircraft means aircraft of 12,500 pounds or less, maximum certificated takeoff weight.

Special VFR conditions mean meteorological conditions that are less than those required for basic VFR flight in controlled airspace and in which some aircraft are permitted flight under visual flight rules.

Special VFR operations means aircraft operating in accordance with clearances within controlled airspace in meteorological conditions less than the basic VFR weather minima. Such operations must be requested by the pilot and approved by ATC.

Standard atmosphere means the atmosphere defined in U.S. Standard Atmosphere, 1962 (Geopotential altitude tables).

Stopway means an area beyond the takeoff runway, no less wide than the runway and centered upon the extended centerline of the runway, able to support the airplane during an aborted takeoff, without causing structural damage to the airplane, and designated by the airport authorities for use in decelerating the airplane during an aborted takeoff.

Takeoff power :

- (1) With respect to reciprocating engines, means the brake horsepower that is developed under standard sea level conditions, and under the maximum conditions of crankshaft rotational speed and engine manifold pressure approved for the normal takeoff, and limited in continuous use to the period of time shown in the approved engine specification; and

- (iii) The conditions defined in paragraph (b)(3) of this section.
- (iv) Unacceptable deterioration of engine handling characteristics.

(7) Except for rotorcraft engines, the following test schedule shall be used :

- (i) Ingestion so as to simulate a flock encounter, with approximately 1 second elapsed time from the moment of the first bird ingestion to the last.
 - (ii) Followed by 2 minutes without power lever movement after the ingestion.
 - (iii) Followed by 3 minutes at 75-percent of the test condition.
 - (iv) Followed by 6 minutes at 60-percent of the test condition.
 - (v) Followed by 6 minutes at 40-percent of the test condition.
 - (vi) Followed by 1 minute at approach idle.
 - (vii) Followed by 2 minutes at 75-percent of the test condition.
 - (viii) Followed by stabilizing at idle and engine shut down. The durations specified are times at the defined conditions with the power lever being moved between each condition in less than 10 seconds.
- (8) For rotorcraft engines, the following test schedule shall be used :
- (i) Ingestion so as to simulate a flock encounter within approximately 1 second elapsed time between the first ingestion and the last.
 - (ii) Followed by 3 minutes at 75-percent of the test condition.
 - (iii) Followed by 90 seconds at descent flight idle.
 - (iv) Followed by 30 seconds at 75-percent of the test condition.
 - (v) Followed by stabilizing at idle and engine shut down. The duration specified are times at the defined conditions with the power lever being changed between each condition in less than 10 seconds.
 - (9) Engines intended for use in multi-engine rotorcraft are not required to comply with the medium bird ingestion portion of this section, providing that the appropriate type certificate documentation is so endorsed.
 - (10) If any engine operating limit(s) is exceeded during the initial 2 minutes without power lever movement, as provided by paragraph (c)(7)(ii) of this section, then it shall be established that the limit exceedance will not result in an unsafe condition.

Amdt. 33-20, EFF. 12/13/2000

FAR 33.77 : [Foreign object ingestion-ice.]

- (a) [[Reserved]
- (b) [Reserved]
- (c) Ingestion of ice under the conditions of paragraph (e) of this section may not—
 - (1) Cause a sustained power or thrust loss; or
 - (2) Require the engine to be shutdown.
- (d) For an engine that incorporates a protection device, compliance with this section need not be demonstrated with respect to foreign objects to be ingested under the conditions prescribed in paragraph (e) of this section if it is shown that—

Engine Inlet Throat Area (A) Square-meters (square-inches)	Bird Weight kg. (lb.)
1.35 (2.092); A	1.85 (4.07) minimum, unless a smaller bird is determined to be a more severe demonstration.
1.35 (2.092) ≤ A; 3.90 (6.045)	2.75 (6.05)
3.90 (6.045) ≤ A	3.65 (8.03)

TAB. 92.1 – (Table of §33.76) : Large Bird Weight Requirements

- (c) Small and medium birds. Compliance with the small and medium bird ingestion requirements shall be in accordance with the following :

- (1) Analysis or component test, or both, acceptable to the Administrator, shall be conducted to determine the critical ingestion parameters affecting power loss and damage. Critical ingestion parameters shall include, but are not limited to, the effects of bird speed, critical target location, and first stage rotor speed. The critical bird ingestion speed should reflect the most critical condition within the range of airspeeds used for normal flight operations up to 1,500 feet above ground level, but not less than V1 minimum for airplanes.
- (2) Medium bird engine tests shall be conducted so as to simulate a flock encounter, and will use the bird weights and quantities specified in (Table 92.2, p. 1156). When only one bird is specified, that bird will be aimed at the engine core primary flow path ; the other critical locations on the engine face area must be addressed, as necessary, by appropriate tests or analysis, or both. When two or more birds are specified in (Table 92.2, p. 1156), the largest of those birds must be aimed at the engine core primary flow path, and a second bird must be aimed at the most critical exposed location on the first stage rotor blades. Any remaining birds must be evenly distributed over the engine face area.
- (3) In addition, except for rotorcraft engines, it must also be substantiated by appropriate tests or analysis or both, that when the full fan assembly is subjected to the ingestion of the quantity and weights of birds from (Table 92.3, p. 1156), aimed at the fan assembly's most critical location outboard of the primary core flowpath, and in accordance with the applicable test conditions of this paragraph, that the engine can comply with the acceptance criteria of this paragraph.
- (4) A small bird ingestion test is not required if the prescribed number of medium birds pass into the engine rotor blades during the medium bird test.
- (5) Small bird ingestion tests shall be conducted so as to simulate a flock encounter using one 85 gram (0.187 lb.) bird for each 0.032 square-meter (49.6 square-inches) of inlet area, or fraction thereof, up to a maximum of 16 birds. The birds will be aimed so as to account for any critical exposed locations on the first stage rotor blades, with any remaining birds evenly distributed over the engine face area.
- (6) Ingestion of small and medium birds tested under the conditions prescribed in this paragraph may not cause any of the following :
 - (i) More than a sustained 25-percent power or thrust loss ;
 - (ii) The engine to be shut down during the required run-on demonstration prescribed in paragraphs (c)(7) or (c)(8) of this section ;

- (2) With respect to turbine engines, means the brake horsepower that is developed under static conditions at a specified altitude and atmospheric temperature, and under the maximum conditions of rotor shaft rotational speed and gas temperature approved for the normal takeoff, and limited in continuous use to the period of time shown in the approved engine specification.

Takeoff safety speed means a referenced airspeed obtained after lift-off at which the required one-engine-inoperative climb performance can be achieved.

Takeoff thrust , with respect to turbine engines, means the jet thrust that is developed under static conditions at a specific altitude and atmospheric temperature under the maximum conditions of rotorshaft rotational speed and gas temperature approved for the normal takeoff, and limited in continuous use to the period of time shown in the approved engine specification.

Tandem wing configuration means a configuration having two wings of similar span, mounted in tandem.

TCAS I means a TCAS that utilizes interrogations of, and replies from, airborne radar beacon transponders and provides traffic advisories to the pilot.

TCAS II means a TCAS that utilizes interrogations of, and replies from airborne radar beacon transponders and provides traffic advisories and resolution advisories in the vertical plane.

TCAS III means a TCAS that utilizes interrogation of, and replies from, airborne radar beacon transponders and provides traffic advisories and resolution advisories in the vertical and horizontal planes to the pilot.

Time in service , with respect to maintenance time records, means the time from the moment an aircraft leaves the surface of the earth until it touches it at the next point of landing.

True airspeed means the airspeed of an aircraft relative to undisturbed air. True airspeed is equal to equivalent airspeed multiplied by $(p_0/p)^{1/2}$.

Traffic pattern means the traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from, an airport.

Type : (1) As used with respect to the certification, ratings, privileges, and limitations of airmen, means a specific make and basic model of aircraft, including modifications thereto that do not change its handling or flight characteristics. Examples include : DC-7, 1049, and F-27 ; and

- (2) As used with respect to the certification of aircraft, means those aircraft which are similar in design. Examples include : DC-7 and DC-7C ; 1049G and 1049H ; and F-27 and F-27F.

- (3) As used with respect to the certification of aircraft engines means those engines which are similar in design. For example, JT8D and JT8D-7 are engines of the same type, and JT9D-3A and JT9D-7 are engines of the same type.

United States , in a geographical sense, means (1) the States, the District of Columbia, Puerto Rico, and the possessions, including the territorial waters, and (2) the airspace of those areas.

United States air carrier means a citizen of the United States who undertakes directly by lease, or other arrangement, to engage in air transportation.

VFR over-the-top , with respect to the operation of aircraft, means the operation of an aircraft over-the-top under VFR when it is not being operated on an IFR flight plan.

Warning area . A warning area is airspace of defined dimensions, extending from 3 nautical miles outward from the coast of the United States, that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both.

Winglet or tip fin means an out-of-plane surface extending from a lifting surface. The surface may or may not have control surfaces.

Amtd. 1-49, Eff. 12/26/2002

FAR 1.2 Abbreviations and symbols

In Subchapters A through K of this chapter :

AGL means above ground level.

ALS means approach light system.

ASR means airport surveillance radar.

ATC means air traffic control.

CAS means calibrated airspeed.

CAT II means Category II.

CONSOL or *CONSOLAN* means a kind of low or medium frequency long range navigational aid.

DH means decision height.

DME means distance measuring equipment compatible with TACAN.

EAS means equivalent airspeed.

FAA means Federal Aviation Administration.

FM means fan marker.

GS means glide slope.

HIRL means high-intensity runway light system.

IAS means indicated airspeed.

ICAO means International Civil Aviation Organization.

IFR means instrument flight rules.

ILS means instrument landing system.

IM means *ILS* inner marker.

INT means intersection.

LDA means localizer-type directional aid.

LFR means low-frequency radio range.

LMM means compass locator at middle marker.

LOC means *ILS* localizer.

LOM means compass locator at outer marker.

M means mach number.

MAA means maximum authorized *IFR* altitude.

MALS means medium intensity approach light system.

- (1) All ingestion tests shall be conducted with the engine stabilized at no less than 100-percent takeoff power or thrust, for test day ambient conditions prior to the ingestion. In addition, the demonstration of compliance must account for engine operation at sea level takeoff conditions on the hottest day that a minimum engine can achieve maximum rated takeoff thrust or power.
 - (2) The engine inlet throat area as used in this section to determine the bird quantity and weights will be established by the applicant and identified as a limitation in the installation instructions required under § 33.5.
 - (3) The impact to the front of the engine from the single large bird and the single largest medium bird which can enter the inlet must be evaluated. It must be shown that the associated components when struck under the conditions prescribed in paragraphs (b) or (c) of this section, as applicable, will not affect the engine to the extent that it cannot comply with the requirements of paragraphs (b)(3) and (c)(6) of this section.
 - (4) For an engine that incorporates an inlet protection device, compliance with this section shall be established with the device functioning. The engine approval will be endorsed to show that compliance with the requirements has been established with the device functioning.
 - (5) Objects that are accepted by the Administrator may be substituted for birds when conducting the bird ingestion tests required by paragraphs (b) and (c) of this section.
 - (6) If compliance with the requirements of this section is not established, the engine type certification documentation will show that the engine shall be limited to aircraft installations in which it is shown that a bird cannot strike the engine, or be ingested into the engine, or adversely restrict airflow into the engine.
- (b) Large birds. Compliance with the large bird ingestion requirements shall be in accordance with the following :
- (1) The large bird ingestion test shall be conducted using one bird of a weight determined from (Table 92.1, p. 1154) aimed at the most critical exposed location on the first stage rotor blades and ingested at a bird speed of 200-knots for engines to be installed on airplanes, or the maximum airspeed for normal rotorcraft flight operations for engines to be installed on rotorcraft.
 - (2) Power lever movement is not permitted within 15 seconds following ingestion of the large bird.
 - (3) Ingestion of a single large bird tested under the conditions prescribed in this section may not cause the engine to :
 - (i) Catch fire;
 - (ii) Release hazardous fragments through the engine casing;
 - (iii) Generate loads greater than those ultimate loads specified under § 33.23(a); or
 - (iv) Lose the ability to be shut down.
 - (4) Compliance with the large bird ingestion requirements of this paragraph may be shown by demonstrating that the requirements of § 33.94(a) constitute a more severe demonstration of blade containment and rotor unbalance than the requirements of this paragraph.

FAR 33.72 : [Hydraulic actuating systems.]

[Each hydraulic actuating system must function properly under all conditions in which the engine is expected to operate. Each filter or screen must be accessible for servicing and each tank must meet the design criteria of Sec. 33.71.]
Amdt. 33-6, Eff. 10/31/74

FAR 33.73 : Power or thrust response.

[The design and construction of the engine must enable an increase—

- (a) From minimum to rated takeoff power or thrust with the maximum bleed air and power extraction to be permitted in an aircraft, without overtemperature, surge, stall, or other detrimental factors occurring to the engine whenever the power control lever is moved from the minimum to the maximum position in not more than 1 second, except that the Administrator may allow additional time increments for different regimes of control operation requiring control scheduling; and
- (b) From the fixed minimum flight idle power lever position when provided, or if not provided, from not more than 15 percent of the rated takeoff power or thrust available to 95 percent rated takeoff power or thrust in not over 5 seconds. The 5-second power or thrust response must occur from a stabilized static condition using only the bleed air and accessories loads necessary to run the engine. This takeoff rating is specified by the applicant and need not include thrust augmentation.]
Amdt. 33-4, Eff. 4/23/71

FAR 33.74 : [Continued rotation.]

[If any of the engine main rotating systems will continue to rotate after the engine is shutdown for any reason while in flight, and where means to prevent that continued rotation are not provided; then any continued rotation during the maximum period of flight, and in the flight conditions expected to occur with that engine inoperative, must not result in any condition described in Sec. 33.75 (a) through (c).]
[Amdt. 33-17, Eff. 7/5/96]

FAR 33.75 : Safety analysis.

It must be shown by analysis that any probable malfunction or any probable single or multiple failure, or any probable improper operation of the engine will not cause the engine to—

- (a) Catch fire;
 - (b) [Burst (release hazardous fragments through the engine case) ;
 - (c) Generate loads greater than those ultimate loads specified in Sec. 33.23(a) ; or]
 - (d) Lose the capability of being shut down.
- Amdt. 33-10, Eff. 3/26/84

FAR 33.76 : [Bird ingestion.]

- (a) [General. Compliance with paragraphs (b) and (c) of this section shall be in accordance with the following :

MALSR means medium intensity approach light system with runway alignment indicator lights.

MCA means minimum crossing altitude.

MDA means minimum descent altitude.

MEA means minimum en route IFR altitude.

MM means *ILS* middle marker.

MOCA means minimum obstruction clearance altitude.

MRA means minimum reception altitude.

MSL means mean sea level.

NDB(ADF) means nondirectional beacon (automatic direction finder).

NOPT means no procedure turn required.

OEI means one engine inoperative.

OM means *ILS* outer marker.

PAR means precision approach radar.

RAIL means runway alignment indicator light system.

RBN means radio beacon.

RCLM means runway centerline marking.

RCLS means runway centerline light system.

REIL means runway end identification lights.

RR means low or medium frequency radio range station.

RVR means runway visual range as measured in the touchdown zone area.

SALS means short approach light system.

SSALS means simplified short approach light system.

SSALSR means simplified short approach light system with runway alignment indicator lights.

TACAN means ultra-high frequency tactical air navigational aid.

TAS means true airspeed.

TCAS means a traffic alert and collision avoidance system.

TDZL means touchdown zone lights.

TVOR means very high frequency terminal omnirange station.

V_A means design maneuvering speed.

V_B means design speed for maximum gust intensity.

V_C means design cruising speed.

V_D means design diving speed.

V_{DF}/M_{DF} means demonstrated flight diving speed.

V_{EF} means the speed at which the critical engine is assumed to fail during takeoff.

V_F means design flap speed.

V_{FC}/M_{FC} means maximum speed for stability characteristics.

V_{FE} means maximum flap extended speed.

V_{FTO} [means final takeoff speed.]

V_H means maximum speed in level flight with maximum continuous power.

V_{LE} means maximum landing gear extended speed.

V_{LO} means maximum landing gear operating speed.

V_{LOF} means lift-off speed.

V_{MC} means minimum control speed with the critical engine inoperative.

V_{MO}/M_{MO} means maximum operating limit speed.

V_{MU} means minimum unstick speed.

V_{NE} means never-exceed speed.

V_{NO} means maximum structural cruising speed.

V_R means rotation speed.

V_{REF} [means reference landing speed]

V_S means the stalling speed or the minimum steady flight speed at which the airplane is controllable.

V_{S0} means the stalling speed or the minimum steady flight speed in the landing configuration.

V_{SR} [means reference stall speed.

V_{SR0} means reference stall speed in the landing configuration.

V_{SR1} means reference stall speed in a specific configuration.

V_{SW} means speed at which onset of natural or artificial stall warning occurs.]

V_{S1} means the stalling speed or the minimum steady flight speed obtained in a specific configuration.

V_{Toss} means takeoff safety speed for Category A rotorcraft.

V_X means speed for best angle of climb.

V_Y means speed for best rate of climb.

V_1 means the maximum speed in the takeoff at which the pilot must take the first action (e.g., apply brakes, reduce thrust, deploy speed brakes) to stop the airplane within the accelerate-stop distance. V_1 also means the minimum speed in the takeoff, following a failure of the critical engine at V_{EF} , at which the pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance.

V_2 means takeoff safety speed.

V_{2min} means minimum takeoff safety speed.

V_{FR} means visual flight rules.

V_{HF} means very high frequency.

VOR means very high frequency omnirange station.

VOR_{TAC} means collocated VOR and $TACAN$.

Amdt. 1-49, EFF. 12/26/2002

provisions for connection with a warning means to warn the pilot of the occurrence of contamination of the screen before it reaches the capacity established in accordance with subparagraph (3) of this paragraph.

(7) Each strainer or filter required by this paragraph must be accessible for draining and cleaning.

(c) *Oil tanks.*

(1) Each oil tank must have an expansion space of not less than 10 percent of the tank capacity.

(2) It must be impossible to inadvertently fill the oil tank expansion space.

(3) Each recessed oil tank filler connection that can retain any appreciable quantity of oil must have provision for fitting a drain.

(4) Each oil tank cap must provide an oil-tight seal.

(5) [Each oil tank filler must be marked with the word "oil".]

(6) Each oil tank must be vented from the top part of the expansion space, with the vent so arranged that condensed water vapor that might freeze and obstruct the line cannot accumulate at any point.

(7) There must be means to prevent entrance into the oil tank or into any oil tank outlet, of any object that might obstruct the flow of oil through the system.

(8) There must be a shutoff valve at the outlet of each oil tank, unless the external portion of the oil system (including oil tank supports) is fireproof.

(9) Each pressurized oil tank may not leak when subjected to maximum operating temperature and an internal pressure of 5 p.s.i., and each pressurized oil tank may not leak when subjected to maximum operating temperature and an internal pressure that is not less than 5 p.s.i., plus the maximum operating pressure of the tank.

(10) Leaked or spilled oil may not accumulate between the tank and the remainder of the engine.

(11) [Each oil tank must have an oil quantity indicator or provisions for one.

(12) If the propeller feathering system depends on engine oil—

(i) There must be means to trap an amount of oil in the tank if the supply becomes depleted due to failure of any part of the lubricating system other than the tank itself;

(ii) The amount of trapped oil must be enough to accomplish the feathering operation and must be available only to the feathering pump; and

(iii) Provision must be made to prevent sludge or other foreign matter from affecting the safe operation of the propeller feathering system.

(d) *Oil drains.* A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must—

(1) Be accessible; and

(2) Have manual or automatic means for positive locking in the closed position.

(e) *Oil radiators.* Each oil radiator must withstand, without failure, any vibration, inertia, and oil pressure load to which it is subjected during the block tests.]

Amdt. 33-10, EFF. 3/26/84

causes a serious loss of power or thrust in continuous maximum and intermittent maximum icing conditions as defined in Appendix C of Part 25 of this chapter ; and

- (b) [Idle for 30 minutes on the ground, with the available air bleed for icing protection at its critical condition, without adverse effect, in an atmosphere that is at a temperature between 15o and 30oF (between -9o and -1oC) and has a liquid water content not less than 0.3 grains per cubic meter in the form of drops having a mean effective diameter not less than 20 microns, followed by a momentary operation at takeoff power or thrust. During the 30 minutes of idle operation the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator.]

Amdt. 33-10, Eff. 3/26/84

FAR 33.69 : [Ignitions system.]

[Each engine must be equipped with an ignition system for starting the engine on the ground and in flight. An electric ignition system must have at least two igniters and two separate secondary electric circuits, except that only one igniter is required for fuel burning augmentation systems.]

Amdt. 33-6, Eff. 10/31/74

FAR 33.71 : Lubrication system.

- (a) *General.* Each lubrication system must function properly in the flight attitudes and atmospheric conditions in which an aircraft is expected to operate.

- (b) [*Oil strainer or filter.* There must be an oil strainer or filter through which all of the engine oil flows. In addition :]

- (1) Each strainer or filter required by this paragraph that has a bypass must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.
- (2) The type and degree of filtering necessary for protection of the engine oil system against foreign particles in the oil must be specified. The applicant must demonstrate that foreign particles passing through the specified filtering means do not impair engine oil system functioning.
- (3) [Each strainer or filter required by this paragraph must have the capacity (with respect to operating limitations established for the engine) to ensure that engine oil system functioning is not impaired with the oil contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine in subparagraph (2) of this paragraph.
- (4) For each strainer or filter required by this paragraph, except the strainer or filter at the oil tank outlet, there must be means to indicate contamination before it reaches the capacity established in accordance with paragraph (b)(3) of this section.]
- (5) Any filter bypass must be designed and constructed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that the collected contaminants are not in the bypass flow path.
- (6) Each strainer or filter required by this paragraph that has no bypass, except the strainer or filter at an oil tank outlet or for a scavenge pump, must have

FAR 1.3 Rules of construction

- (a) In Subchapters A through K of this chapter, unless the context requires otherwise :

- (1) Words importing the singular include the plural ;
- (2) Words importing the plural include the singular ; and
- (3) Words importing the masculine gender include the feminine.

- (b) In Subchapters A through K of this chapter, the word :

- (1) Shall is used in an imperative sense ;
- (2) May is used in a permissive sense to state authority or permission to do the act prescribed, and the words "no person may * * *" or "a person may not * * *" mean that no person is required, authorized, or permitted to do the act prescribed ; and
- (3) Includes means "includes but is not limited to" .

Amdt. 1-10, Eff. 3/29/66

- (1) It must be accessible for draining and cleaning and must incorporate a screen or element that is easily removable.
 - (2) It must have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes.
 - (3) It must be mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter, unless adequate strength margins under all loading conditions are provided in the lines and connections.
 - (4) It must have the type and degree of fuel filtering specified as necessary for protection of the engine fuel system against foreign particles in the fuel. The applicant must show :
 - (i) That foreign particles passing through the specified filtering means do not impair the engine fuel system functioning; and
 - (ii) That the fuel system is capable of sustained operation throughout its flow and pressure range with the fuel initially saturated with water at 80oF (27oC) and having 0.025 fluid ounces per gallon (0.20 milliliters per liter) of free water added and cooled to the most critical condition for icing likely to be encountered in operation. However, this requirement may be met by demonstrating the effectiveness of specified approved fuel anti-icing additives, or that the fuel system incorporates a fuel heater which maintains the fuel temperature at the fuel strainer or fuel inlet above 32oF (0oC) under the most critical conditions.
 - (5) The applicant must demonstrate that the filtering means has the capacity (with respect to engine operating limitations) to ensure that the engine will continue to operate within approved limits, with fuel contaminated to the maximum degree of particle size and density likely to be encountered in service. Operation under these conditions must be demonstrated for a period acceptable to the Administrator, beginning when indication of impending filter blockage is first given by either :
 - (i) Existing engine instrumentation ; or
 - (ii) Additional means incorporated into the engine fuel system.
 - (6) Any strainer or filter bypass must be designed and constructed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.
 - (c) If provided as part of the engine, the applicant must show for each fluid injection (other than fuel) system and its controls that the flow of the injected fluid is adequately controlled.
 - (d) [Engines having a 30-second OEI rating must incorporate means for automatic availability and automatic control of a 30-second OEI power.]
- Amdt. 33-18, Eff. 8/19/96

FAR 33.68 : Induction system icing.

Each engine, with all icing protection systems operating, must—

- (a) Operate throughout its flight power range (including idling) without the accumulation of ice on the engine components that adversely affects engine operation or that

FAR 33.61 : Applicability.

This subpart prescribes additional design and construction requirements for turbine aircraft engines.

FAR 33.62 : [Stress analysis.]

[A stress analysis must be performed on each turbine engine showing the design safety margin of each turbine engine rotor, spacer, and rotor shaft.]
Amdt. 33-6, Eff. 10/31/74

FAR 33.63 : Vibration.

[Each engine must be designed and constructed to function throughout its declared flight envelope and operating range of rotational speeds and power/thrust, without inducing excessive stress in any engine part because of vibration and without imparting excessive vibration forces to the aircraft structure.]
Amdt. 33-17, Eff. 7/5/96

FAR 33.65 : [Surge and stall characteristics.]

[When the engine is operated in accordance with operating instructions required by Sec. 33.5(b), starting, a change of power or thrust, power or thrust augmentation, limiting inlet air distortion, or inlet air temperature may not cause surge or stall to the extent that flameout, structural failure, overtemperature, or failure of the engine to recover power or thrust will occur at any point in the operating envelope.]
Amdt. 33-6, Eff. 10/31/74

FAR 33.66 : Bleed air system.

[The engine must supply bleed air without adverse effect on the engine, excluding reduced thrust or power output, at all conditions set up to the discharge flow conditions established as a limitation under Sec. 33.7(c)(11). If bleed air used for engine anti-icing can be controlled, provision must be made for a means to indicate the functioning of the engine ice protection system.]
Amdt. 33-10, Eff. 3/26/84

FAR 33.67 : Fuel system.

- (a) With fuel supplied to the engine at the flow and pressure specified by the applicant, the engine must function properly under each operating condition required by this part. Each fuel control adjusting means that may not be manipulated while the fuel control device is mounted on the engine must be secured by a locking device and sealed, or otherwise be inaccessible. All other fuel control adjusting means must be accessible and marked to indicate the function of the adjustment unless the function is obvious.
- (b) There must be a fuel strainer or filter between the engine fuel inlet opening and the inlet of either the fuel metering device or the engine-driven positive displacement pump whichever is nearer the engine fuel inlet. In addition, the following provisions apply to each strainer or filter required by this paragraph :

Deuxième partie

FAR 11- General rulemaking procedures

Chapitre 92

Subpart E : Design and Construction ; Turbine Aircraft Engines

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Chapitre 1

Subpart A : Rulemaking Procedures

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higher and the power appropriate to the manifold pressure and speed settings for [rated] maximum continuous power at the higher supercharger speed ratio must be obtainable within five seconds.

Amdt. 33-3, EF. 4/3/67

FAR 33.53 : Engine component tests.

- (a) For each engine that cannot be adequately substantiated by endurance testing in accordance with Sec. 33.49, the applicant must conduct additional tests to establish that components are able to function reliably in all normally anticipated flight and atmospheric conditions.
- (b) Temperature limits must be established for each component that requires temperature controlling provisions in the aircraft installation to assure satisfactory functioning, reliability, and durability.

FAR 33.55 : Teardown inspection.

After completing the endurance test—

- (a) Each engine must be completely disassembled ;
- (b) Each component having an adjustment setting and a functioning characteristic that can be established independent of installation on the engine must retain each setting and functioning characteristic within the limits that were established and recorded at the beginning of the test ; and
- (c) Each engine component must conform to the type design and be eligible for incorporation into an engine for continued operation, in accordance with information submitted in compliance with [Sec. 33.4].

Amdt. 33-9, EF. 10/14/80

FAR 33.57 : General conduct of block tests.

- (a) The applicant may, in conducting the block tests, use separate engines of identical design and construction in the vibration, calibration, detonation, endurance, and operation tests, except that, if a separate engine is used for the endurance test it must be subjected to a calibration check before starting the endurance test.
- (b) The applicant may service and make minor repairs to the engine during the block tests in accordance with the service and maintenance instructions submitted in compliance with [Sec. 33.4]. If the frequency of the service is excessive, or the number of stops due to engine malfunction is excessive, or a major repair, or replacement of a part is found necessary during the block tests or as the result of findings from the teardown inspection, the engine or its parts may be subjected to any additional test the Administrator finds necessary.
- (c) Each applicant must furnish all testing facilities, including equipment and competent personnel, to conduct the block tests.

Amdt. 33-9, EF. 10/14/80

- (e) *Turbosupercharged engines* For engines incorporating a turbosupercharger the following apply except that altitude testing may be simulated provided the applicant shows that the engine and supercharger are being subjected to mechanical loads and operating temperatures no less severe than if run at actual altitude conditions :
- (1) For engines used in airplanes the applicant must conduct the runs specified in paragraph (b) of this section, except—
 - (i) The entire run specified in paragraph (b)(1) of this section must be made at sea level altitude pressure;
 - (ii) [The portions of the runs specified in paragraphs (b)(2) through (7) of this section at rated maximum continuous power must be made at critical altitude pressure, and the portions of the runs at other power must be made at 8,000 feet altitude pressure; and]
 - (iii) The turbosupercharger used during the 150-hour endurance test must be run on the bench for an additional 50 hours at the limiting turbine wheel inlet gas temperature and rotational speed for rated maximum continuous power operation unless the limiting temperature and speed are maintained during 50 hours of the rated maximum continuous power operation.
 - (2) For engines used in helicopters the applicant must conduct the runs specified in paragraph (d) of this section, except—
 - (i) The entire run specified in paragraph (d)(1) of this section must be made at critical altitude pressure;
 - (ii) The portions of the runs specified in paragraph (d)(2) and (3) of this section at rated maximum continuous power must be made at critical altitude pressure and the portions of the runs at other power must be made at 8,000 feet altitude pressure;
 - (iii) The entire run specified in paragraph (d)(4) of this section must be made at 8,000 feet altitude pressure;
 - (iv) The portion of the runs specified in paragraph (d)(5) of this section at 80 percent of rated maximum continuous power must be made at 8,000 feet altitude pressure and the portions of the runs at other power must be made at critical altitude pressure;
 - (v) The entire run specified in paragraph (d)(6) of this section must be made at critical altitude pressure; and
 - (vi) The turbosupercharger used during the endurance test must be run on the bench for 50 hours at the limiting turbine wheel inlet gas temperature and rotational speed for rated maximum continuous power operation unless the limiting temperature and speed are maintained during 50 hours of the rated maximum continuous power operation.

Amdt. 33-10, Eff. 3/26/84

FAR 33.51 : Operation test.

The operation test must include the testing found necessary by the Administrator to demonstrate backfire characteristics, starting, idling, acceleration, overspeeding, functioning of propeller and ignition, and any other operational characteristic of the engine. If the engine incorporates a multispeed supercharger drive, the design and construction must allow the supercharger to be shifted from operation at the lower speed ratio to the

FAR 11.1 : To what does this part apply ?

This part applies to the issuance, amendment, and repeal of any regulation for which FAA ("we") follow public rulemaking procedures under the Administrative Procedure Act ("APA") (5 U.S.C. 553).
Amdt. 11-46, Eff. 9/20/2000

FAR 11.3 : What is an advance notice of proposed rulemaking ?

An advance notice of proposed rulemaking (ANPRM) tells the public that FAA is considering an area for rulemaking and requests written comments on the appropriate scope of the rulemaking or on specific topics. An advance notice of proposed rulemaking may or may not include the text of potential changes to a regulation.
Amdt. 11-46, Eff. 9/20/2000

FAR 11.5 : What is a notice of proposed rulemaking ?

A notice of proposed rulemaking (NPRM) proposes FAA's specific regulatory changes for public comment and contains supporting information. It includes proposed regulatory text.
Amdt. 11-46, Eff. 9/20/2000

FAR 11.7 : What is a supplemental notice of proposed rulemaking ?

On occasion, FAA may decide that it needs more information on an issue, or that we should take a different approach than we proposed. Also, we may want to follow a commenter's suggestion that goes beyond the scope of the original proposed rule. In these cases, FAA may issue a supplemental notice of proposed rulemaking (SNPRM) to give the public an opportunity to comment further or to give us more information.
Amdt. 11-46, Eff. 9/20/2000

FAR 11.9 : What is a final rule ?

A final rule sets out new or revised requirements and their effective date. It also may remove requirements. When preceded by an NPRM, a final rule will also identify significant substantive issues raised by commenters in response to the NPRM and will give the agency's response.
Amdt. 11-46, Eff. 9/20/2000

FAR 11.11 : What is a final rule with request for comments ?

A final rule with request for comment is a rule that the FAA issues in final (with an effective date) that invites public comment on the rule. We usually do this when we have not first issued an ANPRM or NPRM, because we have found that doing so would be impracticable, unnecessary, or contrary to the public interest. We give our reasons for our determination in the preamble. The comment period often ends after the effective date of the rule. A final rule not preceded by an ANPRM or NPRM is commonly called an "immediately adopted final rule." We invite comments on these rules only if we think that we will receive useful information. For example, we would not invite comments when we are just making an editorial clarification or correction.
Amdt. 11-46, Eff. 9/20/2000

FAR 11.13 : What is a direct final rule ?

A direct final rule is a type of final rule with request for comments. Our reason for issuing a direct final rule without an NPRM is that we would not expect to receive any adverse comments, and so an NPRM is unnecessary. However, to be certain that we are correct, we set the comment period to end before the effective date. If we receive an adverse comment or notice of intent to file an adverse comment, we then withdraw the final rule before it becomes effective and may issue an NPRM.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.15 : What is a petition for exemption ?

A petition for exemption is a request to FAA by an individual or entity asking for relief from the requirements of a current regulation.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.17 : What is a petition for rulemaking ?

A petition for rulemaking is a request to FAA by an individual or entity asking the FAA to adopt, amend, or repeal a regulation.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.19 : What is a special condition ?

A special condition is a regulation that applies to a particular aircraft design. The FAA issues special conditions when we find that the airworthiness regulations for an aircraft, aircraft engine, or propeller design do not contain adequate or appropriate safety standards, because of a novel or unusual design feature.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.21 : What are the most common kinds of rulemaking actions for which FAA follows the Administrative Procedure Act ?

FAA follows Administrative Procedure Act (APA) procedures for these common types of rules :

- (a) Rules found in the Code of Federal Regulations;
- (b) Airworthiness directives issued under part 39 of this chapter; and
- (c) Airspace Designations issued under various parts of this chapter.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.23 : Does FAA follow the same procedures in issuing all types of rules ?

Yes, in general, FAA follows the same procedures for all rule types. There are some differences as to which FAA official has authority to issue each type, and where you send petitions for FAA to adopt, amend, or repeal each type. Assume that the procedures in this subpart apply to all rules, except where we specify otherwise.

Amdt. 11-46, Eff. 9/20/2000

- (6) A 10-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and one hour at 65 percent rated maximum continuous power and 87 percent maximum continuous speed.
- (7) A 10-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and one hour at 60 percent rated maximum continuous power and 84.5 percent maximum continuous speed.
- (8) A 10-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and one hour at 50 percent rated maximum continuous power and 79.5 percent maximum continuous speed.
- (9) A 20-hour run consisting of alternate periods in the lower gear ratio of 2 hours at rated maximum continuous power with maximum continuous speed, and two hours at maximum best economy cruising power and speed or at maximum recommended cruising power.
- (10) A 5-hour run in the lower gear ratio at maximum best economy cruising power and speed or at maximum recommended cruising power and speed.

Where simulated altitude test equipment is not available when operating in the higher gear ratio, the runs may be made at the observed horsepower obtained with the critical altitude manifold pressure or specified percentages thereof, and the fuel-air mixtures may be adjusted to be rich enough to suppress detonation.

- (d) *Helicopter engines.* To be eligible for use on a helicopter each engine must either comply with paragraphs (a) through (j) of Sec. 29.923 of this chapter, or must undergo the following series of runs :

- (1) A 35-hour run consisting of alternate periods of 30 minutes each at rated takeoff power with takeoff speed, and at rated maximum continuous power with maximum continuous speed.
- (2) A 25-hour run consisting of alternate periods of 2 1/2 hours each at rated maximum continuous power with maximum continuous speed, and at 70 percent rated maximum continuous power with maximum continuous speed.
- (3) A 25-hour run consisting of alternate periods of 2 1/2 hours each at rated maximum continuous power with maximum continuous speed, and at 70 percent rated maximum continuous power with 80 to 90 percent maximum continuous speed.
- (4) A 25-hour run consisting of alternate periods of 2 1/2 hours each at 80 percent rated maximum continuous power with takeoff speed, and at 80 percent rated maximum continuous power with 80 to 90 percent maximum continuous speed.
- (5) A 25-hour run consisting of alternate periods of 2 1/2 hours each at 80 percent rated maximum continuous power with takeoff speed, and at either rated maximum continuous power with 110 percent maximum continuous speed or at rated takeoff power with 103 percent takeoff speed, whichever results in the greater speed.
- (6) A 15-hour run at 105 percent rated maximum continuous power with 105 percent maximum continuous speed or at full throttle and corresponding speed at standard sea level carburetor entrance pressure, if 105 percent of the rated maximum continuous power is not exceeded.

- (3) A 20-hour run consisting of alternate periods of 1 1/2 hours at rated maximum continuous power with maximum continuous speed, and 1/2 hour at 70 percent rated maximum continuous power and 89 percent maximum continuous speed.
- (4) A 20-hour run consisting of alternate periods of 1 1/2 hours at rated maximum continuous power with maximum continuous speed, and 1/2 hour at 65 percent rated maximum continuous power and 87 percent maximum continuous speed.
- (5) A 20-hour run consisting of alternate periods of 1 1/2 hours at rated maximum continuous power with maximum continuous speed, and 1/2 hour at 60 percent rated maximum continuous power and 84.5 percent maximum continuous speed.
- (6) A 20-hour run consisting of alternate periods of 1 1/2 hours at rated maximum continuous power with maximum continuous speed, and 1/2 hour at 50 percent rated maximum continuous power and 79.5 percent maximum continuous speed.
- (7) A 20-hour run consisting of alternate periods of 2 1/2 hours at rated maximum continuous power with maximum continuous speed, and 2 1/2 hours at maximum best economy cruising power or at maximum recommended cruising power.

(c) *Engines incorporating a gear-driven two-speed supercharger.* For engines incorporating a gear-driven two-speed supercharger the applicant must conduct the following runs :

- (1) A 30-hour run consisting of alternate periods in the lower gear ratio of five minutes at rated takeoff power with takeoff speed, and five minutes at maximum best economy cruising power or at maximum recommended cruising power. If a takeoff power rating is desired in the higher gear ratio, 15 hours of the 30-hour run must be made in the higher gear ratio in alternate periods of five minutes at the observed horsepower obtainable with the takeoff critical altitude manifold pressure and takeoff speed, and five minutes at 70 percent high ratio rated maximum continuous power and 89 percent high ratio maximum continuous speed.
- (2) A 15-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and 1/2 hour at 75 percent rated maximum continuous power and 91 percent maximum continuous speed.
- (3) A 15-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and 1/2 hour at 70 percent rated maximum continuous power and 89 percent maximum continuous speed.
- (4) A 30-hour run in the higher gear ratio at rated maximum continuous power with maximum continuous speed.
- (5) A 5-hour run consisting of alternate periods of five minutes in each of the supercharger gear ratios. The first five minutes of the test must be made at maximum continuous speed in the higher gear ratio and the observed horsepower obtainable with 90 percent of maximum continuous manifold pressure in the higher gear ratio under sea level conditions. The condition for operation for the alternate five minutes in the lower gear ratio must be that obtained by shifting to the lower gear ratio at constant speed.

FAR 11.25 : How does FAA issue rules ?

- (a) The FAA uses APA rulemaking procedures to adopt, amend, or repeal regulations.

To propose or adopt a new regulation, or to change a current regulation, FAA will issue one or more of the following documents. We publish these rulemaking documents in the *Federal Register* unless we name and personally serve a copy of a rule on every person subject to it. We also make all documents available to the public by posting them in the Department of Transportation's electronic docket at <http://dms.dot.gov>.

- (1) An advance notice of proposed rulemaking (ANPRM).
- (2) A notice of proposed rulemaking (NPRM).
- (3) A supplemental notice of proposed rulemaking (SNPRM).
- (4) A final rule.
- (5) A final rule with request for comments.
- (6) A direct final rule.

- (b) Each of the rulemaking documents in paragraph (a) of this section generally contains the following information :

- (1) The topic involved in the rulemaking document.
- (2) FAA's legal authority for issuing the rulemaking document.
- (3) How interested persons may participate in the rulemaking proceeding (for example, by filing written comments or making oral presentations at a public meeting).
- (4) Whom to call if you have questions about the rulemaking document.
- (5) The date, time, and place of any public meetings FAA will hold to discuss the rulemaking document.
- (6) The docket number and regulation identifier number (RIN) for the rulemaking proceeding.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.27 : Are there other ways FAA collects specific rulemaking recommendations before we issue an NPRM ?

Yes, the FAA obtains advice and recommendations from rulemaking advisory committees. One of these committees is the Aviation Rulemaking Advisory Committee (ARAC), which is a formal standing committee comprised of representatives of aviation associations and industry, consumer groups, and interested individuals. In conducting its activities, ARAC complies with the Federal Advisory Committee Act and the direction of FAA. We task ARAC with providing us with recommended rulemaking actions dealing with specific areas and problems. If we accept an ARAC recommendation to change an FAA rule, we ordinarily publish an NPRM using the procedures in this part. The FAA may establish other rulemaking advisory committees as needed to focus on specific issues for a limited period of time.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.29 : May FAA change its regulations without first issuing an NPRM or NPRM ?

The FAA normally adds or changes a regulation by issuing a final rule after an NPRM. However, FAA may adopt, amend, or repeal regulations without first issuing an ANPRM or NPRM in the following situations :

- (a) We may issue a final rule without first requesting public comment if, for good cause, we find that an NPRM is impracticable, unnecessary, or contrary to the public interest. We place that finding and a brief statement of the reasons for it in the final rule. For example, we may issue a final rule in response to a safety emergency.
- (b) If an NPRM would be unnecessary because we do not expect to receive adverse comment, we may issue a direct final rule.

Amdt. 11-46, EF. 9/20/2000

FAR 11.31 : How does FAA process direct final rules ?

- (a) A direct final rule will take effect on a specified date unless FAA receives an adverse comment or notice of intent to file an adverse comment within the comment period—generally 60 days after the direct final rule is published in the *Federal Register*. An adverse comment explains why a rule would be inappropriate, or would be ineffective or unacceptable without a change. It may challenge the rule's underlying premise or approach. Under the direct final rule process, we do not consider the following types of comments to be adverse :

- (1) A comment recommending another rule change, in addition to the change in the direct final rule at issue. We consider the comment adverse, however, if the commenter states why the direct final rule would be ineffective without the change.
- (2) A frivolous or insubstantial comment.

- (b) If FAA has not received an adverse comment or notice of intent to file an adverse comment, we will publish a confirmation document in the *Federal Register*, generally within 15 days after the comment period closes. The confirmation document tells the public the effective date of the rule.

- (c) If we receive an adverse comment or notice of intent to file an adverse comment, we will advise the public by publishing a document in the *Federal Register* before the effective date of the direct final rule. This document may withdraw the direct final rule in whole or in part. If we withdraw a direct final rule because of an adverse comment, we may incorporate the commenter's recommendation into another direct final rule or may publish a notice of proposed rulemaking.

Amdt. 11-46, EF. 9/20/2000

FAR 11.33 : How can I track FAA's rulemaking activities ?

The best ways to track FAA's rulemaking activities are with the docket number or the regulation identifier number.

- (a) *Docket number*. We assign a docket number to each rulemaking proceeding. Each rulemaking document FAA issues in a particular rulemaking proceeding, as well as public comments on the proceeding, will display the same docket number. This number allows you to search DOT's Docket Management System (DMS) for information on most rulemaking proceedings. You can view and copy docket materials

establishing the characteristics of the engine over its entire operating range of crankshaft rotational speeds, manifold pressures, fuel/air mixture settings, and altitudes. Power ratings are based upon standard atmospheric conditions with only those accessories installed which are essential for engine functioning.

- (b) A power check at sea level conditions must be accomplished on the endurance test engine after the endurance test. Any change in power characteristics which occurs during the endurance test must be determined. Measurements taken during the final portion of the endurance test may be used in showing compliance with the requirements of this paragraph.]

Amdt. 33-6, EF. 10/31/74

FAR 33.47 : Detonation test.

Each engine must be tested to establish that the engine can function without detonation throughout its range of intended conditions of operation.

FAR 33.49 : Endurance test.

- (a) *General*. Each engine must be subjected to an endurance test that includes a total of 150 hours of operation (except as provided in paragraph (c)(1)(iii) of this section) and, depending upon the type and contemplated use of the engine, consists of one of the series of runs specified in paragraphs (b) through (e) of this section, as applicable. The runs must be made in the order found appropriate by the Administrator for the particular engine being tested. During the endurance test the engine power and the crankshaft rotational speed must be kept within ± 3 percent of the rated values. During the runs at rated takeoff power and for at least 35 hours at rated maximum continuous power, one cylinder must be operated at not less than the limiting temperature, the other cylinders must be operated at a temperature not lower than 50 degrees F below the limiting temperature, and the oil inlet temperature must be maintained within ± 10 degrees F of the limiting temperature. An engine that is equipped with a propeller shaft must be fitted for the endurance test with a propeller that thrust-loads the engine to the maximum thrust which the engine is designed to resist at each applicable operating condition specified in this section. Each accessory drive and mounting attachment must be loaded. During operation at rated takeoff power and rated maximum continuous power, the load imposed by each accessory used only for an aircraft service must be the limit load specified by the applicant for the engine drive or attachment point.

- (b) *Unsupercharged engines and engines incorporating a gear-driven single-speed supercharger*. For engines not incorporating a supercharger and for engines incorporating a gear-driven single-speed supercharger the applicant must conduct the following runs :

- (1) A 30-hour run consisting of alternate periods of 5 minutes at rated takeoff power with takeoff speed, and 5 minutes at maximum best economy cruising power or maximum recommended cruising power.
- (2) A 20-hour run consisting of alternate periods of 1 1/2 hours at rated maximum continuous power with maximum continuous speed, and 1/2 hour at 75 percent rated maximum continuous power and 91 percent maximum continuous speed.

FAR 33.41 : Applicability.

This subpart prescribes the block tests and inspections for reciprocating aircraft engines.

FAR 33.42 : [General.]

[Before each endurance test required by this subpart, the adjustment setting and functioning characteristic of each component having an adjustment setting and a functioning characteristic that can be established independent of installation on the engine must be established and recorded.]
Amdt. 33-6, Eff. 10/31/74

FAR 33.43 : Vibration test.

(a) [Each engine must undergo a vibration survey to establish the torsional and bending vibration characteristics of the crankshaft and the propeller shaft or other output shaft, over the range of crankshaft speed and engine power, under steady state and transient conditions, from idling speed to either 110 percent of the desired maximum continuous speed rating or 103 percent of the maximum desired takeoff speed rating, whichever is higher. The survey must be conducted using, for airplane engines, the same configuration of the propeller type which is used for the endurance test, and using, for other engines, the same configuration of the loading device type which is used for the endurance test.]

(b) The torsional and bending vibration stresses of the crankshaft and the propeller shaft or other output shaft may not exceed the endurance limit stress of the material from which the shaft is made. If the maximum stress in the shaft cannot be shown to be below the endurance limit by measurement, the vibration frequency and amplitude must be measured. The peak amplitude must be shown to produce a stress below the endurance limit; if not, the engine must be run at the condition producing the peak amplitude until, for steel shafts, 10 million stress reversals have been sustained without fatigue failure and, for other shafts, until it is shown that fatigue will not occur within the endurance limit stress of the material.

(c) Each accessory drive and mounting attachment must be loaded, with the loads imposed by each accessory used only for an aircraft service being the limit load specified by the applicant for the drive or attachment point.

(d) [The vibration survey described in paragraph (a) of this section must be repeated with that cylinder not firing which has the most adverse vibration effect, in order to establish the conditions under which the engine can be operated safely in that abnormal state. However, for this vibration survey, the engine speed range need only extend from idle to the maximum desired takeoff speed, and compliance with paragraph (b) of this section need not be shown.]

Amdt. 33-10, Eff. 3/26/84

FAR 33.45 : Calibration tests.

(a) [Each engine must be subjected to the calibration tests necessary to establish its power characteristics and the conditions for the endurance test specified in Sec. 33.49. The results of the power characteristics calibration tests form the basis for

during regular business hours at the U.S. Department of Transportation, Plaza Level 401, 400 7th Street, SW, Washington, DC 20590-0001. Or you can view and download docketed materials through the Internet at <http://dms.dot.gov>. If you can't find the material in the electronic docket, contact the person listed under FOR FURTHER INFORMATION CONTACT in the document you are interested in.

(b) *Regulation identifier number.* DOT publishes a semiannual agenda of all current and projected DOT rulemakings, reviews of existing regulations, and completed actions. This semiannual agenda appears in the Unified Agenda of Federal Regulations, published in the *Federal Register* in April and October of each year. The semiannual agenda tells the public about DOT's—including FAA's—regulatory activities. DOT assigns a regulation identifier number (RIN) to each individual rulemaking proceeding in the semiannual agenda. This number appears on all rulemaking documents published in the *Federal Register* and makes it easy for you to track those rulemaking proceedings in both the *Federal Register* and the semiannual regulatory agenda.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.35 : Does FAA include sensitive security information and proprietary information in the Docket Management System (DMS) ?

(a) *Sensitive security information.* You should not submit sensitive security information to the rulemaking docket, unless you are invited to do so in our request for comments. If we ask for this information, we will tell you in the specific document how to submit this information, and we will provide a separate non-public docket for it. For all proposed rule changes involving civil aviation security, we review comments as we receive them, before they are placed in the docket. If we find that a comment contains sensitive security information, we remove that information before placing the comment in the general docket.

(b) *Proprietary information.* When we are aware of proprietary information filed with a comment, we do not place it in the docket. We hold it in a separate file to which the public does not have access, and place a note in the docket that we have received it. If we receive a request to examine or copy this information, we treat it as any other request under the Freedom of Information Act (5 U.S.C. 552). We process such a request under the DOT procedures found in 49 CFR part 7.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.37 : Where can I find information about an Airworthiness Directive, an airspace designation, or a petition handled in a region ?

The FAA includes most documents concerning Airworthiness Directives, airspace designations, or petitions handled in a region in the electronic docket. If the information isn't in the docket, contact the person listed under FOR FURTHER INFORMATION CONTACT in the *Federal Register* document about the action.
Amdt. 11-46, Eff. 9/20/2000

FAR 11.38: What public comment procedures does the FAA follow for Special Conditions?

Even though the Administrative Procedure Act does not require notice and comment for rules of particular applicability, FAA does publish proposed special conditions for comment. In the following circumstances we may not invite comment before we issue a special condition. If we don't, we will invite comment when we publish the final special condition.

- (a) The FAA considers prior notice to be impracticable if issuing a design approval would significantly delay delivery of the affected aircraft. We consider such a delay to be contrary to the public interest.
- (b) The FAA considers prior notice to be unnecessary if we have provided previous opportunities to comment on substantially identical proposed special conditions, and we are satisfied that new comments are unlikely.

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FAR 11.39: How may I participate in FAA's rulemaking process?

You may participate in FAA's rulemaking process by doing any of the following :

- (a) File written comments on any rulemaking document that asks for comments, including an ANPRM, NPRM, SNPRM, a final rule with request for comments, or a direct final rule. Follow the directions for commenting found in each rulemaking document.
- (b) Ask that we hold a public meeting on any rulemaking, and participate in any public meeting that we hold.
- (c) File a petition for rulemaking that asks us to adopt, amend, or repeal a regulation.

FAR 11.40: Can I get more information about a rulemaking?

You can contact the person listed under **FOR FURTHER INFORMATION CONTACT** in the preamble of a rule. That person can explain the meaning and intent of a proposed rule, the technical aspects of a document, the terminology in a document, and can tell you our published schedule for the rulemaking process. We cannot give you information that is not already available to other members of the public. The Department of Transportation's policy on oral communications with the public during rulemaking appears in Appendix I of this part.

FAR 11.41: Who may file comments?

Anyone may file written comments about proposals and final rules that request public comments.

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FAR 11.43 : What information must I put in my written comments?

- (a) Your written comments must be in English and must contain the following :

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Chapitre 91

Subpart D : Block Tests; Reciprocating Aircraft Engines

FAR 33.31 : Applicability.

This subpart prescribes additional design and construction requirements for reciprocating aircraft engines.

FAR 33.33 : Vibration.

The engine must be designed and constructed to function throughout its normal operating range of crankshaft rotational speeds and engine powers without inducing excessive stress in any of the engine parts because of vibration and without imparting excessive vibration forces to the aircraft structure.

FAR 33.35 : Fuel and induction system.

- (a) The fuel system of the engine must be designed and constructed to supply an appropriate mixture of fuel to the cylinders throughout the complete operating range of the engine under all flight and atmospheric conditions.
- (b) The intake passages of the engine through which air or fuel in combination with air passes for combustion purposes must be designed and constructed to minimize the danger of ice accretion in those passages. The engine must be designed and constructed to permit the use of a means for ice prevention.
- (c) The type and degree of fuel filtering necessary for protection of the engine fuel system against foreign particles in the fuel must be specified. The applicant must show that foreign particles passing through the prescribed filtering means will not critically impair engine fuel system functioning.
- (d) Each passage in the induction system that conducts a mixture of fuel and air must be self-draining, to prevent a liquid lock in the cylinders, in all attitudes that the applicant establishes as those the engine can have when the aircraft in which it is installed is in the static ground attitude.
- (e) [If provided as part of the engine, the applicant must show for each fluid injection (other than fuel) system and its controls that the flow of the injected fluid is adequately controlled.]

Amdt. 33-10, Eff. 3/26/84

FAR 33.37 : Ignition system.

Each spark ignition engine must have a dual ignition system with at least two spark plugs for each cylinder and two separate electric circuits with separate sources of electrical energy, or have an ignition system of equivalent in-flight reliability.

FAR 33.39 : Lubrication system.

- (a) The lubrication system of the engine must be designed and constructed so that it will function properly in all flight attitudes and atmospheric conditions in which the airplane is expected to operate. In wet sump engines, this requirement must be met when only one-half of the maximum lubricant supply is in the engine.
- (b) The lubrication system of the engine must be designed and constructed to allow installing a means of cooling the lubricant.
- (c) The crankcase must be vented to the atmosphere to preclude leakage of oil from excessive pressure in the crankcase.

- (1) The docket number of the rulemaking document you are commenting on, clearly set out at the beginning of your comments.
 - (2) Your name and mailing address, and, if you wish, other contact information, such as a fax number, telephone number, or e-mail address.
 - (3) Your information, views, or arguments, following the instructions for participation in the rulemaking document on which you are commenting.
- (b) You should also include all material relevant to any statement of fact or argument in your comments, to the extent that the material is available to you and reasonable for you to submit. Include a copy of the title page of the document. Whether or not you submit a copy of the material to which you refer, you should indicate specific places in the material that support your position.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.45 : Where and when do I file my comments ?

- (a) Send your comments to the location specified in the rulemaking document on which you are commenting. If you are asked to send your comments to the Docket Management System, you may send them in either of the following ways :
 - (1) By mail to : U.S. Department of Transportation, Docket Management System, 400 7th Street, SW., Plaza Level 401, Washington, DC 20591.
 - (2) Through the Internet to <http://dms.dot.gov/>.
 - (3) In any other manner designated by FAA.
- (b) Make sure that your comments reach us by the deadline set out in the rulemaking document on which you are commenting. We will consider late-filed comments to the extent possible only if they do not significantly delay the rulemaking process.
- (c) We may reject your paper or electronic comments if they are frivolous, abusive, or repetitious. We may reject comments you file electronically if you do not follow the electronic filing instructions at the Docket Management System web site.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.47 : May I ask for more time to file my comments ?

Yes, if FAA grants your request for more time to file comments, we grant all persons the same amount of time. We will notify the public of the extension by a document in the *Federal Register*. If FAA denies your request, we will notify you of the denial. To ask for more time, you must file a written or electronic request for extension at least 10 days before the end of the comment period. Your letter or message must—

- (a) Show the docket number of the rule at the top of the first page;
- (b) State, at the beginning, that you are requesting an extension of the comment period ;
- (c) Show that you have good cause for the extension and that an extension is in the public interest ;
- (d) Be sent to the address specified for comments in the rulemaking document on which you are commenting.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.51 : May I request that FAA hold a public meeting on a rulemaking action ?

Yes, you may request that we hold a public meeting. FAA holds a public meeting when we need more than written comments to make a fully informed decision. Submit your written request to the address specified in the rulemaking document on which you are commenting. Specify at the top of your letter or message that you are requesting that the agency hold a public meeting. Submit your request no later than 30 days after our rulemaking notice. If we find good cause for a meeting, we will notify you and publish a notice of the meeting in the *Federal Register*.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.53 : What takes place at a public meeting ?

A public meeting is a non-adversarial, fact-finding proceeding conducted by an FAA representative. Public meetings are announced in the *Federal Register*. We invite interested persons to attend and to present their views to the agency on specific issues. There are no formal pleadings and no adverse parties, and any regulation issued afterward is not necessarily based exclusively on the record of the meeting.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.61 : May I ask FAA to adopt, amend, or repeal a regulation, or grant relief from the requirements of a current regulation ?

(a) Using a petition for rulemaking, you may ask FAA to add a new regulation to title 14 of the Code of Federal Regulations (14 CFR) or ask FAA to amend or repeal a current regulation in 14 CFR.

(b) Using a petition for exemption, you may ask FAA to grant you relief from current regulations in 14 CFR.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.63 : How and to whom do I submit my petition for rulemaking or petition for exemption ?

(a) For paper submissions, send the original signed copy of your petition for rulemaking or exemption to this address : U.S. Department of Transportation, Docket Management System, 400 7th Street, SW., Room PL 401, Washington, DC 20591-0001.

(b) For electronic submissions, submit your petition to FAA through the Internet using the Docket Management System web site at this Internet address : *http://dms.dot.gov/*.

(c) In the future, FAA may designate other means by which you can submit petitions.

(d) Submit your petition for exemption 120 days before you need the exemption to take effect.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.71 : What information must I include in my petition for rulemaking ?

(a) You must include the following information in your petition for rulemaking :

(1) Your name and mailing address and, if you wish, other contact information such as a fax number, telephone number, or e-mail address.

Chapitre 90

Subpart C : Design and Construction ; Reciprocating Aircraft Engines

Sommaire

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- (2) An explanation of your proposed action and its purpose.
- (3) The language you propose for a new or amended rule, or the language you would remove from a current rule.
- (4) An explanation of why your proposed action would be in the public interest.
- (5) Information and arguments that support your proposed action, including relevant technical and scientific data available to you.
- (6) Any specific facts or circumstances that support or demonstrate the need for the action you propose.
- (b) In the process of considering your petition, we may ask that you provide information or data available to you about the following :
 - (1) The costs and benefits of your proposed action to society in general, and identifiable groups within society in particular.
 - (2) The regulatory burden of your proposed action on small businesses, small organizations, small governmental jurisdictions, and Indian tribes.
 - (3) The recordkeeping and reporting burdens of your proposed action and whom the burdens would affect.
 - (4) The effect of your proposed action on the quality of the natural and social environments.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.73 : How does FAA process petitions for rulemaking ?

After we have determined the disposition of your petition, we will contact you in writing about our decision. The FAA may respond to your petition for rulemaking in one of the following ways :

- (a) If we determine that your petition justifies our taking the action you suggest, we may issue an NPRM or ANPRM. We will do so no later than 6 months after the date we receive your petition. In making our decision, we consider :
 - (1) The immediacy of the safety or security concerns you raise ;
 - (2) The priority of other issues the FAA must deal with ; and
 - (3) The resources we have available to address these issues.
- (b) If we have issued an ANPRM or NPRM on the subject matter of your petition, we will consider your arguments for a rule change as a comment in connection with the rulemaking proceeding. We will not treat your petition as a separate action.
- (c) If we have begun a rulemaking project in the subject area of your petition, we will consider your comments and arguments for a rule change as part of that project. We will not treat your petition as a separate action.
- (d) If we have tasked ARAC to study the general subject area of your petition, we will ask ARAC to review and evaluate your proposed action. We will not treat your petition as a separate action.
- (e) If we determine that the issues you identify in your petition may have merit, but do not address an immediate safety concern or cannot be addressed because of other priorities and resource constraints, we may dismiss your petition. Your comments and arguments for a rule change will be placed in a database, which we will examine when we consider future rulemaking.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.75 : Does FAA invite public comment on petitions for rulemaking?

Generally, FAA does not invite public comment on petitions for rulemaking.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.77 : Is there any additional information I must include in my petition for designating airspace?

In petitions asking FAA to establish, amend, or repeal a designation of airspace, including special use airspace, you must include all the information specified by § 11.71 and also :

- (a) The location and a description of the airspace you want assigned or designated ;
- (b) A complete description of the activity or use to be made of that airspace, including a detailed description of the type, volume, duration, time, and place of the operations to be conducted in the area ;
- (c) A description of the air navigation, air traffic control, surveillance, and communication facilities available and to be provided if we grant the designation; and
- (d) The name and location of the agency, office, facility, or person who would have authority to permit the use of the airspace when it was not in use for the purpose to which you want it assigned.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.81 : What information must I include in my petition for an exemption?

You must include the following information in your petition for an exemption and submit it to FAA as soon as you know you need an exemption.

- (a) Your name and mailing address and, if you wish, other contact information such as a fax number, telephone number, or e-mail address;
- (b) The specific section or sections of 14 CFR from which you seek an exemption ;
- (c) The extent of relief you seek, and the reason you seek the relief ;
- (d) The reasons why granting your request would be in the public interest ; that is, how it would benefit the public as a whole ;
- (e) The reasons why granting the exemption would not adversely affect safety, or how the exemption would provide a level of safety at least equal to that provided by the rule from which you seek the exemption ;
- (f) A summary we can publish in the *Federal Register*, stating :
 - (1) The rule from which you seek the exemption ; and
 - (2) A brief description of the nature of the exemption you seek ;
- (g) Any additional information, views or arguments available to support your request ; and
- (h) If you want to exercise the privileges of your exemption outside the United States, the reason why you need to do so.

Amdt. 11-46, Eff. 9/20/2000

- (e) Have all associated software designed and implemented to prevent errors that would result in an unacceptable loss of power or thrust, or other unsafe condition, and have the method used to design and implement the software approved by the Administrator.]

Amdt. 33-15, Eff. 8/16/93

FAR 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 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) Determine, in a positive manner, that the engine has been operated at each rating ; and
 - (3) Automatically record each usage and duration of power at each rating.]

Amdt. 33-18, Eff. 8/19/96

(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, 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.
- (iv) 120 percent of the r.p.m. at which, while cold spinning, it is subject to operating stresses that are equivalent to those induced at the maximum operating temperature and maximum permissible r.p.m.
- (v) 105 percent of the highest speed that would result from failure of the most critical component or system in a representative installation of the engine.
- (vi) The highest speed that would result from the failure of any component or system in a representative installation of the engine, in combination with any failure of a component or system that would not normally be detected during a routine preflight check or during normal flight operation.]

Following the test, each rotor must be within approved dimensional limits for an overspeed condition and may not be cracked.

Amdt. 33-10, Eff. 3/26/84

FAR 33.28 : [Electrical and electronic control systems.]

[Each control system which relies on electrical and electronic means for normal operation must :

- (a) Have the control system description, the percent of available power or thrust controlled in both normal operation and failure conditions, and the range of control of other controlled functions, specified in the instruction manual required by Sec. 33.5 for the engine;
- (b) Be designed and constructed so that any failure of aircraft-supplied power or data will not result in an unacceptable change in power or thrust, or prevent continued safe operation of the engine;
- (c) Be designed and constructed so that no single failure or malfunction, or probable combination of failures of electrical or electronic components of the control system, results in an unsafe condition;
- (d) Have environmental limits, including transients caused by lightning strikes, specified in the instruction manual ; and

FAR 11.83 : How can I operate under an exemption outside the United States ?

If you want to be able to operate under your exemption outside the United States, you must request this when you petition for relief and give us the reason for this use. If you do not provide your reason or we determine that it does not justify this relief, we will limit your exemption to use within the United States. Before we extend your exemption for use outside the United States, we will verify that the exemption would be in compliance with the Standards of the International Civil Aviation Organization (ICAO). If it would not, but we still believe it would be in the public interest to allow you to do so, we will file a difference with ICAO. However, a foreign country still may not allow you to operate in that country without meeting the ICAO standard.
Amdt. 11-46, Eff. 9/20/2000

FAR 11.85 : Does FAA invite public comment on petitions for exemption ?

Yes, FAA publishes information about petitions for exemption in the *Federal Register*. The information includes–

- (a) The docket number of the petition ;
- (b) The citation to the rule or rules from which the petitioner requested relief;
- (c) The name of the petitioner ;
- (d) The petitioner's summary of the action requested and the reasons for requesting it ; and
- (e) A request for comments to assist FAA in evaluating the petition.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.87 : Are there circumstances in which FAA may decide not to publish a summary of my petition for exemption ?

The FAA may not publish a summary of your petition for exemption and request comments if you present or we find good cause why we should not delay action on your petition. The factors we consider in deciding not to request comment include :

- (a) Whether granting your petition would set a precedent.
- (b) Whether the relief requested is identical to exemptions granted previously.
- (c) Whether our delaying action on your petition would affect you adversely.
- (d) Whether you filed your petition in a timely manner.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.89 : How much time do I have to submit comments to FAA on a petition for exemption ?

The FAA states the specific time allowed for comments in the *Federal Register* notice about the petition. We usually allow 20 days to comment on a petition for exemption.
Amdt. 11-46, Eff. 9/20/2000

FAR 11.91 : How does FAA inform me of its decision on my petition for exemption ?

(a) The FAA will notify you in writing about its decision on your petition.

(b) The FAA publishes a summary in the *Federal Register* that includes—

- (1) The docket number of your petition;
- (2) Your name;
- (3) The citation to the rules from which you requested relief;
- (4) A brief description of the general nature of the relief requested;
- (5) Whether FAA granted or denied the request;
- (6) The date of FAA's decision; and
- (7) An exemption number.

Amdt. 11-46, Eff. 9/20/2000

FAR 11.101 : May I ask FAA to reconsider my petition for rulemaking or petition for exemption if it is denied ?

Yes, you may petition FAA to reconsider your petition denial. You must submit your request to the address to which you sent your original petition, and FAA must receive it within 60 days after we issued the denial. For us to accept your petition, show the following :

- (a) That you have a significant additional fact and why you did not present it in your original petition;
 - (b) That we made an important factual error in our denial of your original petition ; or
 - (c) That we did not correctly interpret a law, regulation, or precedent.
- Amdt. 11-46, Eff. 9/20/2000

FAR 11.103 : [What exemption relief may be available to federal, state, and local governments when operating aircraft that are not public aircraft ?]

[The Federal Aviation Administration may grant a federal, state, or local government an exemption from part A of subtitle VII of title 49 United States Code, and any regulation issued under that authority that is applicable to an aircraft as a result of the Independent Safety Board Act Amendments of 1994, Public Law 103-411, if—

- (a) The Administrator finds that granting the exemption is necessary to prevent an undue economic burden on the unit of government ; and
- (b) The Administrator certifies that the aviation safety program of the unit of government is effective and appropriate to ensure safe operations of the type of aircraft operated by the unit of government.]

Amdt. 11-48, Eff. 5/13/2003

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

Amdt. 33-10, Eff. 3/26/84

FAR 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 Sec. 35.42 of this chapter.

Amdt. 33-10, Eff. 3/26/84

FAR 33.21 : Engine cooling.

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

FAR 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, Eff. 3/26/84

FAR 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, Eff. 3/26/84

FAR 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.

Subpart B : Design and Construction; General	
FAR 33.11 : Applicability.	
This subpart prescribes the general design and construction requirements for reciprocating and turbine aircraft engines.	
FAR 33.13 : [Reserved.]	
[Reserved.] Amdt. 33-6, Eff. 10/31/74	
FAR 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 stopping. For each cycle, the rotor structural parts must reach stabilized temperature during engine operation at maximum rated 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, Eff. 3/26/84	
FAR 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.] Amdt. 33-10, Eff. 3/26/84	
FAR 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 a fireproof shield. (d) For turbine engines type certificated for use in supersonic aircraft, each external component which conveys or contains flammable fluid must be fireproof.	
1132	Recueil des articles de la FAR - http://www.elodieroux.com

Chapitre 2

Subpart B : Paperwork Reduction Act Control Numbers

Sommaire

FAR 11.201 : Office of Management and Budget (OMB) control numbers assigned under the Paperwork Reduction Act. 50

FAR 11.201 : Office of Management and Budget (OMB) control numbers assigned under the Paperwork Reduction Act.

(a) The Paperwork Reduction Act of 1995 (44 U.S.C. 3501-3520) requires FAA to get approval from OMB for our information collection activities, and to list a record of those approvals in the *Federal Register*. This subpart lists the control numbers OMB assigned to FAA's information collection activities.

(b) The table listing OMB control numbers assigned to FAA collection activities follows :

14 CFR part or section identified and described	Current OMB control number
Part 14	2120-0039
Part 17	2120-0082
Part 18	2120-0078
Part 34	2120-0058
Part 39	2120-0056
Part 43	2120-0020
Part 45	2120-0028
Part 47	2120-0024, 2120-0042
Part 49	2120-0043
Part 61	2120-0021, 2120-0034, 2120-0543, 2120-0571
Part 63	2120-0023
Part 65	2120-0022, 2120-0035, 2120-0571, 2120-0648
Part 67	2120-0014, 2120-0543
Part 77	2120-0001
Part 81	2120-0005, 2120-0026, 2120-0027, 2120-0573, 2120-0606, 2120-0620, 2120-0631, 2120-0641
Part 83	2120-0004, 2120-0006, 2120-0009
Part 85	2120-0027, 2120-0641
Part 102	2120-0076, 2120-0054, 2120-0028
Part 103	2120-0008, 2120-0025, 2120-0536, 2120-0571, 2120-0626, 2120-0642
Part 109	2120-0005
Part 119	2120-0593
Part 121	2120-0008, 2120-0025, 2120-0536, 2120-0571, 2120-0600, 2120-0606, 2120-0614, 2120-0616, 2120-0649, 2120-0650
Part 125	2120-0028, 2120-0026, 2120-0615, 2120-0651
Part 133	2120-0043
Part 135	2120-0028, 2120-0025, 2120-0536, 2120-0616, 2120-0638
Part 138	0016, 2120-0020, 2120-0051, 2120-0053
Part 139	2120-0049
Part 140	2120-0045, 2120-0063
Part 142	2120-0570
Part 145	2120-0003, 2120-0010, 2120-0571
Part 146	2120-0040
Part 147	2120-0577
Part 157	2120-0036
Part 158	2120-0557
Part 161	2120-0063
Part 163	2120-0033, 2120-0604
Part 183	2120-0514
Part 193	2120-0043, 2120-0644, 0649
Part 203	2120-0008
Part 401	2120-0001
Part 440	2120-0007
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SPAR 71	2120-0620

Amdt. 11-47, Ef. 3/1/2002

Chapitre 89

Subpart B : Design and Construction; General

Sommaire

FAR 33.11 : Applicability.	1132
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- (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) For engines to be used in supersonic aircraft, engine rotor windmilling rotational r.p.m.

Amdt. 33-18, Eff. 8/19/96

FAR 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, Eff. 4/3/67

Chapitre 3

Appendix 1 to Part 11

Sommaire

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FAR 11.A1 : Oral Communications With the Public During Rulemaking

1. What is an ex parte contact ? "Ex parte" is a Latin term that means "one sided," and indicates that not all parties to an issue were present when it was discussed. An ex parte contact involving rulemaking is any communication between FAA and someone outside the government regarding a specific rulemaking proceeding, before that proceeding closes. A rulemaking proceeding does not close until we publish the final rule or withdraw the NPRM. Because an ex parte contact excludes other interested persons, including the rest of the public, from the communication, it may give an unfair advantage to one party, or appear to do so.

2. Are written comments to the docket ex parte contacts ? Written comments submitted to the docket are not ex parte contacts because they are available for inspection by all members of the public.

3. What is DOT policy on ex parte contacts ? It is DOT policy provide for open development of rules and to encourage full public participation in rulemaking actions. In addition to providing opportunity to respond in writing to an NPRM and to appear and be heard at a hearing, DOT policy encourages agencies to contact the public directly when we need factual information to resolve questions of substance. It also encourages DOT agencies to be receptive to appropriate contacts from persons affected by or interested in a proposed action. But under some circumstances an ex parte contact could affect the basic openness and fairness of the rulemaking process. Even the appearance of impropriety can affect public confidence in the process. For this reason, DOT policy sets careful guidelines for these contacts. The kind of ex parte contacts permitted and the procedures we follow depend on when the contact occurs in the rulemaking process.

4. What kinds of ex parte contacts does DOT policy permit before we issue an ANPRM, NPRM, Supplemental NPRM, or immediately adopted final rule ? The DOT policy authorizes ex parte contacts that we need to obtain technical and economic information. We need this information to decide whether to issue a regulation and what it should say. Each contact that influences our development of the regulation is noted in the preamble. For multiple contacts that are similar, we may provide only a general discussion. For contacts not discussed in the preamble, we place a report discussing each contact or group of related contacts in the rulemaking docket when it is opened.

5. Does DOT policy permit ex parte contacts during the comment period ? No, during the comment period, the public docket is available for written comments from any member of the public. These comments can be examined and responded to by any interested person. Because this public forum is available, DOT policy discourages ex parte contacts during the comment period. They are not necessary to collect the information the agency needs to make its decision.

6. What if the FAA believes it needs to meet with members of the public to discuss the proposal ? If the FAA determines that it would be helpful to invite members of the public to make oral presentations to it regarding the proposal, we will announce a public meeting in the Federal Register.

(d) [Deleted]

(e) [Deleted]

Amdt. 33-9, EFF. 10/14/80

FAR 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 Sec. 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 ;

FAR 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. 33-14, Eff. 9/10/90

FAR 33.3 : General.

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

FAR 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, Eff. 10/14/80

FAR 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 cowlings.
 - (3) An outline drawing of the engine including overall dimensions.
- (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.
- (c) [[Deleted.]

7. Are any oral contacts concerning the proposal permitted during the comment period? If you contact the agency with questions regarding the proposal during the comment period, we can only provide you with information that has already been made available to the general public. If you contact the agency to discuss the proposal, you will be told that the proper avenue of communication during the comment period is a written communication to the docket.

8. If a substantive ex parte contact does occur during the comment period, what does FAA do? While FAA tries to ensure that FAA personnel and the public are aware of DOT policy, substantive ex parte contacts do occasionally occur, for example, at meetings not intended for that purpose. In such a case, we place a summary of the contact and a copy of any materials provided at the meeting in the rulemaking docket. We encourage participants in such a meeting to file written comments in the docket.

9. Does DOT policy permit ex parte contacts the comment period has closed? DOT policy strongly discourages ex parte contacts initiated by commenters to discuss their position on the proposal once the comment period has closed. Such a contact at this time would be improper, since other interested persons would not have an opportunity to respond. If we need further information regarding a comment in the docket, we may request this from a commenter. A record of this contact and the information provided is placed in the docket. If we need to make other contacts to update factual information, such as economic data, we will disclose this information in the final rule docket or in the economic studies accompanying it, which are available in the docket.

10. What if FAA needs to meet with interested persons to discuss the proposal after the comment period has closed? If FAA determines that it would be helpful to meet with a person or group after the close of the comment period to group to discuss a course of action to be taken, we will announce the meeting in the Federal Register. We will also consider reopening the comment period. If an inappropriate ex parte contact does occur after the comment period closes, a summary of the contact and a copy of any material distributed during meeting will be placed in the docket if it could be seen as influencing the rulemaking process.

11. Under what circumstances will FAA reopen the comment period? If we receive an ex parte communication after the comment period has closed that could substantially influence the rulemaking, we may reopen the comment period. DOT policy requires the agency to carefully consider whether the substance of the contact will give the commenter an unfair advantage, since the rest of the public may not see the record of the contact in the docket. When the substance of a proposed rule is significantly changed as a result of such an oral communication, DOT policy and practice requires that the comment period be reopened by issuing a supplemental NPRM in which the reasons for the change are discussed.

12. What if I have important information for FAA and the comment period is closed? You may always provide FAA with written information after the close of the comment period and it will be considered if time permits. Because contacts after the close of the comment may not be seen by other interested persons, if they substantially and specifically influence the FAA's decision, we may need to reopen the comment period.

Issued in Washington, DC, on August 8, 2000.

15/

Jane F. Garvey,

Administrator.

Amdt. 11-46, Eff. 9/20/2000

Chapitre 88

Subpart A : General

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Troisième partie

**FAR 13- Investigate and
enforcement procedures**

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Chapitre 4

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FAR 13.1 : Reports of violations.

- (a) Any person who knows of a violation of the Federal Aviation Act of 1958, as amended, the Hazardous Materials Transportation Act relating to the transportation or shipment by air of hazardous materials, the Airport and Airway Development Act of 1970, the Airport and Airway Improvement Act of 1982, the Airport and Airway Improvement Act of 1982 as amended by the Airport and Airway Safety and Capacity Expansion Act of 1987, or any rule, regulation, or order issued thereunder, should report it to appropriate personnel of any FAA regional or district office.
- (b) Each report made under this section, together with any other information the FAA may have that is relevant to the matter reported, will be reviewed by FAA personnel to determine the nature and type of any additional investigation or enforcement action the FAA will take.

FAR 13.3 : Investigations (general).

- (a) Under the Federal Aviation Act of 1958, as amended, (49 U.S.C. 1301 et seq.), the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.), the Airport and Airway Development Act of 1970 (49 U.S.C. 1701 et seq.), the Airport and Airway Improvement Act of 1982 (49 U.S.C. 2201 et seq.), the Airport and Airway Improvement Act of 1982 (as amended, 49 U.S.C. App. 2201 et seq., Airport and Airway Safety and Capacity Expansion Act of 1987), and the Regulations of the Office of the Secretary of Transportation (49 CFR 1 et seq.), the Administrator may conduct investigations, hold hearings, issue subpoenas, require the production of relevant documents, records, and property, and take evidence and depositions.
- (b) For the purpose of investigating alleged violations of the Federal Aviation Act of 1958, as amended the Hazardous Materials Transportation Act, the Airport and Airway Development Act of 1970, the Airport and Airway Improvement Act of 1982, the Airport and Airway Improvement Act of 1982 as amended by the Airport and Airway Safety and Capacity Expansion Act of 1987, or any rule, regulation, or order issued thereunder, the Administrator's authority has been delegated to the various services and or offices for matters within their respective areas for all routine investigations. When the compulsory processes of sections 313 and 1004 (49 U.S.C. 1354 and 1454) of the Federal Aviation Act, or section 109 of the Hazardous Materials Transportation Act (49 U.S.C. 1808) are invoked, the Administrator's authority has been delegated to the Chief Counsel, the Deputy Chief Counsel, each Assistant Chief Counsel, each Regional Counsel, the Aeronautical Center Counsel, and the Technical Center Counsel.
- (c) In conducting formal investigations, the Chief Counsel, the Deputy Chief Counsel, each Assistant Chief Counsel, each Regional Counsel, the Aeronautical Center Counsel, and the Technical Center Counsel may issue an order of investigation in accordance with Subpart F of this part.
- (d) A complaint against the sponsor, proprietor, or operator of a Federally-assisted airport involving violations of the legal authorities listed in § 16.1 of this chapter shall be filed in accordance with the provisions of part 16 of this chapter, except in the case of complaints, investigations, and proceedings initiated before December 16, 1996, the effective date of part 16 of this chapter.

Dixième partie

FAR 33- Airworthiness

standards : aircraft engines

FAR 13.5 : Formal complaints.

- (a) Any person may file a complaint with the Administrator with respect to anything done or omitted to be done by any person in contravention of any provision of any Act or of any regulation or order issued under it, as to matters within the jurisdiction of the Administrator. This section does not apply to complaints against the Administrator or employees of the FAA acting within the scope of their employment.
- (b) Complaints filed under this section must –
- (1) Be submitted in writing and identified as a complaint filed for the purpose of seeking an appropriate order or other enforcement action ;
 - (2) Be submitted to the Federal Aviation Administration, Office of the Chief Counsel, Attention : Enforcement Docket (AGC-10), 800 Independence Avenue, S.W., Washington, DC 20591 ;
 - (3) Set forth the name and address, if known, of each person who is the subject of the complaint and, with respect to each person, the specific provisions of the Act or regulation or order that the complainant believes were violated ;
 - (4) Contain a concise but complete statement of the facts relied upon to substantiate each allegation ;
 - (5) State the name, address and telephone number of the person filing the complaint ; and
 - (6) Be signed by the person filing the complaint or a duly authorized representative.
- (c) Complaints which do not meet the requirements of paragraph (b) of this section will be considered reports under § 13.1.
- (d) Complaints which meet the requirements of paragraph (b) of this section will be docketed and a copy mailed to each person named in the complaint.
- (e) Any complaint filed against a member of the Armed Forces of the United States acting in the performance of official duties shall be referred to the Secretary of the Department concerned for action in accordance with the procedures set forth in § 13.21 of this part.
- (f) The person named in the complaint shall file an answer within 20 days after service of a copy of the complaint.
- (g) After the complaint has been answered or after the allotted time in which to file an answer has expired, the Administrator shall determine if there are reasonable grounds for investigating the complaint.
- (h) If the Administrator determines that a complaint does not state facts which warrant an investigation or action, the complaint may be dismissed without a hearing and the reason for the dismissal shall be given, in writing, to the person who filed the complaint and the person named in the complaint.
- (i) If the Administrator determines that reasonable grounds exist, an informal investigation may be initiated or an order of investigation may be issued in accordance with Subpart F of this part, or both. Each person named in the complaint shall be advised which official has been delegated the responsibility under § 13.3(b) or (c) for conducting the investigation.

- (j) If the investigation substantiates the allegations set forth in the complaint, a notice of proposed order may be issued or other enforcement action taken in accordance with this part.
- (k) The complaint and other pleadings and official FAA records relating to the disposition of the complaint are maintained in current docket form in the Enforcement Docket (AGC-10), Office of the Chief Counsel, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D. C. 20591. Any interested person may examine any docketed material at that office, at any time after the docket is established, except material that is ordered withheld from the public under applicable law or regulations, and may obtain a photostatic or duplicate copy upon paying the cost of the copy. (Secs. 313(a), 314(a), 601 through 610, and 1102 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421 through 1430, 1502) ; sec. 6(c), Dept. of Transportation Act (49 U.S.C. 1655(c)))

FAR 13.7 : Records, documents and reports.

Each record, document and report that the Federal Aviation Regulations require to be maintained, exhibited or submitted to the Administrator may be used in any investigation conducted by the Administrator ; and, except to the extent the use may be specifically limited or prohibited by the section which imposes the requirement, the records, documents and reports may be used in any civil penalty action, certificate action, or other legal proceeding.

- (g) Details of what, and how, to inspect after a hard landing.

- (h) Instructions for storage preparation, including any storage limits.

- (i) Instructions for repair of the balloon envelope and its basket or trapeze.]
Amdt. 31-4, Eff. 10/14/80

FAR 31.A4 : Airworthiness Limitations section.

The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, structural inspection interval, and related structural inspection procedure, including envelope structural integrity, required for type certification. If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads : "The Airworthiness Limitations section is FAA approved and specifies maintenance required under Secs. 43.16 and [91.403] of the Federal Aviation Regulations."

Amdt. 31-5, Eff. 8/18/90

FAR 31.A1 : [General.]

- (a) [This appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by Sec. 31.82.]
 - (b) The Instructions for Continued Airworthiness for each balloon must include the Instructions for Continued Airworthiness for all balloon parts required by this chapter and any required information relating to the interface of those parts with the balloon. If Instructions for Continued Airworthiness are not supplied by the part manufacturer for a balloon part, the Instructions for Continued Airworthiness for the balloon must include the information essential to the continued airworthiness of the balloon.
 - (c) The applicant must submit to the FAA a program to show how changes to the Instructions for Continued Airworthiness made by the applicant or by the manufacturers of balloon parts will be distributed.]
- Amdt. 31-4, Eff. 10/14/80

FAR 31.A2 : [Format.]

- (a) [The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.]
 - (b) The format of the manual or manuals must provide for a practical arrangement.]
- Amdt. 31-4, Eff. 10/14/80

FAR 31.A3 : [Content.]

- [The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following information :
- (a) Introduction information that includes an explanation of the balloon's features and data to the extent necessary for maintenance or preventive maintenance.
 - (b) A description of the balloon and its systems and installations.
 - (c) Basic control and operation information for the balloon and its components and systems.
 - (d) Servicing information that covers details regarding servicing of balloon components, including burner nozzles, fuel tanks, and valves during operations.
 - (e) Maintenance information for each part of the balloon and its envelope, controls, rigging, basket structure, fuel systems, instruments, and heater assembly that provides the recommended periods at which it should be cleaned, adjusted, tested, and lubricated, the applicable wear tolerances, and the degree of work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree of complexity requiring specialized maintenance techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross references to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the balloon.
 - (f) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.

Chapitre 5

Subpart B : Administrative Actions

Sommaire

FAR 13.11 : Administrative disposition of certain violations.

- (a) If it is determined that a violation or an alleged violation of the Federal Aviation Act of 1958, or an order or regulation issued under it, or of the Hazardous Materials Transportation Act, or an order or regulation issued under it, does not require legal enforcement action, an appropriate official of the FAA field office responsible for processing the enforcement case or other appropriate FAA official may take administrative action in disposition of the case.
- (b) An administrative action under this section does not constitute a formal adjudication of the matter, and may be taken by issuing the alleged violator –
 - (1) A "Warning Notice" which recites available facts and information about the incident or condition and indicates that it may have been a violation; or
 - (2) A "Letter of Correction" which confirms the FAA decision in the matter and states the necessary corrective action the alleged violator has taken or agrees to take. If the agreed corrective action is not fully completed, legal enforcement action may be taken

Chapitre 87

Appendix A : Instructions for Continued Airworthiness

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[Deleted.]
Amdt. 31-1, Eff. 2/1/65

FAR 31.93 : [Deleted.]

[Deleted.]
Amdt. 31-1, Eff. 2/1/65

FAR 31.95 : [Deleted.]

[Deleted.]
Amdt. 31-1, Eff. 2/1/65

FAR 31.97 : [Deleted.]

[Deleted.]
Amdt. 31-1, Eff. 2/1/65

FAR 31.99 : [Deleted.]

[Deleted.]
Amdt. 31-1, Eff. 2/1/65

FAR 31.101 : [Deleted.]

[Deleted.]
Amdt. 31-1, Eff. 2/1/65

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[Deleted.]
Amdt. 31-1, Eff. 2/1/65

FAR 31.105 : [Deleted.]

[Deleted.]
Amdt. 31-1, Eff. 2/1/65

Chapitre 6

Subpart C : Legal Enforcement Actions

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FAR 13.13 : Consent orders.

- (a) At any time before the issuance of an order under this subpart, the official who issued the notice and the person subject to the notice may agree to dispose of the case by the issuance of a consent order by the official.
- (b) A proposal for a consent order, submitted to the official who issued the notice, under this section must include –
 - (1) A proposed order ;
 - (2) An admission of all jurisdictional facts ;
 - (3) An express waiver of the right to further procedural steps and of all rights to judicial review ; and
 - (4) An incorporation by reference of the notice and an acknowledgment that the notice may be used to construe the terms of the order.
- (c) If the issuance of a consent order has been agreed upon after the filing of a request for hearing in accordance with Subpart D of this part, the proposal for a consent order shall include a request to be filed with the Hearing Officer withdrawing the request for a hearing and requesting that the case be dismissed.

FAR 13.15 : Civil penalties : Federal Aviation Act of 1958, as amended, involving an amount in controversy in excess of \$50,000; an in rem action; seizure of aircraft ; or injunctive relief.

- (a) The following penalties apply to persons who violate the Federal Aviation Act of 1958, as amended :
 - (1) Any person who violates any provision of Title III, V, VI, or XII of the Federal Aviation Act of 1958, as amended, or any rule, regulation, or order issued thereunder, is subject to a civil penalty of not more than the amount specified in the Act for each violation in accordance with section 901 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1471, et seq.).
 - (2) Any person who violates section 404(d) of the Federal Aviation Act of 1958, as amended, or any rule, regulation, or order issued thereunder, is subject to a civil penalty of not more than the amount specified in the Act for each violation in accordance with section 404(d) or section 901 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1374, 1471, et seq.).
 - (3) Any person who operates aircraft for the carriage of persons or property for compensation or hire (other than an airman serving in the capacity of an airman) is subject to a civil penalty of not more than \$10,000 for each violation of Title III, VI, or XII of the Federal Aviation Act of 1958, as amended, or any rule, regulation, or order issued thereunder, occurring after December 30, 1987, in accordance with section 901 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1471 et seq.).
- (b) The authority of the Administrator, under section 901 of the Federal Aviation Act of 1958, as amended, to propose a civil penalty for a violation of that Act, or a rule, regulation, or order issued thereunder, and the ability to refer cases to the United States Attorney General, or the delegate of the Attorney General, for prosecution of civil penalty actions proposed by the Administrator, involving an amount in controversy in excess of \$50,000, an in rem action, seizure of aircraft subject to lien, or suit for injunctive relief, or for collection of an assessed civil penalty, is delegated

Chapitre 86

Subpart G : Certification Procedures

Sommaire

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to the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, the Regional Counsel, the Aeronautical Center Counsel, and the Technical Center Counsel.

- (c) The Administrator may compromise any civil penalty, proposed in accordance with section 901 of the Federal Aviation Act of 1958, as amended, involving an amount in controversy in excess of \$50,000, an in rem action, seizure of aircraft subject to lien, or suit for injunctive relief, prior to referral of the civil penalty action to the United States Attorney General, or the delegate of the Attorney General, for prosecution.

(1) The Administrator, through the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, the Regional Counsel, the Aeronautical Center Counsel, and the Technical Center Counsel sends a civil penalty letter to the person charged with a violation of the Federal Aviation Act of 1958, as amended, or a rule, regulation, or order issued thereunder. The civil penalty letter contains a statement of the charges, the applicable law, rule, regulation, or order, the amount of civil penalty that the Administrator will accept in full settlement of the action or an offer to compromise the civil penalty.

(2) Not later than 30 days after receipt of the civil penalty letter, the person charged with a violation may present any material or information in answer to the charges to the agency attorney, either orally or in writing, that may explain, mitigate, or deny the violation or that may show extenuating circumstances. The Administrator will consider any material or information submitted in accordance with this paragraph to determine whether the person is subject to a civil penalty or to determine the amount for which the Administrator will compromise the action.

(3) If the person charged with the violation offers to compromise for a specific amount, that person shall send a certified check or money order for that amount, payable to the Federal Aviation Administration, to the agency attorney. The Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, the Regional Counsel, the Aeronautical Center Counsel, or the Technical Center Counsel may accept the certified check or money order or may refuse and return the certified check or money order.

(4) If the offer to compromise is accepted by the Administrator, the agency attorney will send a letter to the person charged with the violation stating that the certified check or money order is accepted in full settlement of the civil penalty action.

(5) If the parties cannot agree to compromise the civil penalty action or the offer to compromise is rejected and the certified check or money order submitted in compromise is returned, the Administrator may refer the civil penalty action to the United States Attorney General, or the delegate of the Attorney General, to begin proceedings in a United States District Court, pursuant to the authority in section 903 of the Federal Aviation Act, as amended (49 U.S.C. 1473), to prosecute and collect the civil penalty.

FAR 13.16 : Civil penalties : Federal Aviation Act of 1958, involving an amount in controversy not exceeding \$50,000 ; Hazardous Materials Transportation Act.

- (a) *General* The following penalties apply to persons who violate the Federal Aviation Act of 1958, as amended, and the Hazardous Materials Transportation Act :
- (1) Any person who violates any provision of title III, V, VI, or XII of the Federal Aviation Act of 1958, as amended, or any rule, regulation, or order issued thereunder, is subject to a civil penalty of not more than the amount specified in the Act for each violation in the Act for each violation in accordance with section 901 of the Federal Aviation Act, of 1958, as amended (49 U.S.C. 1471, et seq.).
 - (2) Any person who violates section 404(d) of the Federal Aviation Act of 1958, as amended, or any rule, regulation, or order issued thereunder, is subject to a civil penalty of not more than the amount specified in the Act for each violation in accordance with section 404(d) or section 901 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1374, 1471, et seq.).
 - (3) Any person who operates aircraft for the carriage of persons or property for compensation or hire (other than an airman serving in the capacity of an airman) is subject to a civil penalty of not more than \$10,000 for each violation of title III, VI, or XII of the Federal Aviation Act of 1958, as amended, or any rule, regulation, or order issued thereunder, occurring after December 30, 1987, in accordance with section 901 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1471, et seq.).
 - (4) Any person who knowingly commits an act in violation of the Hazardous Materials Transportation Act, or any rule, regulation, or order issued thereunder, is subject to a civil penalty of not more than \$10,000 for each violation in accordance with section 901 of the Federal Aviation Act of 1958, as amended, and section 110 of the Hazardous Materials Transportation Act (49 U.S.C. 1471 and 1809, et seq.). An order assessing civil penalty for a violation under the Hazardous Materials Transportation Act, or a rule, regulation, or order issued thereunder, will be issued only after consideration of –
 - (i) The nature and circumstances of the violation ;
 - (ii) The extent and gravity of the violation ;
 - (iii) The person's degree of culpability ;
 - (iv) The person's history of prior violations ;
 - (v) The person's ability to pay the civil penalty ;
 - (vi) The effect on the person's ability to continue in business ; and
 - (vii) Such other matters as justice may require.
 - (b) *Order assessing civil penalty.* An order assessing civil penalty may be issued for a violation described in paragraph (a) of this section, or as otherwise provided by statute, after notice and opportunity for a hearing. A person charged with a violation may be subject to an order assessing civil penalty in the following circumstances :
 - (1) An order assessing civil penalty may be issued if a person charged with a violation submits or agrees to submit a civil penalty for a violation.
 - (2) An order assessing civil penalty may be issued if a person charged with a violation does not request a hearing under paragraph (e)(2)(ii) of this section within 15 days after receipt of a final notice of proposed civil penalty.

- (1) [A fuel quantity gauge. If fuel cells are used, means must be incorporated to indicate to the crew the quantity of fuel in each cell during flight. The means must be calibrated in appropriate units or in percent of fuel cell capacity.]

- (2) An envelope temperature indicator.
 - (c) For captive gas balloons, a compass.
- Amdt. 31-4, E.F. 10/14/80

FAR 31.81 : General.

(a) [The following information must be established :

- (1) Each operating limitation, including the maximum weight determined under Sec. 31.14.
- (2) The normal and emergency procedures.
- (3) Other information necessary for safe operation, including—
 - (i) The empty weight determined under Sec. 31.16;
 - (ii) The rate of climb determined under Sec. 31.17, and the procedures and conditions used to determine performance;
 - (iii) The maximum vertical velocity, the altitude drop required to attain that velocity, and altitude drop required to recover from a descent at that velocity, determined under Sec. 31.19, and the procedures and conditions used to determine performance; and
 - (iv) Pertinent information peculiar to the balloon's operating characteristics.
- (b) The information established in compliance with paragraph (a) of this section must be furnished by means of—
 - (1) A Balloon Flight Manual; or
 - (2) A placard on the balloon that is clearly visible to the pilot.]

Amdt. 31-4, Eff. 10/14/80

FAR 31.82 : [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 balloon or issuance of a standard certificate of airworthiness, whichever occurs later.]

Amdt. 31-4, Eff. 10/14/80

FAR 31.83 : Conspicuity.

The exterior surface of the envelope must be of a contrasting color or colors so that it will be conspicuous during operation. However, multicolored banners or streamers are acceptable if it can be shown that they are large enough, and there are enough of them of contrasting color, to make the balloon conspicuous during flight.

FAR 31.85 : Required basic equipment.

In addition to any equipment required by this subchapter for a specific kind of operation, the following equipment is required :

- (a) For all balloons :
 - (1) [Reserved]
 - (2) An altimeter.
 - (3) A rate of climb indicator.
- (b) For hot air balloons :

(3) Unless an appeal is filed with the FAA decisionmaker in a timely manner, an initial decision or order of an administrative law judge shall be considered an order assessing civil penalty if an administrative law judge finds that an alleged violation occurred and determines that a civil penalty, in an amount found appropriate by the administrative law judge, is warranted.

(4) Unless a petition for review is filed with a U.S. Court of Appeals in a timely manner, a final decision and order of the Administrator shall be considered an order assessing civil penalty if the FAA decisionmaker finds that an alleged violation occurred and a civil penalty is warranted.

(c) *Delegation of authority.* The authority of the Administrator, under section 901 and section 905 of the Federal Aviation Act of 1958, as amended, and section 110 of the Hazardous Materials Transportation Act, to initiate and assess civil penalties for a violation of those Acts, or a rule, regulation, or order issued thereunder, is delegated to the Deputy Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, each Regional Counsel, the Aeronautical Center Counsel, and the Technical Center Counsel. The authority of the Administrator to refer cases to the Attorney General of the United States, or the delegate of the Attorney General, for the collection of civil penalties, is delegated to the Chief Counsel, the Deputy Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, each Regional Counsel, the Aeronautical Center Counsel, and the Technical Center Counsel.

(d) *Notice of proposed civil penalty.* A civil penalty action is initiated by sending a notice of proposed civil penalty to the person charged with a violation of the Federal Aviation Act of 1958, as amended, the Hazardous Materials Transportation Act, or a rule, regulation, or order issued thereunder. A notice of proposed civil penalty will be sent to the individual charged with a violation or to the president of the corporation or company charged with a violation. In response to a notice of proposed civil penalty, a corporation or company may designate in writing another person to receive documents in that civil penalty action. The notice of proposed civil penalty contains a statement of the charges and the amount of the proposed civil penalty. Not later than 30 days after receipt of the notice of proposed civil penalty, the person charged with a violation shall —

- (1) Submit the amount of the proposed civil penalty or an agreed-upon amount, in which case either an order assessing civil penalty or compromise order shall be issued in that amount ;
- (2) Submit to the agency attorney one of the following :
 - (i) Written information, including documents and witness statements, demonstrating that a violation of the regulations did not occur or that a penalty or the amount of the penalty is not warranted by the circumstances.
 - (ii) A written request to reduce the proposed civil penalty, the amount of reduction, and the reasons and any documents supporting a reduction of the proposed civil penalty, including records indicating a financial inability to pay or records showing that payment of the proposed civil penalty would prevent the person from continuing in business.

- (iii) A written request for an informal conference to discuss the matter with the agency attorney and to submit relevant information or documents ; or
- (3) Request a hearing in which case a complaint shall be filed with the hearing docket clerk.
- (e) *Final notice of proposed civil penalty.* A final notice of proposed civil penalty may be issued after participation in informal procedures provided in paragraph (d)(2) of this section or failure to respond in a timely manner to a notice of proposed civil penalty. A final notice of proposed civil penalty will be sent to the individual charged with a violation, to the president of the corporation or company charged with a violation, or a person previously designated in writing by the individual, corporation, or company to receive documents in that civil penalty action. If not previously done in response to a notice of proposed civil penalty, a corporation or company may designate in writing another person to receive documents in that civil penalty action. The final notice of proposed civil penalty contains a statement of the charges and the amount of the proposed civil penalty and, as a result of information submitted to the agency attorney during informal procedures, may modify an allegation or a proposed civil penalty contained in a notice of proposed civil penalty.
 - (1) A final notice of proposed civil penalty may be issued –
 - (i) If the person charged with a violation fails to respond to the notice of proposed civil penalty within 30 days after receipt of that notice ; or
 - (ii) If the parties participated in any informal procedures under paragraph (d)(2) of this section and the parties have not agreed to compromise the action or the agency attorney has not agreed to withdraw the notice of proposed civil penalty.
 - (2) Not later than 15 days after receipt of the final notice of proposed civil penalty, the person charged with a violation shall do one of the following –
 - (i) Submit the amount of the proposed civil penalty or an agreed-upon amount, in which case either an order assessing civil penalty or a compromise order shall be issued in that amount ; or
 - (ii) Request a hearing in which case a complaint shall be filed with the hearing docket clerk.
 - (f) *Request for a hearing.* Any person charged with a violation may request a hearing, pursuant to paragraph (d)(3) or paragraph (e)(2)(ii) of this section, to be conducted in accordance with the procedures in subpart G of this part. A person requesting a hearing shall file a written request for a hearing with the hearing docket clerk (Hearing Docket, Federal Aviation Administration, 800 Independence Avenue, SW, Room 924A, Washington, DC 20591, Attention : Hearing Docket Clerk) and shall mail a copy of the request to the agency attorney. The request for a hearing may be in the form of a letter but must be dated and signed by the person requesting a hearing. The request for a hearing may be typewritten or may be legibly handwritten.
 - (g) *Hearing.* If the person charged with a violation requests a hearing pursuant to paragraph (d)(3) or paragraph (e)(2)(ii) of this section, the original complaint shall be filed with the hearing docket clerk and a copy shall be sent to the person requesting the hearing. The procedural rules in subpart G of this part apply to the hearing and any appeal. At the close of the hearing, the administrative law judge shall issue,

Chapitre 85

Subpart F : Operating Limitations and Information

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FAR 31.71 : [Function and installation.]

- (a) [Each item of installed equipment must—
- (1) Be of a kind and design appropriate to its intended function ;
 - (2) Be permanently and legibly marked or, if the item is too small to mark, tagged as to its identification, function, or operating limitations, or any applicable combination of those factors ;
 - (3) Be installed according to limitations specified for that equipment ; and
 - (4) Function properly when installed.
- (b) No item of installed equipment, when performing its function, may affect the function of any other equipment so as to create an unsafe condition.
- (c) The equipment, systems, and installations must be designed to prevent hazards to the balloon in the event of a probable malfunction or failure.]

Amdt. 31-4, Eff. 10/14/80

either orally on the record or in writing, an initial decision, including the reasons for the decision, that contains findings or conclusions on the allegations contained, and the civil penalty sought, in the complaint.

- (h) *Appeal.* Either party may appeal the administrative law judge's initial decision to the FAA decisionmaker pursuant to the procedures in subpart G of this part. If a party files a notice of appeal pursuant to § 13.233 of subpart G, the effectiveness of the initial decision is stayed until a final decision and order of the Administrator have been entered on the record. The FAA decisionmaker shall review the record and issue a final decision and order of the Administrator that affirm, modify, or reverse the initial decision. The FAA decisionmaker may assess a civil penalty but shall not assess a civil penalty in an amount greater than that sought in the complaint.
- (i) *Payment.* A person shall pay a civil penalty by sending a certified check or money order, payable to the Federal Aviation Administration, to the agency attorney.
- (j) *Collection of civil penalties.* If a person does not pay a civil penalty imposed by an order assessing civil penalty or a compromise order within 60 days after service of the order, the Administrator may refer the order to the United States Attorney General, or the delegate of the Attorney General, to begin proceedings to collect the civil penalty. The action shall be brought in a United States District Court, pursuant to the authority in section 903 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1473), or section 110 of the Hazardous Materials Transportation Act (49 U.S.C. 1809).
- (k) *Exhaustion of administrative remedies.* A party may only petition for review of a final decision and order of the Administrator to the courts of appeals of the United States or the United States Court of Appeals for the District of Columbia pursuant to section 1006 of the Federal Aviation Act of 1958, as amended. Neither an initial decision or order issued by an administrative law judge, that has not been appealed to the FAA decisionmaker, nor an order compromising a civil penalty action constitutes a final order of the Administrator for the purposes of judicial appellate review under section 1006 of the Federal Aviation Act of 1958, as amended.
- (l) *Compromise.* The FAA may compromise any civil penalty action initiated in accordance with section 901 and section 905 of the Federal Aviation Act of 1958, as amended, involving an amount in controversy not exceeding \$50,000, or any civil penalty action initiated in accordance with section 901 of the Federal Aviation Act of 1958, as amended, and section 110 of the Hazardous Materials Transportation Act, at any time before referring the action to the United States Attorney for collection.
 - (1) An agency attorney may compromise any civil penalty action where a person charged with a violation agrees to pay a civil penalty and the FAA agrees to make no finding of violation. Pursuant to such agreement, a compromise order shall be issued, stating :
 - (i) The person agrees to pay a civil penalty.
 - (ii) The FAA makes no finding of a violation.
 - (iii) The compromise order shall not be used as evidence of a prior violation in any subsequent civil penalty proceeding or certificate action proceeding.
 - (2) An agency attorney may compromise the amount of any civil penalty proposed in a notice, assessed in an order, or imposed in a compromise order.

FAR 13.17 : Seizure of aircraft.

- (a) Under section 903 of the Federal Aviation Act of 1958 (49 U.S.C. 1473), a State or Federal law enforcement officer, or a Federal Aviation Administration safety inspector, authorized in an order of seizure issued by the Regional Administrator of the region, or by the Chief Counsel, may summarily seize an aircraft that is involved in a violation for which a civil penalty may be imposed on its owner or operator.
- (b) Each person seizing an aircraft under this section shall place it in the nearest available and adequate public storage facility in the judicial district in which it was seized.
- (c) The Regional Administrator or Chief Counsel, without delay, sends a written notice and a copy of this section, to the registered owner of the seized aircraft, and to each other persons shown by FAA records to have an interest in it, stating the –
 - (1) Time, date, and place of seizure;
 - (2) Name and address of the custodian of the aircraft;
 - (3) Reasons for the seizure, including the violations believed, or judicially determined, to have been committed; and
 - (4) Amount that may be tendered as –
 - (i) A compromise of a civil penalty for the alleged violation; or
 - (ii) Payment for a civil penalty imposed by a Federal court for a proven violation.
- (d) The Chief Counsel, or the Regional Counsel or Assistant Chief Counsel for the region or area in which an aircraft is seized under this section, immediately sends a report to the United States District Attorney for the judicial district in which it was seized, requesting the District Attorney to institute proceedings to enforce a lien against the aircraft.
- (e) The Regional Administrator or Chief Counsel directs the release of a seized aircraft whenever –
 - (1) The alleged violator pays a civil penalty or an amount agreed upon in compromise, and the costs of seizing, storing, and maintaining the aircraft;
 - (2) The aircraft is seized under an order of a Federal Court in proceedings in rem to enforce a lien against the aircraft, or the United States District Attorney for the judicial district concerned notifies the FAA that the District Attorney refuses to institute those proceedings; or
 - (3) A bond in the amount and with the sureties prescribed by the Chief Counsel, the Regional Counsel, or the Assistant Chief Counsel is deposited, conditioned on payment of the penalty, or the compromise amount, and the costs of seizing, storing, and maintaining the aircraft.

FAR 13.19 : Certificate action.

- (a) Under section 609 of the Federal Aviation Act of 1958 (49 U.S.C. 1429), the Administrator may reinspect any civil aircraft, aircraft engine, propeller, appliance, air navigation facility, or air agency, and may re-examine any civil airman. Under section 501(e) of the FA Act, any Certificate of Aircraft Registration may be suspended or revoked by the Administrator for any cause that renders the aircraft ineligible for registration.

Chapitre 84

Subpart E : Equipment

Sommaire

FAR 31.71 : [Function and Installation]	1112

the measured values must be adjusted to correspond to a red filter temperature of at least 130° F :

- (1) The intensities in the horizontal plane passing through the light unit must equal or exceed the following values :

Position light	Minimum intensity (candles)
Steady white	20
Flashing red or white	40

- (2) The intensities in vertical planes must equal or exceed the following values. An intensity of one unit corresponds to the applicable horizontal plane intensity specified in paragraph (b)(1) of this section.

Angles above and below the horizontal in any vertical plane (degrees)	Minimum intensity (units)
0	1.00
0 to 5	0.90
5 to 10	0.80
10 to 15	0.70
15 to 20	0.50
20 to 30	0.30
30 to 40	0.10
40 to 60	0.05

- (c) The white light must be located not more than 20 feet below the basket, trapeze, or other means for carrying occupants. The flashing red or white light must be located not less than 7, nor more than 10, feet below the steady white light.]

- (d) There must be a means to retract and store the lights.

- (e) [Each position light color must have the applicable International Commission on Illumination chromaticity coordinates as follows :

- (1) Aviation red—

"y" is not greater than 0.335 ; and

"z" is not greater than 0.002.

- (2) Aviation white—

"x" is not less than 0.300 and not greater than 0.540 ;

"y" is not less than "x - 0.040" or "yo" - 0.010" , whichever is the smaller ; and

"y" is not greater than "x - 0.020" nor "0.636 - 0.400 x" ;

Where "yo" is the "y" coordinate of the Planckian radiator for the value of "x" considered.]

Amdt. 31-4, Eff. 10/14/80

- (b) If, as a result of such a reinspection re-examination, or other investigation made by the Administrator under section 609 of the FA Act, the Administrator determines that the public interest and safety in air commerce requires it, the Administrator may issue an order amending, suspending, or revoking, all or part of any type certificate, production certificate, airworthiness certificate, airman certificate, air carrier operating certificate, air navigation facility certificate, or air agency certificate. This authority may be exercised for remedial purposes in cases involving the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.) or regulations issued under that Act. This authority is also exercised by the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, each Regional Counsel, and the Aeronautical Center Counsel. If the Administrator finds that any aircraft registered under Part 47 of this chapter is ineligible for registration or if the holder of a Certificate of Aircraft Registration has refused or failed to submit AC Form 8050-73, as required by § 47.51 of this chapter, the Administrator issues an order suspending or revoking that certificate. This authority as to aircraft found ineligible for registration is also exercised by each Regional Counsel, the Aeronautical Center Counsel, and the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office.

- (c) Before issuing an order under paragraph (b) of this section, the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, each Regional Counsel, or the Aeronautical Center Counsel advises the certificate holder of the charges or other reasons upon which the Administrator bases the proposed action and, except in an emergency, allows the holder to answer any charges and to be heard as to why the certificate should not be amended, suspended, or revoked. The holder may, by checking the appropriate box on the form that is sent to the holder with the notice of proposed certificate action, elect to —

- (1) Admit the charges and surrender his or her certificate ;

- (2) Answer the charges in writing ;

- (3) Request that an order be issued in accordance with the notice of proposed certificate action so that the certificate holder may appeal to the National Transportation Safety Board, if the charges concerning a matter under Title VI of the FA Act ;

- (4) Request an opportunity to be heard in an informal conference with the FAA counsel ; or

- (5) Request a hearing in accordance with Subpart D of this part if the charges concern a matter under Title V of the FA Act. Except as provided in § 13.35(b), unless the certificate holder returns the form and, where required, an answer or motion, with a postmark of not later than 15 days after the date of receipt of the notice, the order of the Administrator is issued as proposed. If the certificate holder has requested an informal conference with the FAA counsel and the charges concern a matter under Title V of the FA Act, the holder may after that conference also request a formal hearing in writing with a postmark of not later than 10 days after the close of the conference. After considering any information submitted by the certificate holder, the Chief Counsel, the Assistant Chief Counsel for Regulations and Enforcement, the Regional Counsel concerned, or the Aeronautical Center Counsel (as to matters under Title

- V of the FA Act) issues the order of the Administrator, except that if the holder has made a valid request for a formal hearing on a matter under Title V of the FA Act initially or after an informal conference, Subpart D of this part governs further proceedings.

- (d) Any person whose certificate is affected by an order issued under this section may appeal to the National Transportation Safety Board. If the certificate holder files an appeal with the Board, the Administrator's order is stayed unless the Administrator advises the Board that an emergency exists and safety in air commerce requires that the order become effective immediately. If the Board is so advised, the order remains effective and the Board shall finally dispose of the appeal within 60 days after the date of the advice. This paragraph does not apply to any person whose Certificate of Aircraft Registration is affected by an order issued under this section.

FAR 13.20 : Orders of compliance, cease and desist orders, orders of denial, and other orders.

- (a) This section applies to orders of compliance, cease and desist orders, orders of denial, and other orders issued by the Administrator to carry out the provisions of the Federal Aviation Act of 1958, as amended, the Hazardous Materials Transportation Act, the Airport and Airway Development Act of 1970, and the Airport and Airway Improvement Act of 1982, or the Airport and Airway Capacity Expansion Act of 1987. This section does not apply to orders issued pursuant to section 602 or section 609 of the Federal Aviation Act of 1958, as amended.
- (b) Unless the Administrator determines that an emergency exists and safety in air commerce requires the immediate issuance of an order under this section, the person subject to the order shall be provided with notice prior to issuance.
- (c) Within 30 days after service of the notice, the person subject to the order may reply in writing or request a hearing in accordance with Subpart D of this part.
- (d) If a reply is filed, as to any charges not dismissed or not subject to a consent order, the person subject to the order may, within 10 days after receipt of notice that the remaining charges are not dismissed, request a hearing in accordance with Subpart D of this part.
- (e) Failure to request a hearing within the period provided in paragraphs (c) or (d) of this section –
- (1) Constitutes a waiver of the right to appeal and the right to a hearing, and
- (2) Authorizes the official who issued the notice to find the facts to be as alleged in the notice, or as modified as the official may determine necessary based on any written response, and to issue an appropriate order, without further notice or proceedings.
- (f) If a hearing is requested in accordance with paragraph (c) or (d) of this section, the procedure of Subpart D of this part applies. At the close of the hearing, the Hearing Officer, on the record or subsequently in writing, shall set forth findings and conclusions and the reasons therefor, and either –
- (1) Dismiss the notice ; or
- (2) Issue an order.

FAR 31.55 : Deflation means.

[There must be a means to allow emergency deflation of the envelope so as to allow a safe emergency landing. If a system other than a manual system is used, the reliability of the system used must be substantiated.]

Amdt. 31-2, EFF. 4/12/65

FAR 31.57 : Rip cords.

- (a) If a rip cord is used for emergency deflation, it must be designed and installed to preclude entanglement.
- (b) The force required to operate the rip cord may not be less than 25, or more than 75, pounds.
- (c) The end of the rip cord to be operated by the pilot must be colored red.
- (d) The rip cord must be long enough to allow an increase of at least 10 percent in the vertical dimension of the envelope.

FAR 31.59 : Trapeze, basket, or other means provided for occupants.

- (a) The trapeze, basket, or other means provided for carrying occupants may not rotate independently of the envelope.
- (b) Each projecting object on the trapeze, basket, or other means provided for carrying occupants, that could cause injury to the occupants, must be padded.

FAR 31.61 : [Static discharge.]

[Unless shown not to be necessary for safety, there must be appropriate bonding means in the design of each balloon using flammable gas as a lifting means to ensure that the effects of static discharges will not create a hazard.]

Amdt. 31-2, EFF. 4/12/65

FAR 31.63 : Safety belts.

[(a)] There must be a safety belt, harness, or other restraining means for each occupant, unless the Administrator finds it unnecessary. If installed, the belt, harness, or other restraining means and its supporting structure must meet the strength requirements of Subpart C.

- (b) [This section does not apply to balloons that incorporate a basket or gondola.]

Amdt. 31-3, EFF. 2/1/77

FAR 31.65 : Position lights.

- (a) [If position lights are installed, there must be one steady aviation white position light and one flashing aviation red (or flashing aviation white) position light with an effective flash frequency of at least 40, but not more than 100, cycles per minute.
- (b) Each light must have 360 ° horizontal coverage at the intensities prescribed in this paragraph. The following light intensities must be determined with the light source operating at a steady state and with all light covers and color filters in place and at the manufacturer's rated minimum voltage. For the flashing aviation red light,

- (2) The test program for the secondary or backup operation of the burner must include six hours of operation with a burn time for each five minute cycle of one minute at an intermediate fuel pressure.]

- (e) The test must also include at least three flameouts and restarts.
 (f) Each element of the system must be serviceable at the end of the test.

Amdt. 31-7, Eff. 5/24/96

FAR 31.49 : Control systems.

- (a) Each control must operate easily, smoothly, and positively enough to allow proper performance of its functions. Controls must be arranged and identified to provide for convenience of operation and to prevent the possibility of confusion and subsequent inadvertent operation.
 (b) Each control system and operating device must be designed and installed in a manner that will prevent jamming, chafing, or interference from passengers, cargo, or loose objects. Precaution must be taken to prevent foreign objects from jamming the controls. The elements of the control system must have design features or must be distinctly and permanently marked to minimize the possibility of incorrect assembly that could result in malfunctioning of the control system.

- (c) Each balloon using a captive gas as the lifting means must have an automatic valve or appendix that is able to release gas automatically at the rate of at least three percent of the total volume per minute when the balloon is at its maximum operating pressure.

- (d) [Each hot air balloon must have a means to allow the controlled release of hot air during flight.

- (e) Each hot air balloon must have a means to indicate the maximum envelope skin temperature occurring during operation. The indicator must be readily visible to the pilot and marked to indicate the limiting safe temperature of the envelope material. If the markings are on the cover glass of the instrument, there must be provisions to maintain the correct alignment of the glass cover with the face of the dial.]

Amdt. 31-2, Eff. 4/12/65

FAR 31.51 : Ballast.

Each captive gas balloon must have a means for the safe storage and controlled release of ballast. The ballast must consist of material that, if released during flight, is not hazardous to persons on the ground.

FAR 31.53 : Drag rope.

If a drag rope is used, the end that is released overboard must be stiffened to preclude the probability of the rope becoming entangled with trees, wires, or other objects on the ground.

- (g) Any party to the hearing may appeal from the order of the Hearing Officer by filing a notice of appeal with the Administrator within 20 days after the date of issuance of the order.

- (h) If a notice of appeal is not filed from the order issued by a Hearing Officer, such order is the final agency order.

- (i) Any person filing an appeal authorized by paragraph (g) of this section shall file an appeal brief with the Administrator within 40 days after the date of issuance of the order, and serve a copy on the other party. A reply brief must be filed within 20 days after service of the appeal brief and a copy served on the appellant.

- (j) On appeal the Administrator reviews the available record of the proceeding, and issues an order dismissing, reversing, modifying or affirming the order. The Administrator's order includes the reasons for the Administrator's action.

- (k) For good cause shown, requests for extensions of time to file any document under this section may be granted by —

- (1) The official who issued the order, if the request is filed prior to the designation of a Hearing Officer; or
- (2) The Hearing Officer, if the request is filed prior to the filing of a notice of appeal; or

- (3) The Administrator, if the request is filed after the filing of a notice of appeal.
- (l) Except in the case of an appeal from the decision of a Hearing Officer, the authority of the Administrator under this section is also exercised by the Chief Counsel, Deputy Chief Counsel, each Assistant Chief Counsel, each Regional Counsel, and the Aeronautical Center Counsel (as to matters under Title V of the Federal Aviation Act of 1958).

- (m) Filing and service of documents under this section shall be accomplished in accordance with §13.43; and the periods of time specified in this section shall be computed in accordance with §13.44.

FAR 13.21 : Military personnel.

If a report made under this part indicates that, while performing official duties, a member of the Armed Forces, or a civilian employee of the Department of Defense who is subject to the Uniform Code of Military Justice (10 U.S.C. Ch. 47), has violated the Federal Aviation Act of 1958, or a regulation or order issued under it, the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, each Regional Counsel, and the Aeronautical Center Counsel send a copy of the report to the appropriate military authority for such disciplinary action as that authority considers appropriate and a report to the Administrator thereon.

FAR 13.23 : Criminal penalties.

- (a) Sections 902 and 1203 of the Federal Aviation Act of 1958 (49 U.S.C. 1472 and 1523), provide criminal penalties for any person who knowingly and willfully violates specified provisions of that Act, or any regulation or order issued under those provisions. Section 110(b) of the Hazardous Materials Transportation Act (49 U.S.C. 1809(b)) provides for a criminal penalty of a fine of not more than \$25,000, imprisonment for not more than five years, or both, for any person who willfully violates a provision of that Act or a regulation or order issued under it.

- (b) If an inspector or other employee of the FAA becomes aware of a possible violation of any criminal provision of the Federal Aviation Act of 1958 (except a violation of section 902 (j) through (m) which is reported directly to the Federal Bureau of Investigation), or of the Hazardous Materials Transportation Act, relating to the transportation or shipment by air of hazardous materials, he or she shall report it to the Office of the Chief Counsel or the Regional Counsel or Assistant Chief Counsel for the region or area concerned. If appropriate, that office refers the report to the Department of Justice for criminal prosecution of the offender. If such an inspector or other employee becomes aware of a possible violation of a Federal statute that is within the investigatory jurisdiction of another Federal agency, he or she shall immediately report it to that agency according to standard FAA practices.

FAR 13.25 : Injunctions.

- (a) Whenever it is determined that a person has engaged, or is about to engage, in any act or practice constituting a violation of the Federal Aviation Act of 1958, or any regulation or order issued under it for which the FAA exercises enforcement responsibility, or, with respect to the transportation or shipment by air of any hazardous materials, in any act or practice constituting a violation of the Hazardous Materials Transportation Act, or any regulation or order issued under it for which the FAA exercises enforcement responsibility, the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, each Regional Counsel, and the Aeronautical Center Counsel may request the United States Attorney General, or the delegate of the Attorney General, to bring an action in the appropriate United States District Court for such relief as is necessary or appropriate, including mandatory or prohibitive injunctive relief, interim equitable relief, and punitive damages, as provided by section 1007 of the Federal Aviation Act of 1958 (49 U.S.C. 1487) and section 111(a) of the Hazardous Materials Transportation Act (49 U.S.C. 1810).

- (b) Whenever it is determined that there is substantial likelihood that death, serious illness, or severe personal injury, will result from the transportation by air of a particular hazardous material before an order of compliance proceeding, or other administrative hearing or formal proceeding to abate the risk of the harm can be completed, the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, each Regional Counsel, and the Aeronautical Center Counsel may bring, or request the United States Attorney General to bring, an action in the appropriate United States District Court for an order suspending or restricting the transportation by air of the hazardous material or for such other order as is necessary to eliminate or ameliorate the imminent hazard, as provided by section 111(b) of the Hazardous Materials Transportation Act (49 U.S.C. 1810).

FAR 13.27 : Final order of Hearing Officer in certificate of aircraft registration proceedings.

- (a) If, in proceedings under section 501(b) of the Federal Aviation Act of 1958 (49 USC 1401), the Hearing Officer determines that the holder of the Certificate of Aircraft Registration has refused or failed to submit AC Form 8050-73, as required by § 47.51 of this chapter, or that the aircraft is ineligible for a Certificate of

FAR 31.45 : Fuel cells.

[If fuel cells are used, the fuel cells, their attachments and related supporting structure must be shown by tests to be capable of withstanding, without detrimental distortion or failure, any inertia loads to which the installation may be subjected, including the drop tests prescribed in Sec. 31.27(c). In the tests, the fuel cells must be loaded to the weight and pressure equivalent to the full fuel quantity condition.]
Amdt. 31-3, Eff. 2/1/77

FAR 31.46 : [Pressurized fuel systems.]

[For pressurized fuel systems, each element and its connecting fittings and lines must be tested to an ultimate pressure of at least twice the maximum pressure to which the system will be subjected in normal operation. No part of the system may fail or malfunction during the test. The test configuration must be representative of the normal fuel system installation and balloon configuration.]
Amdt. 31-3, Eff. 2/1/77

FAR 31.47 : [Burners.]

- (a) [If a burner is used to provide the lifting means, the system must be designed and installed so as not to create a fire hazard.]
(b) There must be shielding to protect parts adjacent to the burner flame, and the occupants, from heat effects.
(c) There must be controls, instruments, or other equipment essential to the safe control and operation of the heater. They must be shown to be able to perform their intended functions during normal and emergency operation.
(d) [The burner system (including the burner unit, controls, fuel lines, fuel cells, regulators, control valves, and other related elements) must be substantiated by an endurance test of at least 40 hours. Each element of the system must be installed and tested to simulate actual balloon installation and use.]
(1) The test program for the main blast valve operation of the burner must include :
(i) Five hours at the maximum fuel pressure for which approval is sought, with a burn time for each one minute cycle of three to ten seconds. The burn time must be established so that each burner is subjected to the maximum thermal shock for temperature affected elements;
(ii) Seven and one-half hours at an intermediate fuel pressure, with a burn time for each one minute cycle of three to ten seconds. An intermediate fuel pressure is 40 to 60 percent of the range between the maximum fuel pressure referenced in paragraph (d)(1)(i) and minimum fuel pressure referenced in paragraph (d)(1)(iii) ;
(iii) Six hours and fifteen minutes at the minimum fuel pressure for which approval is sought, with a burn time for each one minute cycle of three to ten seconds ;
(iv) Fifteen minutes of operation on vapor, with a burn time for each one minute cycle of at least 30 seconds ; and
(v) Fifteen hours of normal flight operation.

FAR 31.31 : General.

The suitability of each design detail or part that bears on safety must be established by tests or analysis.

FAR 31.33 : Materials.

- (a) The suitability and durability of all materials must be established on the basis of experience or tests. Materials must conform to approved specifications that will ensure that they have the strength and other properties assumed in the design data.
- (b) Material strength properties must be based on enough tests of material conforming to specifications so as to establish design values on a statistical basis.

FAR 31.35 : Fabrication methods.

The methods of fabrication used must produce a consistently sound structure. If a fabrication process requires close control to reach this objective, the process must be performed in accordance with an approved process specification.

FAR 31.37 : Fastenings.

Only approved bolts, pins, screws, and rivets may be used in the structure. Approved locking devices or methods must be used for all these bolts, pins, and screws, unless the installation is shown to be free from vibration. Self-locking nuts may not be used on bolts that are subject to rotation in service.

FAR 31.39 : Protection.

Each part of the balloon must be suitably protected against deterioration or loss of strength in service due to weathering, corrosion, or other causes.

FAR 31.41 : Inspection provisions.

There must be a means to allow close examination of each part that requires repeated inspection and adjustment.

FAR 31.43 : Fitting factor.

- (a) A fitting factor of at least 1.15 must be used in the analysis of each fitting the strength of which is not proven by limit and ultimate load tests in which the actual stress conditions are simulated in the fitting and surrounding structure. This factor applies to all parts of the fitting, the means of attachment, and the bearing on the members joined.
- (b) Each part with an integral fitting must be treated as a fitting up to the point where the section properties become typical of the member.
- (c) The fitting factor need not be used if the joint design is made in accordance with approved practices and is based on comprehensive test data.

Aircraft Registration, the Hearing Officer shall suspend or revoke the respondent's certificate, as proposed in the notice of proposed certificate action.

- (b) If the final order of the Hearing Officer makes a decision on the merits, it shall contain a statement of the findings and conclusions of law on all material issues of fact and law. If the Hearing Officer finds that the allegations of the notice have been proven, but that no sanction is required, the Hearing Officer shall make appropriate findings and issue an order terminating the notice. If the Hearing Officer finds that the allegations of the notice have not been proven, the Hearing Officer shall issue an order dismissing the notice. If the Hearing Officer finds it to be equitable and in the public interest, the Hearing Officer shall issue an order terminating the proceeding upon payment by the respondent of a civil penalty in an amount agreed upon by the parties.
- (c) If the order is issued in writing, it shall be served upon the parties.

FAR 13.29 : Civil penalties : Streamlined enforcement procedures for certain security violations.

This section may be used, at the agency's discretion, in enforcement actions involving individuals presenting dangerous or deadly weapons for screening at airports or in checked baggage where the amount of the proposed civil penalty is less than \$5,000. In these cases, sections 13.16(a), 13.16(c), and 13.16 (f) through (l) of this chapter are used, as well as paragraphs (a) through (d) of this section :

- (a) *Delegation of authority.* The authority of the Administrator, under 49 U.S.C. 46301, to initiate the assessment of civil penalties for a violation of 49 U.S.C. Subtitle VII, or a rule, regulation, or order issued thereunder, is delegated to the regional Civil Aviation Security Division Manager and the regional Civil Aviation Security Deputy Division Manager for the purpose of issuing notices of violation in cases involving violations of 49 U.S.C. Subtitle VII and the FAA's regulations by individuals presenting dangerous or deadly weapons for screening at airport checkpoints or in checked baggage. This authority may not be delegated below the level of the regional Civil Aviation Security Deputy Division Manager.
- (b) *Notice of violation.* A civil penalty action is initiated by sending a notice of violation to the person charged with the violation. The notice of violation contains a statement of the charges and the amount of the proposed civil penalty. Not later than 30 days after receipt of the notice of violation, the person charged with a violation shall :
 - (1) Submit the amount of the proposed civil penalty or an agreed-upon amount, in which case either an order assessing a civil penalty or a compromise order shall be issued in that amount; or
 - (2) Submit to the agency attorney identified in the material accompanying the notice any of the following :
 - (i) Written information, including documents and witness statements, demonstrating that a violation of the regulations did not occur or that a penalty or the penalty amount is not warranted by the circumstances; or
 - (ii) A written request to reduce the proposed civil penalty, the amount of reduction, and the reasons and any documents supporting a reduction of the proposed civil penalty, including records indicating a financial inability to pay or records showing that payment of the proposed civil penalty would prevent the person from continuing in business; or

- (iii) A written request for an informal conference to discuss the matter with an agency attorney and submit relevant information or documents ; or
 - (3) Request a hearing in which case a complaint shall be filed with the hearing docket clerk.
- (c) *Final notice of violation and civil penalty assessment order*: A final notice of violation and civil penalty assessment order ("final notice and order") may be issued after participation in any informal proceedings as provided in paragraph (b)(2) of this section, or after failure of the respondent to respond in a timely manner to a notice of violation. A final notice and order will be sent to the individual charged with a violation. The final notice and order will contain a statement of the charges and the amount of the proposed civil penalty and, as a result of information submitted to the agency attorney during any informal procedures, may reflect a modified allegation or proposed civil penalty. A final notice and order may be issued –
- (1) If the person charged with a violation fails to respond to the notice of violation within 30 days after receipt of that notice ; or
 - (2) If the parties participated in any informal procedures under paragraph (b)(2) of this section and the parties have not agreed to compromise the action or the agency attorney has not agreed to withdraw the notice of violation.
- (d) *Order assessing civil penalty*. An order assessing civil penalty may be issued after notice and opportunity for a hearing. A person charged with a violation may be subject to an order assessing civil penalty in the following circumstances :
- (1) An order assessing civil penalty may be issued if a person charged with a violation submits, or agrees to submit, the amount of civil penalty proposed in the notice of violation.
 - (2) An order assessing civil penalty may be issued if a person charged with a violation submits, or agrees to submit, an agreed-upon amount of civil penalty that is not reflected in either the notice of violation or the final notice and order.
 - (3) The final notice and order becomes (and contains a statement so indicating) an order assessing a civil penalty when the person charged with a violation submits the amount of the proposed civil penalty that is reflected in the final notice and order.
 - (4) The final notice and order becomes (and contains a statement so indicating) an order assessing a civil penalty 16 days after receipt of the final notice and order, unless not later than 15 days after receipt of the final notice and order, the person charged with a violation does one of the following –
 - (i) Submits an agreed-upon amount of civil penalty that is not reflected in the final notice and order, in which case an order assessing civil penalty or a compromise order shall be issued in that amount ; or
 - (ii) Requests a hearing in which case a complaint shall be filed with the hearing docket clerk.
 - (5) Unless an appeal is filed with the FAA decisionmaker in a timely manner, an initial decision or order of an administrative law judge shall be considered an order assessing civil penalty if an administrative law judge finds that an alleged violation occurred and determines that a civil penalty, in an amount found to be appropriate by the administrative law judge, is warranted.

Chapitre 83

Subpart D : Design Construction

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FAR 31.21 : Loads.

Strength requirements are specified in terms of limit loads, that are the maximum load to be expected in service, and ultimate loads, that are limit loads multiplied by prescribed factors of safety. Unless otherwise specified, all prescribed loads are limit loads.

FAR 31.23 : Flight load factor.

In determining limit load, the limit flight load factor must be at least 1.4.

FAR 31.25 : Factor of safety.

- (a) Except as specified in paragraphs (b) and (c) of this section, the factor of safety is 1.5.
- (b) A factor of safety of at least five must be used in envelope design. A reduced factor of safety of at least two may be used if it is shown that the selected factor will preclude failure due to creep or instantaneous rupture from lack of rip stoppers. The selected factor must be applied to the more critical of the maximum operating pressure or envelope stress.
- (c) A factor of safety of at least five must be used in the design of all fibrous or non-metallic parts of the rigging and related attachments of the envelope to basket, trapeze, or other means provided for carrying occupants. [The primary attachments of the envelope to the basket, trapeze, or other means provided for carrying occupants must be designed so that failure is extremely remote or so that any single failure will not jeopardize safety of flight.]
- (d) In applying factors of safety, the effect of temperature, and other operating characteristics, or both, that may affect strength of the balloon must be accounted for.
- (e) For design purposes, an occupant weight of at least 170 pounds must be assumed. Amdt. 31-2, Eff. 4/12/65

FAR 31.27 : Strength.

- (a) The structure must be able to support limit loads without detrimental effect.
- (b) The structure must be substantiated by test to be able to withstand the ultimate loads for at least three seconds without failure. For the envelope, a test of a representative part is acceptable, if the part tested is large enough to include critical seams, joints, and load attachment points and members.
- (c) [An ultimate free-fall drop test must be made of the basket, trapeze, or other place provided for occupants. The test must be made at design maximum weight on a horizontal surface, with the basket, trapeze, or other means provided for carrying occupants, striking the surface at angles of 0, 15, and 30 degrees. The weight may be distributed to simulate actual conditions. There must be no distortion or failure that is likely to cause serious injury to the occupants. A drop test height of 36 inches, or a drop test height that produces, upon impact, a velocity equal to the maximum vertical velocity determined in accordance with Sec. 31.19, whichever is higher, must be used.]

Amdt. 31-4, Eff. 10/14/80

- (6) Unless a petition for review is filed with a U.S. Court of Appeals in a timely manner, a final decision and order of the Administrator shall be considered an order assessing civil penalty if the FAA decisionmaker finds that an alleged violation occurred and a civil penalty is warranted.

Chapitre 82

Subpart C : Strength Requirements

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Chapitre 7

Subpart D : Rules of Practice
for FAA Hearings

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FAR 13.31 : Applicability.

This subpart applies to proceedings in which a hearing has been requested in accordance with §§ 13.19(c)(5), 13.20(c), 13.20(d), 13.75(a)(2), 13.75(b), or 13.81(e).

FAR 13.33 : Appearances.

Any party to a proceeding under this subpart may appear and be heard in person or by attorney.

FAR 13.35 : Request for hearing.

- (a) A request for hearing must be made in writing to the Hearing Docket, Room 924A, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591. It must describe briefly the action proposed by the FAA, and must contain a statement that a hearing is requested. A copy of the request for hearing and a copy of the answer required by paragraph (b) of this section must be served on the official who issued the notice of proposed action.
- (b) An answer to the notice of proposed action must be filed with the request for hearing. All allegations in the notice not specifically denied in the answer are deemed admitted.
- (c) Within 15 days after service of the copy of the request for hearing, the official who issued the notice of proposed action forwards a copy of that notice, which serves as the complaint, to the Hearing Docket

FAR 13.37 : Hearing Officer's powers.

Any Hearing Officer may –

- (a) Give notice concerning, and hold, prehearing conferences and hearings;
- (b) Administrator oaths and affirmations;
- (c) Examine witnesses;
- (d) Adopt procedures for the submission of evidence in written form;
- (e) Issue subpoenas and take depositions or cause them to be taken;
- (f) Rule on offers of proof;
- (g) Receive evidence;
- (h) Regulate the course of the hearing;
- (i) Hold conferences, before and during the hearing, to settle and simplify issues by consent of the parties;
- (j) Dispose of procedural requests and similar matters; and
- (k) Issue decisions, make findings of fact, make assessments, and issue orders, as appropriate.

FAR 13.39 : Disqualification of Hearing Officer.

If disqualified for any reason, the Hearing Officer shall withdraw from the case.

FAR 13.41 : [Reserved]

[Reserved]

FAR 31.19 : [Performance : Uncontrolled descent.]

- (a) [The following must be determined for the most critical uncontrolled descent that can result from any single failure of the heater assembly, fuel cell system, gas valve system, or maneuvering vent system, or from any single tear in the balloon envelope between tear stoppers :
 - (1) The maximum vertical velocity attained.
 - (2) The altitude loss from the point of failure to the point at which maximum vertical velocity is attained.
 - (3) The altitude required to achieve level flight after corrective action is initiated, with the balloon descending at the maximum vertical velocity determined in paragraph (a)(1) of this section.
- (b) Procedures must be established for landing at the maximum vertical velocity determined in paragraph (a)(1) of this section and for arresting that descent rate in accordance with paragraph (a)(3) of this section.]

Amtd. 31-4, Eff. 10/14/80

FAR 31.20 : [Controllability]

[The applicant must show that the balloon is safely controllable and maneuverable during takeoff, ascent, descent, and landing without requiring exceptional piloting skill.]
Amtd. 31-3, Eff. 2/1/77

FAR 31.11 : [Reserved.]

[Reserved.]

Amdt. 31-3, Eff. 2/1/77

FAR 31.12 : [Proof of compliance.]

(a) [Each requirement of this subpart must be met at each weight within the range of loading conditions for which certification is requested. This must be shown by—

- (1) Tests upon a balloon of the type for which certification is requested or by calculations based on, and equal in accuracy to, the results of testing; and
- (2) Systematic investigation of each weight if compliance cannot be reasonably inferred from the weights investigated.

(b) Except as provided in Sec. 31.17(b), allowable weight tolerances during flight testing are +5 percent and -10 percent.]

Amdt. 31-4, Eff. 10/14/80

FAR 31.14 : [Weight limits.]

(a) [The range of weights over which the balloon may be safely operated must be established.

(b) Maximum weight. The maximum weight is the highest weight at which compliance with each applicable requirement of this part is shown. The maximum weight must be established so that it is not more than—

- (i) The highest weight selected by the applicant ;
- (ii) The design maximum weight which is the highest weight at which compliance with each applicable structural loading condition of this part is shown ; or
- (iii) The highest weight at which compliance with each applicable flight requirement of this part is shown.

(c) The information established under paragraphs (a) and (b) of this section must be made available to the pilot in accordance with Sec. 31.81.]

Amdt. 31-3, Eff. 2/1/77

FAR 31.16 : [Empty weight.]

[The empty weight must be determined by weighing the balloon with installed equipment but without lifting gas or heater fuel.]

Amdt. 31-4, Eff. 10/14/80

FAR 31.17 : [Performance : Climb.]

(a) [Each balloon must be capable of climbing at least 300 feet in the first minute after takeoff with a steady rate of climb. Compliance with the requirements of this section must be shown at each altitude and ambient temperature for which approval is sought.

(b) Compliance with the requirements of paragraph (a) of this section must be shown at the maximum weight with a weight tolerance of +5 percent.]

Amdt. 31-4, Eff. 10/14/80

FAR 13.43 : Service and filing of pleadings, motions, and documents.

(a) Copies of all pleadings, motions, and documents filed with the Hearing Docket must be served upon all parties to the proceedings by the person filing them.

(b) Service may be made by personal delivery or by mail.

(c) A certificate of service shall accompany all documents when they are tendered for filing and shall consist of a certificate of personal delivery or a certificate of mailing, executed by the person making the personal delivery or mailing the document.

(d) Whenever proof of service by mail is made, the date of mailing or the date as shown on the postmark shall be the date of service, and where personal service is made, the date of personal delivery shall be the date of service.

(e) The date of filing is the date the document is actually received.

FAR 13.44 : Computation of time and extension of time.

(a) In computing any period of time prescribed or allowed by this subpart, the date of the act, event, default, notice or order after which the designated period of time begins to run is not to be included in the computation. The last day of the period so computed is to be included unless it is a Saturday, Sunday, or legal holiday for the FAA, in which event the period runs until the end of the next day which is neither a Saturday, Sunday nor a legal holiday.

(b) Upon written request filed with the Hearing Docket and served upon all parties, and for good cause shown, a Hearing Officer may grant an extension of time to file any documents specified in this subpart.

FAR 13.45 : Amendment of notice and answer.

At any time more than 10 days before the date of hearing, any party may amend his or her notice, answer, or other pleading, by filing the amendment with the Hearing Officer and serving a copy of it on each other party. After that time, amendments may be allowed only in the discretion of the Hearing Officer. If an amendment to an initial pleading has been allowed, the Hearing Officer shall allow the other parties a reasonable opportunity to answer.

FAR 13.47 : Withdrawal of notice or request for hearing.

At any time before the hearing, the FAA counsel may withdraw the notice of proposed action, and the party requesting the hearing may withdraw the request for hearing.

FAR 13.49 : Motions.

(a) *Motion to dismiss for insufficiency.* A respondent who requests a formal hearing may, in place of an answer, file a motion to dismiss for failure of the allegations in the notice of proposed action to state a violation of the FA Act or of this chapter or to show lack of qualification of the respondent. If the Hearing Officer denies the motion, the respondent shall file an answer within 10 days.

(b) [Reserved]

(c) *Motion for more definite statement.* The certificate holder may, in place of an answer, file a motion that the allegations in the notice be made more definite and certain. If

the Hearing Officer grants the motion, the FAA counsel shall comply within 10 days after the date it is granted. If the Hearing Officer denies the motion the certificate holder shall file an answer within 10 days after the date it is denied.

(d) *Motion for judgment on the pleadings.* After the pleadings are closed, either party may move for a judgment on the pleadings.

(e) *Motion to strike.* Upon motion of either party, the Hearing Officer may order stricken, from any pleadings, any insufficient allegation or defense, or any immaterial, impertinent, or scandalous matter.

(f) *Motion for production of documents.* Upon motion of any party showing good cause, the Hearing Officer may, in the manner provided by Rule 34, Federal Rules of Civil Procedure, order any party to produce any designated document, paper, book, account, letter, photograph, object, or other tangible thing, that is not privileged, that constitutes or contains evidence relevant to the subject matter of the hearings, and that is in the party's possession, custody, or control.

(g) *Consolidation of motions.* A party who makes a motion under this section shall join with it all other motions that are then available to the party. Any objection that is not so raised is considered to be waived.

(h) *Answers to motions.* Any party may file an answer to any motion under this section within 5 days after service of the motion.

FAR 13.51 : Intervention.

Any person may move for leave to intervene in a proceeding and may become a party thereto, if the Hearing Officer, after the case is sent to the Hearing Officer for hearing, finds that the person may be bound by the order to be issued in the proceedings or has a property or financial interest that may not be adequately represented by existing parties, and that the intervention will not unduly broaden the issues or delay the proceedings. Except for good cause shown, a motion for leave to intervene may not be considered if it is filed less than 10 days before the hearing.

FAR 13.53 : Depositions.

After the respondent has filed a request for hearing and an answer, either party may take testimony by deposition in accordance with section 1004 of the Federal Aviation Act of 1958 (49 U.S.C. 1484) or Rule 26, Federal Rules of Civil Procedure.

FAR 13.55 : Notice of hearing.

The Hearing Officer shall set a reasonable date, time, and place for the hearing, and shall give the parties adequate notice thereof and of the nature of the hearing. Due regard shall be given to the convenience of the parties with respect to the place of the hearing.

FAR 13.57 : Subpoenas and witness fees.

(a) The Hearing Officer to whom a case is assigned may, upon application by any party to the proceeding, issue subpoenas requiring the attendance of witnesses or the production of documentary or tangible evidence at a hearing or for the purpose of taking depositions. However, the application for producing evidence must show its general relevance and reasonable scope. This paragraph does not apply to the

Chapitre 81

Subpart B : Flight Requirements

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FAR 31.1 : Applicability.

- (a) [This Part prescribes airworthiness standards for the issue of type certificates and changes to those certificates, for manned free balloons.
- (b) Each person who applies under Part 21 for such a certificate or change must show compliance with the applicable requirements of this Part.
- (c) | For the purposes of this Part—
 - (1) A captive gas balloon is a balloon that derives its lift from a captive lighter-than-air gas;
 - (2) A hot air balloon is a balloon that derives its lift from heated air ;
 - (3) The envelope is the enclosure in which the lifting means is contained ;
 - (4) The basket is the container, suspended beneath the envelope, for the balloon occupants ;
 - (5) The trapeze is a harness or is a seat consisting of a horizontal bar or platform suspended beneath the envelope for the balloon occupants ; and
 - (6) The design maximum weight is the maximum total weight of the balloon, less the lifting gas or air.

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attendance of FAA employees or to the production of documentary evidence in the custody of such an employee at a hearing.

- (b) A person who applies for the production of a document in the custody of an FAA employee must follow the procedure in § 13.49(f). A person who applies for the attendance of an FAA employee must send the application, in writing, to the Hearing Officer setting forth the need for that employee's attendance.
- (c) A witness in a proceeding under this subpart is entitled to the same fees and mileage as is paid to a witness in a court of the United States under comparable circumstances. The party at whose instance the witness is subpoenaed or appears shall pay the witness fees.
- (d) Notwithstanding the provisions of paragraph (c) of this section, the FAA pays the witness fees and mileage if the Hearing Officer who issued the subpoena determines, on the basis of a written request and good cause shown, that —
 - (1) The presence of the witness will materially advance the proceeding ; and
 - (2) The party at whose instance the witness is subpoenaed would suffer a serious hardship if required to pay the witness fees and mileage.

FAR 13.59 : Evidence.

- (a) Each party to a hearing may present the party's case or defense by oral or documentary evidence, submit evidence in rebuttal, and conduct such cross-examination as may be needed for a full disclosure of the facts.
- (b) Except with respect to affirmative defenses and orders of denial, the burden of proof is upon the FAA counsel.
- (c) The Hearing Officer may order information contained in any report or document filed or in any testimony given pursuant to this subpart withheld from public disclosure when, in the judgment of the Hearing Officer, disclosure would adversely affect the interests of any person and is not required in the public interest or is not otherwise required by statute to be made available to the public. Any person may make written objection to the public disclosure of such information, stating the ground for such objection.

FAR 13.61 : Argument and submittals.

The Hearing Officer shall give the parties adequate opportunity to present arguments in support of motions, objections, and the final order. The Hearing Officer may determine whether arguments are to be oral or written. At the end of the hearing the Hearing Officer may, in the discretion of the Hearing Officer, allow each party to submit written proposed findings and conclusions and supporting reasons for them.

FAR 13.63 : Record.

The testimony and exhibits presented at a hearing, together with all papers, requests, and rulings filed in the proceedings are the exclusive basis for the issuance of an order. Either party may obtain a transcript from the official reporter upon payment of the fees fixed therefor.

Chapitre 80

Subpart A : General

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Chapitre 8

Subpart E : Orders of
Compliance Under the
Hazardous Materials
Transportation Act

Sommaire

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FAR 13.71 : Applicability.

Whenever the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, or a Regional Counsel has reason to believe that a person is engaging in the transportation or shipment by air of hazardous materials in violation of the Hazardous Materials Transportation Act, or any regulation or order issued under it for which the FAA exercises enforcement responsibility, and the circumstances do not require the issuance of an order of immediate compliance, he may conduct proceedings pursuant to section 109 of that Act (49 U.S.C. 1808) to determine the nature and extent of the violation, and may thereafter issue an order directing compliance.

FAR 13.73 : Notice of proposed order of compliance.

A compliance order proceeding commences when the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, or a Regional Counsel sends the alleged violator a notice of proposed order of compliance advising the alleged violator of the charges and setting forth the remedial action sought in the form of a proposed order of compliance.

FAR 13.75 : Reply or request for hearing.

- (a) Within 30 days after service upon the alleged violator of a notice of proposed order of compliance, the alleged violator may –
 - (1) File a reply in writing with the official who issued the notice; or
 - (2) Request a hearing in accordance with Subpart D of this part.
- (b) If a reply is filed, as to any charges not dismissed or not subject to a consent order of compliance, the alleged violator may, within 10 days after receipt of notice that the remaining charges are not dismissed, request a hearing in accordance with Subpart D of this part.
- (c) Failure of the alleged violator to file a reply or request a hearing within the period provided in paragraph (a) or (b) of this section –
 - (1) Constitutes a waiver of the right to a hearing and the right to an appeal, and
 - (2) Authorizes the official who issued the notice to find the facts to be as alleged in the notice and to issue an appropriate order directing compliance, without further notice or proceedings.

FAR 13.77 : Consent order of compliance.

- (a) At any time before the issuance of an order of compliance, the official who issued the notice and the alleged violator may agree to dispose of the case by the issuance of a consent order of compliance by the official.
- (b) A proposal for a consent order submitted to the official who issued the notice under this section must include –
 - (1) A proposed order of compliance;
 - (2) An admission of all jurisdictional facts;
 - (3) An express waiver of right to further procedural steps and of all rights to judicial review;

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- (4) An incorporation by reference of the notice and an acknowledgement that the notice may be used to construe the terms of the order of compliance ; and
- (5) If the issuance of a consent order has been agreed upon after the filing of a request for hearing in accordance with Subpart D of this part, the proposal for a consent order shall include a request to be filed with the Hearing Officer withdrawing the request for a hearing and requesting that the case be dismissed.

FAR 13.79 : Hearing.

If an alleged violator requests a hearing in accordance with § 13.75, the procedure of Subpart D of this part applies. At the close of the hearing, the Hearing Officer, on the record or subsequently in writing, sets forth the Hearing Officer's findings and conclusion and the reasons therefor, and either –

- (a) Dismisses the notice of proposed order of compliance ; or
- (b) Issues an order of compliance.

FAR 13.81 : Order of immediate compliance.

- (a) Notwithstanding §§ 13.73 through 13.79, the Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, or a Regional Counsel may issue an order of immediate compliance, which is effective upon issuance, if the person who issues the order finds that –

- (1) There is strong probability that a violation is occurring or is about to occur ;
 - (2) The violation poses a substantial risk to health or to safety of life or property ; and
 - (3) The public interest requires the avoidance or amelioration of that risk through immediate compliance and waiver of the procedures afforded under §§ 13.73 through 13.79.
- (b) An order of immediate compliance is served promptly upon the person against whom the order is issued by telephone or telegram, and a written statement of the relevant facts and the legal basis for the order, including the findings required by paragraph (a) of this section, is served promptly by personal service or by mail.
 - (c) The official who issued the order of immediate compliance may rescind or suspend the order if it appears that the criteria set forth in paragraph (a) of this section are no longer satisfied, and, when appropriate, may issue a notice of proposed order of compliance under § 13.73 in lieu thereof.
 - (d) If at any time in the course of a proceeding commenced in accordance with § 13.73 the criteria set forth in paragraph (a) of this section are satisfied, the official who issued the notice may issue an order of immediate compliance, even if the period for filing a reply or requesting a hearing specified in § 13.75 has not expired.
 - (e) Within three days after receipt of service of an order of immediate compliance, the alleged violator may request a hearing in accordance with Subpart D of this part and the procedure in that subpart will apply except that –
 - (1) The case will be heard within fifteen days after the date of the order of immediate compliance unless the alleged violator requests a later date ;

- (2) The order will serve as the complaint; and
- (3) The Hearing Officer shall issue his decision and order dismissing, reversing, modifying, or affirming the order of immediate compliance on the record at the close of the hearing.
- (f) The filing of a request for hearing in accordance with paragraph (e) of this section does not stay the effectiveness of an order of immediate compliance.
- (g) At any time after an order of immediate compliance has become effective, the official who issued the order may request the United States Attorney General, or the delegate of the Attorney General, to bring an action for appropriate relief in accordance with § 13.25.

FAR 13.83 : Appeal.

- (a) Any party to the hearing may appeal from the order of the Hearing Officer by filing a notice of appeal with the Administrator within 20 days after the date of issuance of the order.
- (b) Any person against whom an order of immediate compliance has been issued in accordance with § 13.81 or the official who issued the order of immediate compliance may appeal from the order of the Hearing Officer by filing a notice of appeal with the Administrator within three days after the date of issuance of the order by the Hearing Officer.
- (c) Unless the Administrator expressly so provides, the filing of a notice of appeal does not stay the effectiveness of an order of immediate compliance.
- (d) If a notice of appeal is not filed from the order of compliance issued by a Hearing Officer, such order is the final agency order of compliance.
- (e) Any person filing an appeal authorized by paragraph (a) of this section shall file an appeal brief with the Administrator within 40 days after the date of the issuance of the order, and serve a copy on the other party. Any reply brief must be filed within 20 days after service of the appeal brief. A copy of the reply brief must be served on the appellant.
- (f) Any person filing an appeal authorized by paragraph (b) of this section shall file an appeal brief with the Administrator with the notice of appeal and serve a copy on the other party. Any reply brief must be filed within 3 days after receipt of the appeal brief. A copy of the reply brief must be served on the appellant.
- (g) On appeal the Administrator reviews the available record of the proceeding, and issues an order dismissing, reversing, modifying or affirming the order of compliance or the order of immediate compliance. The Administrator's order includes the reasons for the action.
- (h) In cases involving an order of immediate compliance, the Administrator's order on appeal is issued within ten days after the filing of the notice of appeal.

FAR 13.85 : Filing, service and computation of time.

Filing and service of documents under this subpart shall be accomplished in accordance with § 13.43 except service of orders of immediate compliance under § 13.81(b); and the periods of time specified in this subpart shall be computed in accordance with § 13.44.

Neuvième partie
FAR 31- Airworthiness
standards : manned free
balloons

- (l) No prior indication may be given to any crewmember or passenger of the particular exits to be used in the demonstration.
- (m) The applicant may not practice, rehearse, or describe the demonstration for the participants nor may any participant have taken part in this type of demonstration within the preceding 6 months.
- (n) A pretakeoff passenger briefing may be given. The passengers may also be advised to follow directions of crewmembers, but not be instructed on the procedures to be followed in the demonstration.
- (o) If safety equipment, as allowed by paragraph (c) of this appendix, is provided, either all passenger and cockpit windows must be blacked out or all emergency exits must have safety equipment to prevent disclosure of the available emergency exits.
- (p) Not more than 50 percent of the emergency exits in the sides of the fuselage of a rotorcraft that meet all of the requirements applicable to the required emergency exits for that rotorcraft may be used for demonstration. Exits that are not to be used for the demonstration must have the exit handle deactivated or must be indicated by red lights, red tape, or other acceptable means placed outside the exits to indicate fire or other reasons why they are unusable. The exits to be used must be representative of all the emergency exits on the rotorcraft and must be designated by the applicant, subject to approval by the Administrator. If installed, at least one floor level exit (Type I; Sec. 29.807(a)(1)) must be used as required by Sec. 29.807(c).
- (q) All evacuees must leave the rotorcraft by a means provided as part of the rotorcraft's equipment.
- (r) Approved procedures must be fully utilized during the demonstration.
- (s) The evacuation time period is completed when the last occupant has evacuated the rotorcraft and is on the ground.]
- Amdt. 29-30, Eff. 4/5/90

FAR 13.87 : Extension of time.

- (a) The official who issued the notice of proposed order of compliance, for good cause shown, may grant an extension of time to file any document specified in this subpart, except documents to be filed with the Administrator.
- (b) Extensions of time to file documents with the Administrator may be granted by the Administrator upon written request, served upon all parties, and for good cause shown.

FAR 29.D1 : [Criteria For Demonstration of Emergency Evacuation Procedures Under Sec. 29.803.]

- (a) [The demonstration must be conducted either during the dark of the night or during daylight with the dark of night simulated. If the demonstration is conducted indoors during daylight hours, it must be conducted inside a darkened hangar having doors and windows covered. In addition, the doors and windows of the rotorcraft must be covered if the hangar illumination exceeds that of a moonless night. Illumination on the floor or ground may be used, but it must be kept low and shielded against shining into the rotorcraft's windows or doors.
- (b) The rotorcraft must be in a normal attitude with landing gear extended.
- (c) Safety equipment such as mats or inverted life rafts may be placed on the floor or ground to protect participants. No other equipment that is not part of the rotorcraft's emergency evacuation equipment may be used to aid the participants in reaching the ground.
- (d) Except as provided in paragraph (a) of this appendix, only the rotorcraft's emergency lighting system may provide illumination.
- (e) All emergency equipment required for the planned operation of the rotorcraft must be installed.
- (f) Each external door and exit and each internal door or curtain must be in the takeoff configuration.
- (g) Each crewmember must be seated in the normally assigned seat for takeoff and must remain in that seat until receiving the signal for commencement of the demonstration. For compliance with this section, each crewmember must be—
 - (1) A member of a regularly scheduled line crew; or
 - (2) A person having knowledge of the operation of exits and emergency equipment.
- (h) A representative passenger load of persons in normal health must be used as follows :
 - (1) At least 25 percent must be over 50 years of age, with at least 40 percent of these being females.
 - (2) The remaining, 75 percent or less, must be 50 years of age or younger, with at least 30 percent of these being females.
 - (3) Three life-size dolls, not included as part of the total passenger load, must be carried by passengers to simulate live infants 2 years old or younger, except for a total passenger load of fewer than 44 but not more than 19, one doll must be carried. A doll is not required for a 19 or fewer passenger load.
 - (4) Crewmembers, mechanics, and training personnel who maintain or operate the rotorcraft in the normal course of their duties may not be used as passengers.
- (i) No passenger may be assigned a specific seat except as the Administrator may require. Except as required by paragraph (1) of this appendix, no employee of the applicant may be seated next to an emergency exit, except as allowed by the Administrator.
- (j) Seat belts and shoulder harnesses (as required) must be fastened.
- (k) Before the start of the demonstration, approximately one-half of the total average amount of carry-on baggage, blankets, pillows, and other similar articles must be distributed at several locations in the aisles and emergency exit access ways to create minor obstructions.

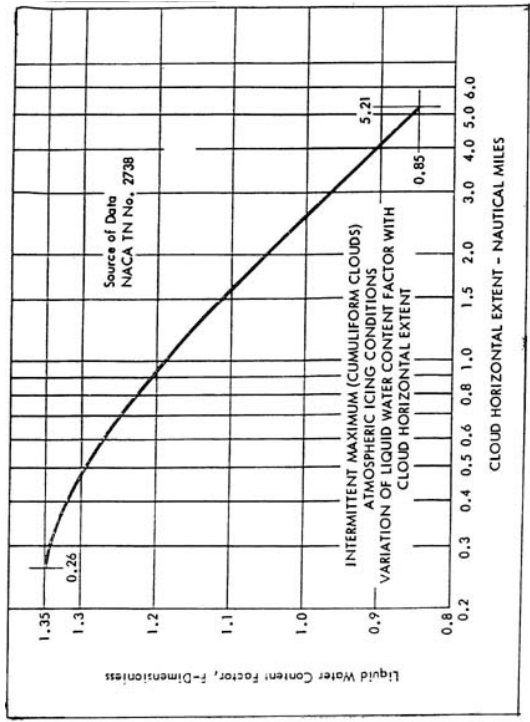


FIG. 79.6 - Intermittent Maximum (Cumuliform Clouds) Variation of Liquid Water Content Factor with Cloud Horizontal Extent

Chapitre 9

Subpart F : Formal Fact-Finding Investigation Under an Order of Investigation

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FAR 13.101 : Applicability.

- (a) This subpart applies to fact-finding investigations in which an order of investigation has been issued under § 13.3(c) or § 13.5(i) of this part.
- (b) This subpart does not limit the authority of duly designated persons to issue subpoenas, administer oaths, examine witnesses and receive evidence in any informal investigation as provided for in sections 313 and 1004(a) of the Federal Aviation Act (49 U.S.C. 1354 and 1484(a)) and section 109(a) of the Hazardous Materials Transportation Act (49 U.S.C. 1808(a)).

FAR 13.103 : Order of investigation.

The order of investigation –

- (a) Defines the scope of the investigation by describing the information sought in terms of its subject matter or its relevancy to specified FAA functions;
- (b) Sets forth the form of the investigation which may be either by individual deposition or investigative proceeding or both; and
- (c) Names the official who is authorized to conduct the investigation and serve as the Presiding Officer.

FAR 13.105 : Notification.

Any person under investigation and any person required to testify and produce documentary or physical evidence during the investigation will be advised of the purpose of the investigation, and of the place where the investigative proceeding or deposition will be convened. This may be accomplished by a notice of investigation or by a subpoena. A copy of the order of investigation may be sent to such persons, when appropriate.

FAR 13.107 : Designation of additional parties.

- (a) The Presiding Officer may designate additional persons as parties to the investigation, if in the discretion of the Presiding Officer, it will aid in the conduct of the investigation.
- (b) The Presiding Officer may designate any person as a party to the investigation if that person –
 - (1) Petitions the Presiding Officer to participate as a party; and
 - (2) Is so situated that the disposition of the investigation may as a practical matter impair the ability to protect that person's interest unless allowed to participate as a party; and
 - (3) Is not adequately represented by existing parties.

FAR 13.109 : Convening the investigation.

The investigation shall be conducted at such place or places designated by the Presiding Officer, and as convenient to the parties involved as expeditious and efficient handling of the investigation permits.

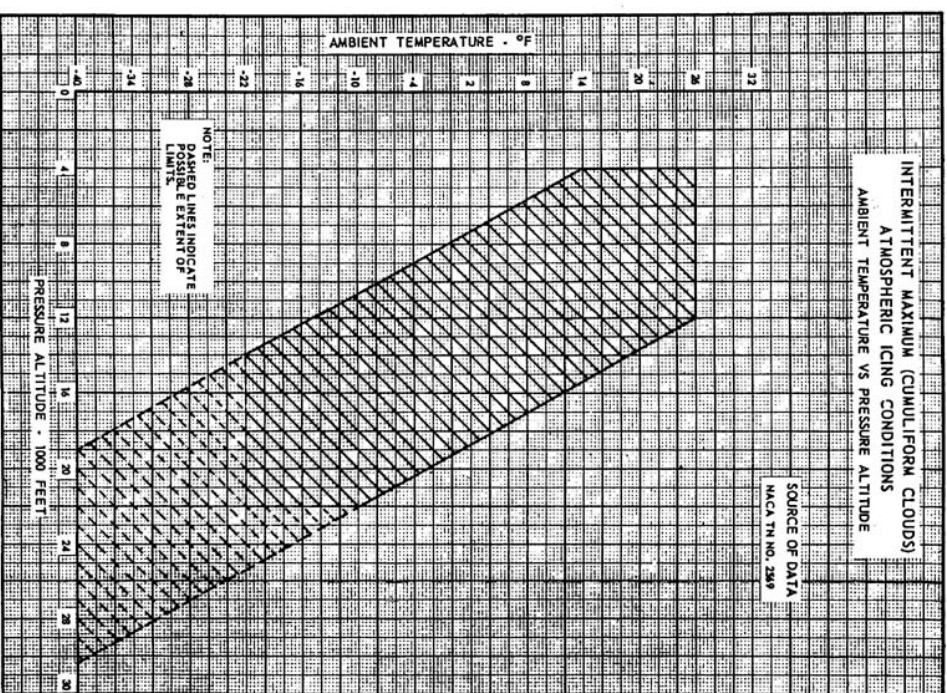


FIG. 79.5 – Intermittent Maximum (Cumuliform Clouds) Ambient Temperature vs Pressure Altitude

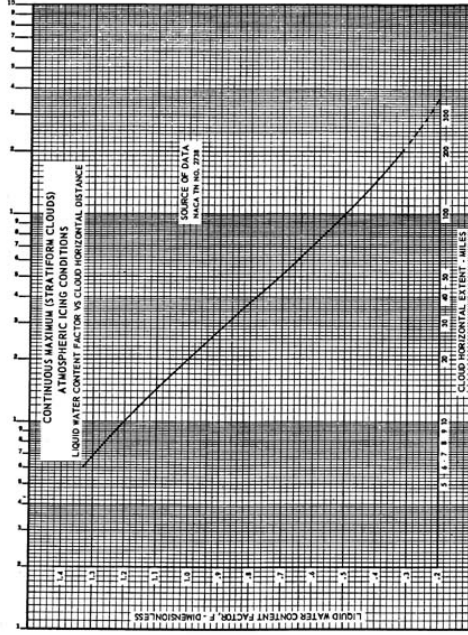


FIG. 79.3 – Continuous Maximum (Stratiform Clouds) Liquid Water Content Factor vs Cloud Horizontal Distance

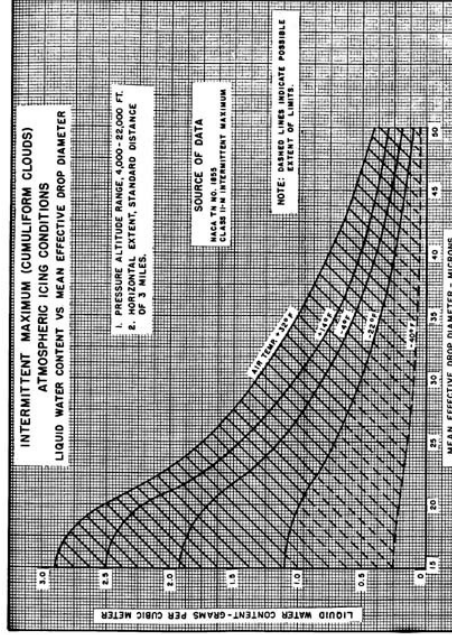


FIG. 79.4 – Intermittent Maximum (Cumuliform Clouds) Liquid Water Content vs Mean Effective Drop Diameter

FAR 13.111 : Subpoenas.

- (a) Upon motion of the Presiding Officer, or upon the request of a party to the investigation, the Presiding Officer may issue a subpoena directing any person to appear at a designated time and place to testify or to produce documentary or physical evidence relating to any matter under investigation.
- (b) Subpoenas shall be served by personal service, or upon an agent designated in writing for the purpose, or by registered or certified mail addressed to such person or agent. Whenever service is made by registered or certified mail, the date of mailing shall be considered as the time when service is made.
- (c) Subpoenas shall extend in jurisdiction throughout the United States or any territory or possession thereof.

FAR 13.113 : Noncompliance with the investigative process.

If any person fails to comply with the provisions of this subpart or with any subpoena or order issued by the Presiding Officer or the designee of the Presiding Officer, judicial enforcement may be initiated against that person under applicable statutes.

FAR 13.115 : Public proceedings.

- (a) All investigative proceedings and depositions shall be public unless the Presiding Officer determines that the public interest requires otherwise.
- (b) The Presiding Officer may order information contained in any report or document filed or in any testimony given pursuant to this subpart withheld from public disclosure when, in the judgment of the Presiding Officer, disclosure would adversely affect the interests of any person and is not required in the public interest or is not otherwise required by statute to be made available to the public. Any person may make written objection to the public disclosure of such information, stating the grounds for such objection.

FAR 13.117 : Conduct of investigative proceeding or deposition.

- (a) The Presiding Officer or the designee of the Presiding Officer may question witnesses.
- (b) Any witness may be accompanied by counsel.
- (c) Any party may be accompanied by counsel and either the party or counsel may –
 - (1) Question witnesses, provided the questions are relevant and material to the matters under investigation and would not unduly impede the progress of the investigation; and
 - (2) Make objections on the record and argue the basis for such objections.
- (d) Copies of all notices or written communications sent to a party or witness shall upon request be sent to that person's attorney of record.

FAR 13.119 : Rights of persons against self-incrimination.

- (a) Whenever a person refuses, on the basis of a privilege against self-incrimination, to testify or provide other information during the course of any investigation conducted under this subpart, the Presiding Officer may, with the approval of the Attorney General of the United States, issue an order requiring the person to give testimony

or provide other information. However, no testimony or other information so compelled (or any information directly or indirectly derived from such testimony or other information) may be used against the person in any criminal case, except in a prosecution for perjury, giving a false statement, or otherwise failing to comply with the order.

(b) The Presiding Officer may issue an order under this section if –

- (1) The testimony or other information from the witness may be necessary to the public interest; and
 - (2) The witness has refused or is likely to refuse to testify or provide other information on the basis of a privilege against self-incrimination.
- (c) Immunity provided by this section will not become effective until the person has refused to testify or provide other information on the basis of a privilege against self-incrimination, and an order under this section has been issued. An order, however, may be issued prospectively to become effective in the event of a claim of the privilege.

FAR 13.121 : Witness fees.

All witnesses appearing shall be compensated at the same rate as a witness appearing before a United States District Court.

FAR 13.123 : Submission by party to the investigation.

- (a) During an investigation conducted under this subpart, a party may submit to the Presiding Officer –
 - (1) A list of witnesses to be called, specifying the subject matter of the expected testimony of each witness, and
 - (2) A list of exhibits to be considered for inclusion in the record.
- (b) If the Presiding Officer determines that the testimony of a witness or the receipt of an exhibit in accordance with paragraph (a) of this section will be relevant, competent and material to the investigation, the Presiding Officer may subpoena the witness or use the exhibit during the investigation.

FAR 13.125 : Depositions.

Depositions for investigative purposes may be taken at the discretion of the Presiding Officer with reasonable notice to the party under investigation. Such depositions shall be taken before the Presiding Officer or other person authorized to administer oaths and designated by the Presiding Officer. The testimony shall be reduced to writing by the person taking the deposition, or under the direction of that person, and where possible shall then be subscribed by the deponent. Any person may be compelled to appear and testify and to produce physical and documentary evidence.

FAR 13.127 : Reports, decisions and orders.

The Presiding Officer shall issue a written report based on the record developed during the formal investigation, including a summary of principal conclusions. A summary of principal conclusions shall be prepared by the official who issued the order of investigation in every case which results in no action, or no action as to a particular party to

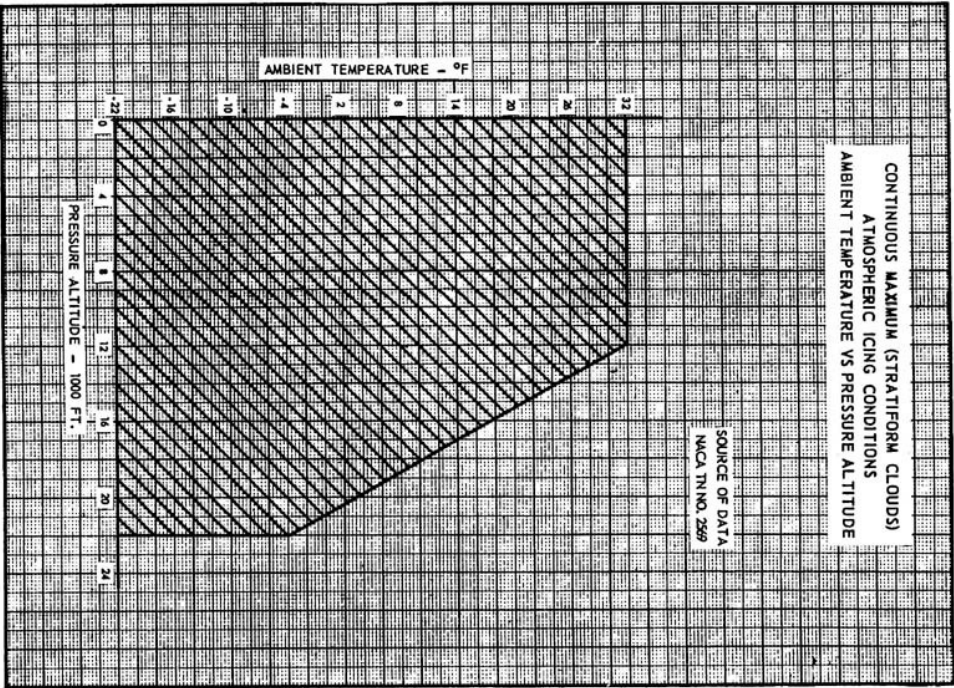


FIG. 79.2 – Continuous Maximum (Stratiform Clouds) Ambient Temperature vs Pressure Altitude

determined from (Figure 79.1, p. 1086) and (Figure 79.2, p. 1087). The cloud liquid water content for continuous maximum icing conditions of a horizontal extent, other than 17.4 nautical miles, is determined by the value of liquid water content of (Figure 79.1, p. 1086), multiplied by the appropriate factor from (Figure 79.3, p. 1088) of this appendix.

- (b) *Intermittent maximum icing.* The intermittent maximum intensity of atmospheric icing conditions (intermittent maximum icing is defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the interrelationship of these three variables as shown in (Figure 79.4, p. 1088) of this appendix. The limiting icing envelope in terms of altitude and temperature is given in (Figure 79.5, p. 1089) of this appendix. The interrelationship of cloud liquid water content with drop diameter and altitude is determined from (Figure 79.4, p. 1088) and (Figure 79.5, p. 1089). The cloud liquid water content for intermittent maximum icing conditions of a horizontal extent, other than 2.6 nautical miles, is determined by the value of cloud liquid water content of (Figure 79.4, p. 1088) multiplied by the appropriate factor in (Figure 79.6, p. 1090) of this appendix.]

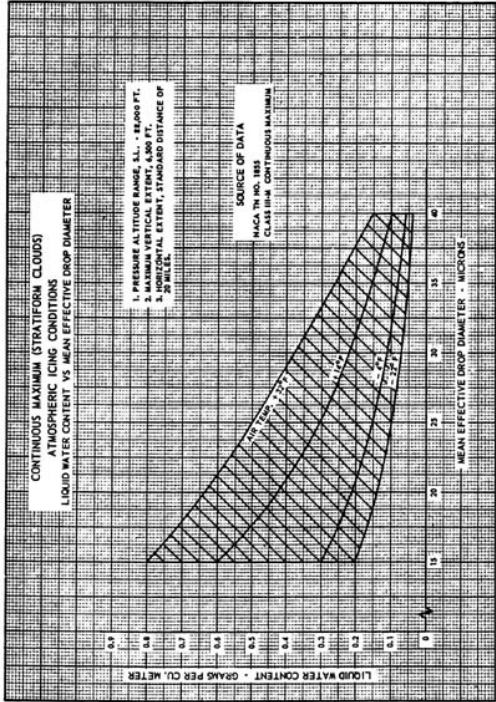


FIG. 79.1 – Continuous Maximum (Stratiform Clouds) Liquid Water Content vs Mean Effective Drop Diameter

Andt. 29-21, Eff. 3/2/83

the investigation. All such reports shall be furnished to the parties to the investigation and filed in the public docket. Insertion of the report in the Public Docket shall constitute "entering of record" and publication as prescribed by section 313(b) of the Federal Aviation Act.

FAR 13.129 : Post-investigation action.

A decision on whether to initiate subsequent action shall be made on the basis of the record developed during the formal investigation and any other information in the possession of the Administrator.

FAR 13.131 : Other procedures.

Any question concerning the scope or conduct of a formal investigation not covered in this subpart may be ruled on by the Presiding Officer on motion of the Presiding Officer, or on the motion of a party or a person testifying or producing evidence.

- (i) Only the required flight instruments for the first pilot may be connected to that operating system ;
 - (ii) Additional instruments, systems, or equipment may not be connected to an operating system for a second pilot unless provisions are made to ensure the continued normal functioning of the required instruments in the event of any malfunction of the additional instruments, systems, or equipment which is not shown to be extremely improbable ;
 - (iii) The equipment, systems, and installations must be designed so that one display of the information essential to the safety of flight which is provided by the instruments will remain available to a pilot, without additional crewmember action, after any single failure or combination of failures that is not shown to be extremely improbable ; and
 - (iv) For single-pilot configurations, instruments which require a static source must be provided with a means of selecting an alternate source and that source must be calibrated.
 - (6) [In determining compliance with the requirements of Sec. 29.1351(d)(2), the supply of electrical power to all systems necessary for flight under IFR must be included in the evaluation.]
 - (c) *Thunderstorm lights.* In addition to the instrument lights required by Sec. 29.1381(a), thunderstorm lights which provide high intensity white flood lighting to the basic flight instruments must be provided. The thunderstorm lights must be installed to meet the requirements of Sec. 29.1381(b).
- Amdt. 29-40, Eff. 8/8/96

FAR 29.B9 : [IX. Rotorcraft Flight Manual.]

[A Rotorcraft Flight Manual or Rotorcraft Flight Manual IFR Supplement must be provided and must contain—

- (a) Limitations. The approved IFR flight envelope, the IFR flightcrew composition, the revised kinds of operation, and the steepest IFR precision approach gradient for which the helicopter is approved ;
 - (b) Procedures. Required information for proper operation of IFR systems and the recommended procedures in the event of stability augmentation or electrical system failures ; and
 - (c) Performance. If V_{Y_i} differs from V_Y , climb performance at V_{Y_i} and with maximum continuous power throughout the ranges of weight, altitude, and temperature for which approval is requested.]
- Amdt. 29-21, Eff. 3/2/83

FAR 29.C1 : [Icing certification.]

- (a) [*Continuous maximum icing.* The maximum continuous intensity of atmospheric icing conditions (continuous maximum icing) is defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the interrelationship of these three variables as shown in (Figure 79.1, p. 1086) of this appendix. The limiting icing envelope in terms of altitude and temperature is given in (Figure 79.2, p. 1087) of this appendix. The interrelationship of cloud liquid water content with drop diameter and altitude is

FAR 29.B7 : [VII. Stability augmentation system (SAS).]

(a) [If a SAS is used, the reliability of the SAS must be related to the effects of its failure. The occurrence of any failure condition which would prevent continued safe flight and landing must be extremely improbable. For any failure condition of the SAS which is not shown to be extremely improbable—

- (1) The helicopter must be safely controllable and capable of prolonged instrument flight without undue pilot effort. Additional unrelated probable failures affecting the control system must be considered; and
 - (2) The flight characteristics requirements in Subpart B of Part 29 must be met throughout a practical flight envelope.
- (b) The SAS must be designed so that it cannot create a hazardous deviation in flight path or produce hazardous loads on the helicopter during normal operation or in the event of malfunction or failure, assuming corrective action begins within an appropriate period of time. Where multiple systems are installed, subsequent malfunction conditions must be considered in sequence unless their occurrence is shown to be improbable.]

Amdt. 29-21, Eff. 3/2/83

FAR 29.B8 : VIII. Equipment, systems, and installation.

The basic equipment and installation must comply with Subpart F of Part 29 through Amendment 29-14, with the following exceptions and additions :

- (a) *Flight and navigation instruments.*
 - (1) A magnetic gyro-stabilized direction indicator instead of the gyroscopic direction indicator required by Sec. 29.1303(h) ; and
 - (2) A standby attitude indicator which meets the requirements of Secs. 29.1303(g)(1) through (7), instead of a rate-of-turn indicator required by Sec. 29.1303(g). If standby batteries are provided, they may be charged from the aircraft electrical system if adequate isolation is incorporated. The system must be designed so that the standby batteries may not be used for engine starting.
- (b) *Miscellaneous requirements.*
 - (1) Instrument systems and other systems essential for IFR flight that could be adversely affected by icing must be provided with adequate ice protection whether or not the rotorcraft is certificated for operation in icing conditions.
 - (2) There must be means in the generating system to automatically de-energize and disconnect from the main bus any power source developing hazardous overvoltage.
 - (3) Each required flight instrument using a power supply (electric, vacuum, etc.) must have a visual means integral with the instrument to indicate the adequacy of the power being supplied.
 - (4) When multiple systems performing like functions are required, each system must be grouped, routed, and spaced so that physical separation between systems is provided to ensure that a single malfunction will not adversely affect more than one system.
 - (5) For systems that operate the required flight instruments at each pilot's station—

Chapitre 10

Subpart G : Rules of Practice in FAA Civil Penalty Actions

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- (e) *Descent.* Stability must be shown throughout the speed range 20 knots either side of trim with—
- (1) The helicopter trimmed at $0.8 V_H$ $0.8 V_{FE}$ (or $0.8 V_G$ for the landing gear extended case), whichever is lower;
 - (2) Power required for 1,000 fpm descent at trim speed; and
 - (3) Landing gear extended and retracted, if applicable.
- (f) *Approach.* Stability must be shown throughout the speed range from 0.7 times the minimum recommended approach speed to 20 knots above the maximum recommended approach speed with—
- (1) The helicopter trimmed at the recommended approach speed or speeds;
 - (2) Landing gear extended and retracted, if applicable; and
 - (3) Power required to maintain a 3° glide path and power required to maintain the steepest approach gradient for which approval is requested.]
- Amdt. 29-21, Eff. 3/2/83
- FAR 29.B5 : [Y. Static lateral-directional stability.]**
- (a) [Static directional stability must be positive throughout the approved ranges of airspeed, power, and vertical speed. In straight, steady sideslips up to $\pm 10^\circ$ from trim, directional control position must increase in approximately constant proportion to angle of sideslip. At greater angles up to the maximum sideslip angle appropriate to the type, increased directional control position must produce increased angle of sideslip.
- (b) During sideslips up to $\pm 10^\circ$ from trim throughout the approved ranges of airspeed, power, and vertical speed there must be no negative dihedral stability perceptible to the pilot through lateral control motion or force. Longitudinal cycle movement with sideslip must not be excessive.]
- Amdt. 29-21, Eff. 3/2/83
- FAR 29.B6 : [VL. Dynamic stability.]**
- (a) Any oscillation having a period of less than 5 seconds must damp to $\frac{1}{2}$ amplitude in not more than one cycle.
 - (b) Any oscillation having a period of 5 seconds or more but less than 10 seconds must damp to $\frac{1}{4}$ amplitude in not more than two cycles.
 - (c) Any oscillation having a period of 10 seconds or more but less than 20 seconds must be damped.
 - (d) Any oscillation having a period of 20 seconds or more may not achieve double amplitude in less than 20 seconds.
 - (e) Any aperiodic response may not achieve double amplitude in less than 9 seconds.
- Amdt. 29-21, Eff. 3/2/83

FAR 29.B1 : [I. General.]

[A transport category helicopter may not be type certificated for operation under the instrument flight rules (IFR) of this chapter unless it meets the design and installation requirements contained in this Appendix.]
Amdt. 29-21, Eff. 3/2/83

FAR 29.B2 : [II. Definitions.]

- (a) [V_{Y_i} means instrument climb speed, utilized instead of V_Y for compliance with the climb requirements for instrument flight.
(b) V_{NE_i} means instrument flight never exceed speed, utilized instead of V_{NE} for compliance with maximum limit speed requirements for instrument flight.
(c) V_{mini} means instrument flight minimum speed, utilized in complying with minimum limit speed requirements for instrument flight.]
Amdt. 29-21, Eff. 3/2/83

FAR 29.B3 : [III. Trim.]

[It must be possible to trim the cyclic, collective, and directional control forces to zero at all approved IFR airspeeds, power settings, and configurations appropriate to the type.]
Amdt. 29-21, Eff. 3/2/83

FAR 29.B4 : [IV. Static longitudinal stability.]

- (a) [*General.* The helicopter must possess positive static longitudinal control force stability at critical combinations of weight and center of gravity at the conditions specified in paragraphs IV(b) through (f) of this Appendix. The stick force must vary with speed so that any substantial speed change results in a stick force clearly perceptible to the pilot. The airspeed must return to within 10 percent of the trim speed when the control force is slowly released for each trim condition specified in paragraphs IV(b) through (f) of this Appendix.
(b) *Climb.* Stability must be shown in climb throughout the speed range 20 knots either side of trim with—
(1) The helicopter trimmed at V_{Y_i} ;
(2) Landing gear retracted (if retractable); and
(3) Power required for limit climb rate (at least 1,000 fpm) at V_{Y_i} or maximum continuous power, whichever is less.
(c) *Cruise.* Stability must be shown throughout the speed range from 0.7 to 1.1 V_H or V_{NE_i} , whichever is lower, not to exceed ± 20 knots from trim with—
(1) The helicopter trimmed and power adjusted for level flight at 0.9 V_H or 0.9 V_{NE_i} , whichever is lower; and
(2) Landing gear retracted (if retractable).
(d) *Slow cruise.* Stability must be shown throughout the speed range from 0.9 V_{mini} to 1.3 V_{mini} or 20 knots above trim speed, whichever is greater, with—
(1) The helicopter trimmed and power adjusted for level flight at 1.1 V_{mini} ; and
(2) Landing gear retracted (if retractable).

FAR 13.201 : Applicability.

(a) This subpart applies to the following actions :

- (1) A civil penalty action in which a complaint has been issued for an amount not exceeding \$50,000 for a violation arising under the Federal Aviation Act of 1958, as amended (49 U.S.C. 1301, et seq.), or a rule, regulation, or order issued thereunder.
(2) A civil penalty action in which a complaint has been issued for a violation arising under the Federal Aviation Act of 1958, as amended (49 U.S.C. 1471, et seq.) and the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.), or a rule, regulation, or order issued thereunder.
(b) This subpart applies only to proceedings initiated after September 7, 1988. All other cases, hearings, or other proceedings pending or in progress before September 7, 1988, are not affected by the rules in this subpart.
(c) Notwithstanding the provisions of paragraph (a) of this section, the United States district courts shall have exclusive jurisdiction of any civil penalty action initiated by the Administrator :
(1) Which involves an amount in controversy in excess of \$50,000;
(2) Which is an in rem action or in which an in rem action based on the same violation has been brought;
(3) Regarding which an aircraft subject to lien has been seized by the United States; and
(4) In which a suit for injunctive relief based on the violation giving rise to the civil penalty has also been brought.

FAR 13.202 : Definitions.

Administrative law judge means an administrative law judge appointed pursuant to the provisions of 5 U.S.C. 3105.

Agency attorney means the Deputy Chief Counsel, the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, each Regional Counsel, the Aeronautical Center Counsel, or the Technical Center Counsel, or an attorney on the staff of the Assistant Chief Counsel, Enforcement, the Assistant Chief Counsel, Regulations, the Assistant Chief Counsel, Europe, Africa, and Middle East Area Office, each Regional Counsel, the Aeronautical Center Counsel, or the Technical Center Counsel who prosecutes a civil penalty action. An agency attorney shall not include :

- (1) The Chief Counsel, the Assistant Chief Counsel for Litigation, or the Special Counsel and Director of Civil Penalty Adjudications ; or
(2) Any attorney on the staff of either the Assistant Chief Counsel for Litigation or the Special Counsel and Director of Civil Penalty Adjudications who advises the FAA decisionmaker regarding an initial decision or any appeal to the FAA decisionmaker ; or
(3) Any attorney who is supervised in a civil penalty action by a person who provides such advice to the FAA decisionmaker in that action or a factually-related action.

Attorney means a person licensed by a state, the District of Columbia, or a territory of the United States to practice law or appear before the courts of that state or territory.

Complaint means a document issued by an agency attorney alleging a violation of the Federal Aviation Act of 1958, as amended, or a rule, regulation, or order issued thereunder, or the Hazardous Materials Transportation Act, or a rule, regulation, or order issued thereunder that has been filed with the hearing docket after a hearing has been requested pursuant to §13.16(d)(3) or §13.16(e)(2)(ii) of this part.

FAA decisionmaker means the Administrator of the Federal Aviation Administration, acting in the capacity of the decisionmaker on appeal, or any person to whom the Administrator has delegated the Administrator's decisionmaking authority in a civil penalty action. As used in this subpart, the FAA decisionmaker is the official authorized to issue a final decision and order of the Administrator in a civil penalty action.

Mail includes U.S. certified mail, U.S. registered mail, or use of an overnight express courier service.

Order assessing civil penalty means a document that contains a finding of violation of the Federal Aviation Act of 1958, as amended, or a rule, regulation, or order issued thereunder, or the Hazardous Materials Transportation Act, or a rule, regulation, or order issued thereunder and may direct payment of a civil penalty. Unless an appeal is filed with the FAA decisionmaker in a timely manner, an initial decision or order of an administrative law judge shall be considered an order assessing civil penalty if an administrative law judge finds that an alleged violation occurred and determines that a civil penalty, in an amount found appropriate by the administrative law judge, is warranted. Unless a petition for review is filed with a U.S. Court of Appeals in a timely manner, a final decision and order of the Administrator shall be considered an order assessing civil penalty if the FAA decisionmaker finds that an alleged violation occurred and a civil penalty is warranted.

Party means the respondent or the Federal Aviation Administration (FAA).

Personal delivery includes hand-delivery or use of a contract or express messenger service. "Personal delivery" does not include the use of Government interoffice mail service.

Pleading means a complaint, an answer, and any amendment of these documents permitted under this subpart.

Properly addressed means a document that shows an address contained in agency records, a residential, business, or other address submitted by a person on any document provided under this subpart, or any other address shown by other reasonable and available means.

Respondent means a person, corporation, or company named in a complaint.

FAR 13.203 : Separation of functions.

- (a) Civil penalty proceedings, including hearings, shall be prosecuted by an agency attorney.
- (b) An agency employee engaged in the performance of investigative or prosecutorial functions in a civil penalty action shall not, in that case or a factually-related case, participate or give advice in a decision by the administrative law judge or

Chapitre 79

Appendix B : Airworthiness Criteria for Helicopter Instrument Flight

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by the FAA decisionmaker on appeal, except as counsel or a witness in the public proceedings.

- (c) The Chief Counsel, the Assistant Chief Counsel for Litigation, the Special Counsel and Director of Civil Penalty Adjudications, or an attorney on the staff of either the Assistant Chief Counsel for Litigation or the Special Counsel and Director of Civil Penalty Adjudications, will advise the FAA decisionmaker regarding an initial decision or any appeal of a civil penalty action to the FAA decisionmaker.

FAR 13.204 : Appearances and rights of parties.

- (a) Any party may appear and be heard in person.
- (b) Any party may be accompanied, represented, or advised by an attorney or representative designated by the party and may be examined by that attorney or representative in any proceeding governed by this subpart. An attorney or representative who represents a party may file a notice of appearance in the action, in the manner provided in §13.210 of this subpart, and shall serve a copy of the notice of appearance on each party, in the manner provided in §13.211 of this subpart, before participating in any proceeding governed by this subpart. The attorney or representative shall include the name, address, and telephone number of the attorney or representative in the notice of appearance.
- (c) Any person may request a copy of a document upon payment of reasonable costs. A person may keep an original document, data, or evidence, with the consent of the administrative law judge, by substituting a legible copy of the document for the record.

FAR 13.205 : Administrative law judges.

- (a) *Powers of an administrative law judge.* In accordance with the rules of this subpart, an administrative law judge may :
 - (1) Give notice of, and hold, prehearing conferences and hearings ;
 - (2) Administer oaths and affirmations ;
 - (3) Issue subpoenas authorized by law and issue notices of deposition requested by the parties ;
 - (4) Rule on offers of proof ;
 - (5) Receive relevant and material evidence ;
 - (6) Regulate the course of the hearing in accordance with the rules of this subpart ;
 - (7) Hold conferences to settle or to simplify the issues by consent of the parties ;
 - (8) Dispose of procedural motions and requests ; and
 - (9) Make findings of fact and conclusions of law, and issue an initial decision.
- (b) *Limitations on the power of the administrative law judge.* The administrative law judge shall not issue an order of contempt, award costs to any party, or impose any sanction not specified in this subpart. If the administrative law judge imposes any sanction not specified in this subpart, a party may file an interlocutory appeal of right with the FAA decisionmaker pursuant to §13.219(c)(4) of this subpart. This section does not preclude an administrative law judge from issuing an order that bars a person from a specific proceeding based on a finding of obstreperous or disruptive behavior in that specific proceeding.

- (c) *Disqualification.* The administrative law judge may disqualify himself or herself at any time. A party may file a motion, pursuant to §13.218(f)(6), requesting that an administrative law judge be disqualified from the proceedings.

FAR 13.206 : Intervention.

- (a) A person may submit a motion for leave to intervene as a party in a civil penalty action. Except for good cause shown, a motion for leave to intervene shall be submitted not later than 10 days before the hearing.
- (b) If the administrative law judge finds that intervention will not unduly broaden the issues or delay the proceedings, the administrative law judge may grant a motion for leave to intervene if the person will be bound by any order or decision entered in the action or the person has a property, financial, or other legitimate interest that may not be addressed adequately by the parties. The administrative law judge may determine the extent to which an intervenor may participate in the proceedings.

FAR 13.207 : Certification of documents.

- (a) *Signature required.* The attorney of record, the party, or the party's representative shall sign each document tendered for filing with the hearing docket clerk, the administrative law judge, the FAA decisionmaker on appeal, or served on each party.
- (b) *Effect of signing a document.* By signing a document, the attorney of record, the party, or the party's representative certifies that the attorney, the party, or the party's representative has read the document and, based on reasonable inquiry and to the best of that person's knowledge, information, and belief, the document is –
- (1) Consistent with these rules;
 - (2) Warranted by existing law or that a good faith argument exists for extension, modification, or reversal of existing law ; and
 - (3) Not unreasonable or unduly burdensome or expensive, not made to harass any person, not made to cause unnecessary delay, not made to cause needless increase in the cost of the proceedings, or for any other improper purpose.
- (c) *Sanctions.* If the attorney of record, the party, or the party's representative signs a document in violation of this section, the administrative law judge or the FAA decisionmaker shall :
- (1) Strike the pleading signed in violation of this section ;
 - (2) Strike the request for discovery or the discovery response signed in violation of this section and preclude further discovery by the party ;
 - (3) Deny the motion or request signed in violation of this section ;
 - (4) Exclude the document signed in violation of this section from the record ;
 - (5) Dismiss the interlocutory appeal and preclude further appeal on that issue by the party who filed the appeal until an initial decision has been entered on the record ; or
 - (6) Dismiss the appeal of the administrative law judge's initial decision to the FAA decisionmaker.

- (1) Scheduling information for each part of the rotorcraft and its engines, auxiliary power units, rotors, accessories, instruments, and equipment that provides the recommended periods at which they should be cleaned, inspected, adjusted, tested, and lubricated, and the degree of inspection, the applicable wear tolerances, and work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree of complexity requiring specialized techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross references to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the rotorcraft.
- (2) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.
- (3) Information describing the order and method of removing and replacing products and parts with any necessary precautions to be taken.
- (4) Other general procedural instructions including procedures for system testing during ground running, symmetry checks, weighing and determining the center of gravity, lifting and shoring, and storage limitations.
- (c) Diagrams of structural access plates and information needed to gain access for inspections when access plates are not provided.
- (d) Details for the application of special inspection techniques including radiographic and ultrasonic testing where such processes are specified.
- (e) Information needed to apply protective treatments to the structure after inspection.
- (f) All data relative to structural fasteners such as identification, discard recommendations, and torque values.
- (g) A list of special tools needed.]
- Amdt. 29-20, Eff. 10/14/80

FAR 29.A4 : Airworthiness Limitations section.

The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, structural inspection interval, and related structural inspection procedure approved under Sec. 29.571. If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads : "The Airworthiness Limitations section is FAA approved and specifies maintenance required under Secs. 43.16 and [91.403] of the Federal Aviation Regulations unless an alternative program has been FAA approved."

Amdt. 29-27, Eff. 8/18/90

FAR 29.A1 : [General.]

- (a) [This appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by Sec. 29.1529.
- (b) The Instructions for Continued Airworthiness for each rotorcraft must include the Instructions for Continued Airworthiness for each engine and rotor (hereinafter designated "products"), for each appliance required by this chapter, and any required information relating to the interface of those appliances and products with the rotorcraft. If Instructions for Continued Airworthiness are not supplied by the manufacturer of an appliance or product installed in the rotorcraft, the Instructions for Continued Airworthiness for the rotorcraft must include the information essential to the continued airworthiness of the rotorcraft.
- (c) The applicant must submit to the FAA a program to show how changes to the Instructions for Continued Airworthiness made by the applicant or by the manufacturers of products and appliances installed in the rotorcraft will be distributed.]

Amdt. 29-20, Eff. 10/14/80

FAR 29.A2 : [Format.]

- (a) [The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.
- (b) The format of the manual or manuals must provide for a practical arrangement.]

Amdt. 29-20, Eff. 10/14/80

FAR 29.A3 : [Content.]

[The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following manuals or sections, as appropriate, and information :

- (a) *Rotorcraft maintenance manual or section.*

- (1) Introduction information that includes an explanation of the rotorcraft's features and data to the extent necessary for maintenance or preventive maintenance.
- (2) A description of the rotorcraft and its systems and installations including its engines, rotors, and appliances.
- (3) Basic control and operation information describing how the rotorcraft components and systems are controlled and how they operate, including any special procedures and limitations that apply.
- (4) Servicing information that covers details regarding servicing points, capacities of tanks, reservoirs, types of fluids to be used, pressures applicable to the various systems, location of access panels for inspection and servicing, locations of lubrication points, the lubricants to be used, equipment required for servicing, tow instructions and limitations, mooring, jacking, and leveling information.

- (b) *Maintenance Instructions.*

FAR 13.208 : Complaint.

- (a) *Filing.* The agency attorney shall file the original and one copy of the complaint with the hearing docket clerk, or may file a written motion pursuant to §13.218(f)(2)(i) of this subpart instead of filing a complaint, not later than 20 days after receipt by the agency attorney of a request for hearing. The agency attorney should suggest a location for the hearing when filing the complaint.
- (b) *Service.* An agency attorney shall personally deliver or mail a copy of the complaint on the respondent, the president of the corporation or company named as a respondent, or a person designated by the respondent to accept service of documents in the civil penalty action.
- (c) *Contents.* A complaint shall set forth the facts alleged, any regulation allegedly violated by the respondent, and the proposed civil penalty in sufficient detail to provide notice of any factual or legal allegation and proposed civil penalty.
- (d) *Motion to dismiss allegations or complaint.* Instead of filing an answer to the complaint, a respondent may move to dismiss the complaint, or that part of the complaint, alleging a violation that occurred on or after August 2, 1990, and more than 2 years before an agency attorney issued a notice of proposed civil penalty to the respondent.
- (1) An administrative law judge may not grant the motion and dismiss the complaint or part of the complaint if the administrative law judge finds that the agency has shown good cause for any delay in issuing the notice of proposed civil penalty.
- (2) If the agency fails to show good cause for any delay, an administrative law judge may dismiss the complaint, or that part of the complaint, alleging a violation that occurred more than 2 years before an agency attorney issued the notice of proposed civil penalty to the respondent.
- (3) A party may appeal the administrative law judge's ruling on the motion to dismiss the complaint or any part of the complaint in accordance with §13.219(b) of this subpart.

FAR 13.209 : Answer.

- (a) *Writing required.* A respondent shall file a written answer to the complaint, or may file a written motion pursuant to §13.208(d) or §13.218(f)(1-4) of this subpart instead of filing an answer, not later than 30 days after service of the complaint. The answer may be in the form of a letter but must be dated and signed by the person responding to the complaint. An answer may be typewritten or may be legibly handwritten.
- (b) *Filing and address.* A person filing an answer shall personally deliver or mail the original and one copy of the answer for filing with the hearing docket clerk, not later than 30 days after service of the complaint, to the Hearing Docket, Federal Aviation Administration, 800 Independence Avenue, SW., Room 924A, Washington, DC 20591, Attention : Hearing Docket Clerk. The person filing an answer should suggest a location for the hearing when filing the answer.
- (c) *Service.* A person filing an answer shall serve a copy of the answer on the agency attorney who filed the complaint.

- (d) *Contents.* An answer shall specifically state any affirmative defense that the respondent intends to assert at the hearing. A person filing an answer may include a brief statement of any relief requested in the answer.
- (e) *Specific denial of allegations required.* A person filing an answer shall admit, deny, or state that the person is without sufficient knowledge or information to admit or deny, each numbered paragraph of the complaint. Any statement or allegation contained in the complaint that is not specifically denied in the answer may be deemed an admission of the truth of that allegation. A general denial of the complaint is deemed a failure to file an answer.
- (f) *Failure to file answer.* A person's failure to file an answer without good cause shall be deemed an admission of the truth of each allegation contained in the complaint.

FAR 13.210 : Filing of documents.

- (a) *Address and method of filing.* A person tendering a document for filing shall personally deliver or mail the signed original and one copy of each document to the Hearing Docket, Federal Aviation Administration, 800 Independence Avenue, SW., Room 924A, Washington, DC 20591. Attention : Hearing Docket Clerk. A person shall serve a copy of each document on each party in accordance with §13.211 of this subpart.
- (b) *Date of filing.* A document shall be considered to be filed on the date of personal delivery ; or if mailed, the mailing date shown on the certificate of service, the date shown on the postmark if there is no certificate of service, or other mailing date shown by other evidence if there is no certificate of service or postmark.
- (c) *Form.* Each document shall be typewritten or legibly handwritten.
- (d) *Contents.* Unless otherwise specified in this subpart, each document must contain a short, plain statement of the facts on which the person's case rests and a brief statement of the action requested in the document.

FAR 13.211 : Service of documents.

- (a) *General.* A person shall serve a copy of any document filed with the Hearing Docket on each party at the time of filing. Service on a party's attorney of record or a party's designated representative may be considered adequate service on the party.
- (b) *Type of service.* A person may serve documents by personal delivery or by mail.
- (c) *Certificate of service.* A person may attach a certificate of service to a document tendered for filing with the hearing docket clerk. A certificate of service shall consist of a statement, dated and signed by the person filing the document, that the document was personally delivered or mailed to each party on a specific date.
- (d) *Date of service.* The date of service shall be the date of personal delivery ; or if mailed, the mailing date shown on the certificate of service, the date shown on the postmark if there is no certificate of service, or other mailing date shown by other evidence if there is no certificate of service or postmark.
- (e) *Additional time after service by mail.* Whenever a party has a right or a duty to act or to make any response within a prescribed period after service by mail, or on a date certain after service by mail, 5 days shall be added to the prescribed period.

Chapitre 78

Appendix A : Instructions for Continued Airworthiness

Sommaire

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FAR 29.1589 : Loading information.

There must be loading instructions for each possible loading condition between the maximum and minimum weights determined under Sec. 29.25 that can result in a center of gravity beyond any extreme prescribed in Sec. 29.27, assuming any probable occupant weights.

(f) *Service by the administrative law judge.* The administrative law judge shall serve a copy of each document including, but not limited to, notices of prehearing conferences and hearings, rulings on motions, decisions, and orders, upon each party to the proceedings by personal delivery or by mail.

(g) *Valid service.* A document that was properly addressed, was sent in accordance with this subpart, and that was returned, that was not claimed, or that was refused, is deemed to have been served in accordance with this subpart. The service shall be considered valid as of the date and the time that the document was deposited with a contract or express messenger, the document was mailed, or personal delivery of the document was refused.

(h) *Presumption of service.* There shall be a presumption of service where a party or a person, who customarily receives mail, or receives it in the ordinary course of business, at either the person's residence or the person's principal place of business, acknowledges receipt of the document.

FAR 13.212 : Computation of time.

(a) This section applies to any period of time prescribed or allowed by this subpart, by notice or order of the administrative law judge, or by any applicable statute.

(b) The date of an act, event, or default, after which a designated time period begins to run, is not included in a computation of time under this subpart.

(c) The last day of a time period is included in a computation of time unless it is a Saturday, Sunday, or a legal holiday. If the last day of the time period is a Saturday, Sunday, or legal holiday, the time period runs until the end of the next day that is not a Saturday, Sunday, or legal holiday.

FAR 13.213 : Extension of time.

(a) *Oral requests.* The parties may agree to extend for a reasonable period the time for filing a document under this subpart. If the parties agree, the administrative law judge shall grant one extension of time to each party. The party seeking the extension of time shall submit a draft order to the administrative law judge to be signed by the administrative law judge and filed with the hearing docket clerk. The administrative law judge may grant additional oral requests for an extension of time where the parties agree to the extension.

(b) *Written motion.* A party shall file a written motion for an extension of time with the administrative law judge not later than 7 days before the document is due unless good cause for the late filing is shown. A party filing a written motion for an extension of time shall serve a copy of the motion on each party. The administrative law judge may grant the extension of time if good cause for the extension is shown.

(c) *Failure to rule.* If the administrative law judge fails to rule on a written motion for an extension of time by the date the document was due, the motion for an extension of time is deemed granted for no more than 20 days after the original date the document was to be filed.

FAR 13.214 : Amendment of pleadings.

(a) *Filing and service.* A party shall file the amendment with the administrative law judge and shall serve a copy of the amendment on all parties to the proceeding.

(b) *Time.* A party shall file an amendment to a complaint or an answer within the following :

(1) Not later than 15 days before the scheduled date of a hearing, a party may amend a complaint or an answer without the consent of the administrative law judge.

(2) Less than 15 days before the scheduled date of a hearing, the administrative law judge may allow amendment of a complaint or an answer only for good cause shown in a motion to amend.

(c) *Responses.* The administrative law judge shall allow a reasonable time, but not more than 20 days from the date of filing, for other parties to respond if an amendment to a complaint, answer, or other pleading has been filed with the administrative law judge.

FAR 13.215 : Withdrawal of complaint or request for hearing.

At any time before or during a hearing, an agency attorney may withdraw a complaint or a party may withdraw a request for a hearing without the consent of the administrative law judge. If an agency attorney withdraws the complaint or a party withdraws the request for a hearing and the answer, the administrative law judge shall dismiss the proceedings under this subpart with prejudice.

FAR 13.216 : Waivers.

Waivers of any rights provided by statute or regulation shall be in writing or by stipulation made at a hearing and entered into the record. The parties shall set forth the precise terms of the waiver and any conditions.

FAR 13.217 : Joint procedural or discovery schedule.

(a) *General.* The parties may agree to submit a schedule for filing all prehearing motions, a schedule for conducting discovery in the proceedings, or a schedule that will govern all prehearing motions and discovery in the proceedings.

(b) *Form and content of schedule.* If the parties agree to a joint procedural or discovery schedule, one of the parties shall file the joint schedule with the administrative law judge, setting forth the dates to which the parties have agreed, and shall serve a copy of the joint schedule on each party.

(1) The joint schedule may include, but need not be limited to, requests for discovery, any objections to discovery requests, responses to discovery requests to which there are no objections, submission of prehearing motions, responses to prehearing motions, exchange of exhibits to be introduced at the hearing, and a list of witnesses that may be called at the hearing.

(2) Each party shall sign the original joint schedule to be filed with the administrative law judge.

(c) *Time.* The parties may agree to submit all prehearing motions and responses and may agree to close discovery in the proceedings under the joint schedule within a reasonable time before the date of the hearing, but not later than 15 days before the hearing.

(1) The indicated airspeeds corresponding with those determined for takeoff, and the procedures to be followed if the critical engine fails during takeoff;

(2) The airspeed calibrations;

(3) The techniques, associated airspeeds, and rates of descent for autorotative landings;

(4) The rejected takeoff distance determined under Sec. 29.62 and the takeoff distance determined under Sec. 29.61[];

(5) The landing data determined under Sec. 29.81 or [Sec. 29.85];

(6) The steady gradient of climb for each weight, altitude, and temperature for which takeoff data are to be scheduled, along the takeoff path determined in the flight conditions required in Sec. 29.67(a)(1) and (a)(2) :

(i) In the flight conditions required in Sec. 29.67(a)(1) between the end of the takeoff distance and the point at which the rotorcraft is 200 feet above the takeoff surface (or 200 feet above the lowest point of the takeoff profile for elevated heliports) ;

(ii) In the flight conditions required in Sec. 29.67(a)(2) between the points at which the rotorcraft is 200 and 1000 feet above the takeoff surface (or 200 and 1000 feet above the lowest point of the takeoff profile for elevated heliports) ; and

(7) Out-of-ground effect hover performance determined under Sec. 29.49 and the maximum safe wind demonstrated under the ambient conditions for data presented.

(b) *Category B.* For each category B rotorcraft, the Rotorcraft Flight Manual must contain—

(1) The takeoff distance and the climbout speed together with the pertinent information defining the flight path with respect to autorotative landing if an engine fails, including the calculated effects of altitude and temperature;

(2) The steady rates of climb and hovering ceiling, together with the corresponding airspeeds and other pertinent information, including the calculated effects of altitude and temperature;

(3) The landing distance, appropriate airspeed, and type of landing surface, together with all pertinent information that might affect this distance, including the effects of weight, altitude, and temperature;

(4) The maximum safe wind for operation near the ground ;

(5) The airspeed calibrations;

(6) The height-speed envelope except for rotorcraft incorporating this as an operating limitation ;

(7) Glide distance as a function of altitude when autorotating at the speeds and conditions for minimum rate of descent and best glide angle, as determined in Sec. 29.71 ;

(8) Out-of-ground effect hover performance determined under Sec. 29.49 and the maximum safe wind demonstrated under the ambient conditions for data presented ; and

(9) Any additional performance data necessary for the application of any operating rule in this chapter.

Amdt. 29-44, EFF. 11/17/99

- (f) *Limiting heights.* Enough information must be furnished to allow compliance with Sec. 29.1517.
- (g) [*Maximum allowable wind.* For Category A rotorcraft, the maximum allowable wind for safe operation near the ground must be furnished.]
- (h) *Altitude.* The altitude established under Sec. 29.1527 and an explanation of the limiting factors must be furnished.
- (i) [*Ambient temperature.* Maximum and minimum ambient temperature limitations must be furnished.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.1585 : Operating procedures.

- (a) The parts of the manual containing operating procedures must have information concerning any normal and emergency procedures, and other information necessary for safe operation, including the applicable procedures, such as those involving minimum speeds, to be followed if an engine fails.
- (b) For multiengine rotorcraft, information identifying each operating condition in which the fuel system independence prescribed in Sec. 29.953 is necessary for safety must be furnished, together with instructions for placing the fuel system in a configuration used to show compliance with that section.
- (c) For helicopters for which a V_{NE} (power-off) is established under Sec. 29.1505(c), information must be furnished to explain the V_{NE} (power-off) and the procedures for reducing airspeed to not more than the V_{NE} (power-off) following failure of all engines.
- (d) For each rotorcraft showing compliance with Sec. 29.1353 (c)(6)(ii) or (c)(6)(iii), the operating procedures for disconnecting the battery from its charging source must be furnished.
- (e) If the unusable fuel supply in any tank exceeds 5 percent of the tank capacity, or 1 gallon, whichever is greater, information must be furnished which indicates that when the fuel quantity indicator reads "zero" in level flight, any fuel remaining in the fuel tank cannot be used safely in flight.
- (f) Information on the total quantity of usable fuel for each fuel tank must be furnished.
- (g) [For Category B rotorcraft, the airspeeds and corresponding rotor speeds for minimum rate of descent and best glide angle as prescribed in Sec. 29.71 must be provided.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.1587 : Performance information.

Flight manual performance information which exceeds any operating limitation may be shown only to the extent necessary for presentation clarity or to determine the effects of approved optional equipment or procedures. When data beyond operating limits are shown, the limits must be clearly indicated. The following must be provided :

- (a) *Category A.* For each category A rotorcraft, the Rotorcraft Flight Manual must contain a summary of the performance data, including data necessary for the application of any operating rule of this chapter, together with descriptions of the conditions, such as airspeeds, under which this data was determined, and must contain—

- (d) *Order establishing joint schedule.* The administrative law judge shall approve the joint schedule filed by the parties. One party shall submit a draft order establishing a joint schedule to the administrative law judge to be signed by the administrative law judge and filed with the hearing docket clerk.
- (e) *Disputes.* The administrative law judge shall resolve disputes regarding discovery or disputes regarding compliance with the joint schedule as soon as possible so that the parties may continue to comply with the joint schedule.
- (f) *Sanctions for failure to comply with joint schedule.* If a party fails to comply with the administrative law judge's order establishing a joint schedule, the administrative law judge may direct that party to comply with a motion to discovery request or, limited to the extent of the party's failure to comply with a motion or discovery request, the administrative law judge may :
 - (1) Strike that portion of a party's pleadings ;
 - (2) Preclude prehearing or discovery motions by that party ;
 - (3) Preclude admission of that portion of a party's evidence at the hearing, or
 - (4) Preclude that portion of the testimony of that party's witnesses at the hearing.

FAR 13.218 : Motions.

- (a) *General.* A party applying for an order or ruling not specifically provided in this subpart shall do so by motion. A party shall comply with the requirements of this section when filing a motion with the administrative law judge. A party shall serve a copy of each motion on each party.
- (b) *Form and contents.* A party shall state the relief sought by the motion and the particular grounds supporting that relief. If a party has evidence in support of a motion, the party shall attach any supporting evidence, including affidavits, to the motion.
- (c) *Filing of motions.* A motion made prior to the hearing must be in writing. Unless otherwise agreed by the parties or for good cause shown, a party shall file any prehearing motion, and shall serve a copy on each party, not later than 30 days before the hearing. Motions introduced during a hearing may be made orally on the record unless the administrative law judge directs otherwise.
- (d) *Answers to motions.* Any party may file an answer, with affidavits or other evidence in support of the answer, not later than 10 days after service of a written motion on that party. When a motion is made during a hearing, the answer may be made at the hearing on the record, orally or in writing, within a reasonable time determined by the administrative law judge.
- (e) *Rulings on motions.* The administrative law judge shall rule on all motions as follows :
 - (1) *Discovery motions.* The administrative law judge shall resolve all pending discovery motions not later than 10 days before the hearing.
 - (2) *Prehearing motions.* The administrative law judge shall resolve all pending prehearing motions not later than 7 days before the hearing. If the administrative law judge issues a ruling or order orally, the administrative law judge shall serve a written copy of the ruling or order, within 3 days, on each party. In all other cases, the administrative law judge shall issue rulings and orders in writing and shall serve a copy of the ruling or order on each party.

- (3) *Motions made during the hearing.* The administrative law judge may issue rulings and orders on motions made during the hearing orally. Oral rulings or orders on motions must be made on the record.
- (4) *Specific motions.* A party may file the following motions with the administrative law judge :
- (1) *Motion to dismiss for insufficiency.* A respondent may file a motion to dismiss the complaint for insufficiency instead of filing an answer. If the administrative law judge denies the motion to dismiss the complaint for insufficiency, the respondent shall file an answer not later than 10 days after service of the administrative law judge's denial of the motion. A motion to dismiss the complaint for insufficiency must show that the complaint fails to state a violation of the Federal Aviation Act of 1958, as amended, or a rule, regulation, or order issued thereunder, or a violation of the Hazardous Materials Transportation Act, or a rule, regulation, or order issued thereunder.
- (2) *Motion to dismiss.* A party may file a motion to dismiss, specifying the grounds for dismissal. If an administrative law judge grants a motion to dismiss in part, a party may appeal the administrative law judge's ruling on the motion to dismiss under §13.219(b) of this subpart.
- (i) *Motion to dismiss a request for a hearing.* An agency attorney may file a motion to dismiss a request for a hearing instead of filing a complaint. If the motion to dismiss is not granted, the agency attorney shall file the complaint and shall serve a copy of the complaint on each party not later than 10 days after service of the administrative law judge's ruling or order on the motion to dismiss. If the motion to dismiss is granted and the proceedings are terminated without a hearing, the respondent may file an appeal pursuant to §13.233 of this subpart. If required by the decision on appeal, the agency attorney shall file a complaint and shall serve a copy of the complaint on each party not later than 10 days after service of the decision on appeal.
- (ii) *Motion to dismiss a complaint.* A respondent may file a motion to dismiss a complaint instead of filing an answer. If the motion to dismiss is not granted, the respondent shall file an answer and shall serve a copy of the answer on each party not later than 10 days after service of the administrative law judge's ruling or order on the motion to dismiss. If the motion to dismiss is granted and the proceedings are terminated without a hearing, the agency attorney may file an appeal pursuant to §13.233 of this subpart. If required by the decision on appeal, the respondent shall file an answer and shall serve a copy of the answer on each party not later than 10 days after service of the decision on appeal.
- (3) *Motion for more definite statement.* A party may file a motion for more definite statement of any pleading which requires a response under this subpart. A party shall set forth, in detail, the indefinite or uncertain allegations contained in a complaint or response to any pleading and shall submit the details that the party believes would make the allegation or response definite and certain.
- (i) *Complaint.* A respondent may file a motion requesting a more definite statement of the allegations contained in the complaint instead of filing an answer. If the administrative law judge grants the motion, the agency attorney shall supply a more definite statement not later than 15 days

- (d) Each liferaft must have obviously marked operating instructions.
- (e) Approved survival equipment must be marked for identification and method of operation.

FAR 29.1565 : Tail rotor.

[Each tail rotor must be marked so that its disc is conspicuous under normal daylight ground conditions.]
Amdt. 29-3, EFF. 2/25/68

77.3 Rotorcraft Flight Manual

FAR 29.1581 : General.

- (a) [Furnishing information. A Rotorcraft Flight Manual must be furnished with each rotorcraft, and it must contain the following :
- (1) Information required by Secs. 29.1583 through 29.1589.
- (2) Other information that is necessary for safe operation because of design, operation, or handling characteristics.
- (b) *Approved information.* Each part of the manual listed in Sec. 29.1583 through 29.1589 that is appropriate to the rotorcraft, must be furnished, verified, and approved, and must be segregated, identified, and clearly distinguished from each unapproved part of that manual.
- (c) [Reserved.]
- (d) *Table of contents.* Each Rotorcraft Flight Manual must include a table of contents if the complexity of the manual indicates a need for it.]
Amdt. 29-15, EFF. 3/1/78
- FAR 29.1583 : Operating limitations.**
- (a) *Airspeed and rotor limitations.* Information necessary for the marking of airspeed and rotor limitations on or near their respective indicators must be furnished. The significance of each limitation and of the color coding must be explained.
- (b) *Powerplant limitations.* The following information must be furnished :
- (1) Limitations required by Sec. 29.1521.
- (2) Explanation of the limitations, when appropriate.
- (3) Information necessary for marking the instruments required by Secs. 29.1549 through 29.1553.
- (c) *Weight and loading distribution.* The weight and center of gravity limits required by Secs. 29.25 and 29.27, respectively, must be furnished. If the variety of possible loading conditions warrants, instructions must be included to allow ready observance of the limitations.
- (d) *Flight crews.* When a flight crew of more than one is required, the number and functions of the minimum flight crew determined under Sec. 29.1523 must be furnished.
- (e) *Kinds of operation.* Each kind of operation for which the rotorcraft and its equipment installations are approved must be listed.

- (2) Each emergency control must be red and must be marked as to method of operation.

- (e) [For rotorcraft incorporating retractable landing gear, the maximum landing gear operating speed must be displayed in clear view of the pilot.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.1557 : Miscellaneous markings and placards.

- (a) *Baggage and cargo compartments, and ballast location.* Each baggage and cargo compartment, and each ballast location must have a placard stating any limitations on contents, including weight, that are necessary under the loading requirements.

- (b) *Seats.* If the maximum allowable weight to be carried in a seat is less than 170 pounds, a placard stating the lesser weight must be permanently attached to the seat structure.

- (c) *Fuel and oil filler openings.* The following apply :

- (1) Fuel filler openings must be marked at or near the filler cover with—
 - (i) The word "fuel" ;
 - (ii) For reciprocating engine powered rotorcraft, the minimum fuel grade ;
 - (iii) [For turbine-engine-powered rotorcraft, the permissible fuel designations, except that if impractical, this information may be included in the rotorcraft flight manual, and the fuel filler may be marked with an appropriate reference to the flight manual ; and]
 - (iv) For pressure fueling systems, the maximum permissible fueling supply pressure and the maximum permissible defueling pressure.
- (2) Oil filler openings must be marked at or near the filler cover with the word "oil."
- (d) *Emergency exit placards.* Each placard and operating control for each emergency exit must differ in color from the surrounding fuselage surface as prescribed in Sec. 29.811(h)(2). A placard must be near each emergency exit control and must clearly indicate the location of that exit and its method of operation.

Amdt. 29-26, Eff. 10/3/88

FAR 29.1559 : Limitations placard.

[There must be a placard in a clear view of the pilot that specifies the kinds of operations (VFR, IFR, day, night, or icing) for which the rotorcraft is approved.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.1561 : Safety equipment.

- (a) Each safety equipment control to be operated by the crew in emergency, such as controls for automatic liferaft releases, must be plainly marked as to its method of operation.
- (b) Each location, such as a locker or compartment, that carries any fire extinguishing, signaling, or other life saving equipment, must be so marked.
- (c) Stowage provisions for required emergency equipment must be conspicuously marked to identify the contents and facilitate removal of the equipment.

after service of the ruling granting the motion. If the agency attorney fails to supply a more definite statement, the administrative law judge shall strike the allegations in the complaint to which the motion is directed. If the administrative law judge denies the motion, the respondent shall file an answer and shall serve a copy of the answer on each party not later than 10 days after service of the order of denial.

- (ii) *Answer.* An agency attorney may file a motion requesting a more definite statement if an answer fails to respond clearly to the allegations in the complaint. If the administrative law judge grants the motion, the respondent shall supply a more definite statement not later than 15 days after service of the ruling on the motion. If the respondent fails to supply a more definite statement, the administrative law judge shall strike those statements in the answer to which the motion is directed. The respondent's failure to supply a more definite statement may be deemed an admission of unanswered allegations in the complaint.

- (4) *Motion to strike.* Any party may make a motion to strike any insufficient allegation or defense, or any redundant, immaterial, or irrelevant matter in a pleading. A party shall file a motion to strike with the administrative law judge and shall serve a copy on each party before a response is required under this subpart or, if a response is not required, not later than 10 days after service of the pleading.

- (5) *Motion for decision.* A party may make a motion for decision, regarding all or any part of the proceedings, at any time before the administrative law judge has issued an initial decision in the proceedings. The administrative law judge shall grant a party's motion for decision if the pleadings, depositions, answers to interrogatories, admissions, matters that the administrative law judge has officially noticed, or evidence introduced during the hearing show that there is no genuine issue of material fact and that the party making the motion is entitled to a decision as a matter of law. The party making the motion for decision has the burden of showing that there is no genuine issue of material fact disputed by the parties.

- (6) *Motion for disqualification.* A party may file a motion for disqualification with the administrative law judge and shall serve a copy on each party. A party may file the motion at any time after the administrative law judge has been assigned to the proceedings but shall make the motion before the administrative law judge files an initial decision in the proceedings.

- (i) *Motion and supporting affidavit.* A party shall state the grounds for disqualification, including, but not limited to, personal bias, pecuniary interest, or other factors showing disqualification, in the motion for disqualification. A party shall submit an affidavit with the motion for disqualification that sets forth, in detail, the matters alleged to constitute grounds for disqualification.

- (ii) *Answer.* A party shall respond to the motion for disqualification not later than 5 days after service of the motion for disqualification.

- (iii) *Decision on motion for disqualification.* The administrative law judge shall render a decision on the motion for disqualification not later than 15 days after the motion has been filed. If the administrative law judge finds that the motion for disqualification and supporting affidavit show

a basis for disqualification, the administrative law judge shall withdraw from the proceedings immediately. If the administrative law judge finds that disqualification is not warranted, the administrative law judge shall deny the motion and state the grounds for the denial on the record. If the administrative law judge fails to rule on a party's motion for disqualification within 15 days after the motion has been filed, the motion is deemed granted.

(iv) *Appeal.* A party may appeal the administrative law judge's denial of the motion for disqualification in accordance with §13.219(b) of this subpart.

FAR 13.219 : Interlocutory appeals.

(a) *General.* Unless otherwise provided in this subpart, a party may not appeal a ruling or decision of the administrative law judge to the FAA decisionmaker until the initial decision has been entered on the record. A decision or order of the FAA decisionmaker on the interlocutory appeal does not constitute a final order of the Administrator for the purposes of judicial appellate review under section 1006 of the Federal Aviation Act of 1958, as amended.

(b) *Interlocutory appeal for cause.* If a party files a written request for an interlocutory appeal for cause with the administrative law judge, or orally requests an interlocutory appeal for cause, the proceedings are stayed until the administrative law judge issues a decision on the request. If the administrative law judge grants the request, the proceedings are stayed until the FAA decisionmaker issues a decision on the interlocutory appeal. The administrative law judge shall grant an interlocutory appeal for cause if a party shows that delay of the appeal would be detrimental to the public interest or would result in undue prejudice to any party.

(c) *Interlocutory appeals of right.* If a party notifies the administrative law judge of an interlocutory appeal of right, the proceedings are stayed until the FAA decisionmaker issues a decision on the interlocutory appeal. A party may file an interlocutory appeal with the FAA decisionmaker, without the consent of the administrative law judge, before an initial decision has been entered in the case of :

- (1) A ruling or order by the administrative law judge barring a person from the proceedings.
- (2) Failure of the administrative law judge to dismiss the proceedings in accordance with §13.215 of this subpart.
- (3) A ruling or order by the administrative law judge in violation of §13.205(b) of this subpart.

(d) *Procedure.* A party shall file a notice of interlocutory appeal, with supporting documents, with the FAA decisionmaker and the hearing docket clerk, and shall serve a copy of the notice and supporting documents on each party and the administrative law judge, not later than 10 days after the administrative law judge's decision forming the basis of an interlocutory appeal of right or not later than 10 days after the administrative law judge's decision granting an interlocutory appeal for cause, whichever is appropriate. A party shall file a reply brief, if any, with the FAA decisionmaker and serve a copy of the reply brief on each party, not later than 10 days after service of the appeal brief. The FAA decisionmaker shall render a decision on the interlocutory appeal, on the record and as a part of the decision in the proceedings, within a reasonable time after receipt of the interlocutory appeal.

FAR 29.1549 : Powerplant instruments.

For each required powerplant instrument, as appropriate to the type of instruments—

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line;

(b) Each normal operating range must be marked with a green arc or green line, not extending beyond the maximum and minimum safe limits;

(c) Each takeoff and precautionary range must be marked with a yellow arc or yellow line;

(d) Each engine or propeller range that is restricted because of excessive vibration stresses must be marked with red arcs or red lines and

(e) [Each OEL limit or approved operating range must be marked to be clearly differentiated from the markings of paragraphs (a) through (d) of this section except that no marking is normally required for the 30-second OEL limit.]

Amdt. 29-34, EFF. 10/17/94

FAR 29.1551 : Oil quantity indicator.

Each oil quantity indicator must be marked with enough increments to indicate readily and accurately the quantity of oil.

FAR 29.1553 : Fuel quantity indicator.

If the unusable fuel supply for any tank exceeds one gallon, or five percent of the tank capacity, whichever is greater, a red arc must be marked on its indicator extending from the calibrated zero reading to the lowest reading obtainable in level flight.

FAR 29.1555 : Control markings.

(a) Each cockpit control, other than primary flight controls or control whose function is obvious, must be plainly marked as to its function and method of operation.

(b) For powerplant fuel controls—

(1) Each fuel tank selector valve control must be marked to indicate the position corresponding to each tank and to each existing cross feed position;

(2) If safe operation requires the use of any tanks in a specific sequence, that sequence must be marked on, or adjacent to, the selector for those tanks; and

(3) Each valve control for any engine of a multiengine rotorcraft must be marked to indicate the position corresponding to each engine controlled.

(c) Usable fuel capacity must be marked as follows :

(1) For fuel systems having no selector controls, the usable fuel capacity of the system must be indicated at the fuel quantity indicator.

(2) For fuel systems having selector controls, the usable fuel capacity available at each selector control position must be indicated near the selector control.

(d) For accessory, auxiliary, and emergency controls—

(1) Each essential visual position indicator, such as those showing rotor pitch or landing gear position, must be marked so that each crewmember can determine at any time the position of the unit to which it relates; and

77.2 Markings and Placards

FAR 29.1541 : General.

- (a) The rotorcraft must contain—
 - (1) The markings and placards specified in Secs. 29.1545 through 29.1565; and
 - (2) Any additional information, instrument markings, and placards required for the safe operation of the rotorcraft if it has unusual design, operating or handling characteristics.
- (b) Each marking and placard prescribed in paragraph (a) of this section—
 - (1) Must be displayed in a conspicuous place; and
 - (2) May not be easily erased, disfigured, or obscured.

FAR 29.1543 : Instrument markings : general.

For each instrument—

- (a) When markings are on the cover glass of the instrument there must be means to maintain the correct alignment of the glass cover with the face of the dial; and
- (b) Each arc and line must be wide enough, and located to be clearly visible to the pilot.

FAR 29.1545 : Airspeed indicator.

- (a) [Each airspeed indicator must be marked as specified in paragraph (b) of this section, with the marks located at the corresponding indicated airspeeds.]
- (b) The following marking must be made :
 - (1) A red radial line—
 - (i) For rotorcraft other than helicopters, at V_{NE} ; and
 - (ii) For helicopters, at V_{NE} (power-on).
 - (2) A red, cross-hatched radial line at V_{NE} (power-off) for helicopters, if V_{NE} (power-off) is less than V_{NE} (power-on).
 - (3) For the caution range, a yellow arc.
 - (4) For the safe operating range, a green arc.

Amdt. 29-17, Eff. 12/1/78

FAR 29.1547 : Magnetic direction indicator.

- (a) A placard meeting the requirements of this section must be installed on or near the magnetic direction indicator.
- (b) The placard must show the calibration of the instrument in level flight with the engines operating.
- (c) The placard must state whether the calibration was made with radio receivers on or off.
- (d) Each calibration reading must be in terms of magnetic heading in not more than 45 degree increments.

- (e) The FAA decisionmaker may reject frivolous, repetitive, or dilatory appeals, and may issue an order precluding one or more parties from making further interlocutory appeals in a proceeding in which there have been frivolous, repetitive, or dilatory interlocutory appeals.

FAR 13.220 : Discovery.

- (a) *Initiation of discovery.* Any party may initiate discovery described in this section, without the consent or approval of the administrative law judge, at any time after a complaint has been filed in the proceedings.
- (b) *Methods of discovery.* The following methods of discovery are permitted under this section : depositions on oral examination or written questions of any person ; written interrogatories directed to a party ; requests for production of documents or tangible items to any person ; and requests for admission by a party. A party is not required to file written interrogatories and responses, requests for production of documents or tangible items and responses, and requests for admission and response with the administrative law judge or the hearing docket clerk. In the event of a discovery dispute, a party shall attach a copy of these documents in support of a motion made under this section.
- (c) *Service on the agency.* A party shall serve each discovery request directed to the agency or any agency employee on the agency attorney of record.
- (d) *Time for response to discovery requests.* Unless otherwise directed by this subpart or agreed by the parties, a party shall respond to a request for discovery, including filing objections to a request for discovery, not later than 30 days of service of the request.
- (e) *Scope of discovery.* Subject to the limits on discovery set forth in paragraph (f) of this section, a party may discover any matter that is not privileged and that is relevant to the subject matter of the proceeding. A party may discover information that relates to the claim or defense of any party including the existence, description, nature, custody, condition, and location of any document or other tangible item and the identity and location of any person having knowledge of discoverable matter. A party may discover facts known, or opinions held, by an expert who any other party expects to call to testify at the hearing. A party has no ground to object to a discovery request on the basis that the information sought would not be admissible at the hearing if the information sought during discovery is reasonably calculated to lead to the discovery of admissible evidence.
- (f) *Limiting discovery.* The administrative law judge shall limit the frequency and extent of discovery permitted by this section if a party shows that —
 - (1) The information requested is cumulative or repetitious ;
 - (2) The information requested can be obtained from another less burdensome and more convenient source ;
 - (3) The party requesting the information has had ample opportunity to obtain the information through other discovery methods permitted under this section ; or
 - (4) The method or scope of discovery requested by the party is unduly burdensome or expensive.

- (g) *Confidential orders.* A party or person who has received a discovery request for information that is related to a trade secret, confidential or sensitive material, competitive or commercial information, proprietary data, or information on research and development, may file a motion for a confidential order with the administrative law judge and shall serve a copy of the motion for a confidential order on each party.
- (1) The party or person making the motion must show that the confidential order is necessary to protect the information from disclosure to the public.
- (2) If the administrative law judge determines that the requested material is not necessary to decide the case, the administrative law judge shall preclude any inquiry into the matter by any party.
- (3) If the administrative law judge determines that the requested material may be disclosed during discovery, the administrative law judge may order that the material may be discovered and disclosed under limited conditions or may be used only under certain terms and conditions.
- (4) If the administrative law judge determines that the requested material is necessary to decide the case and that a confidential order is warranted, the administrative law judge shall provide :
- (i) An opportunity for review of the document by the parties off the record ;
- (ii) Procedures for excluding the information from the record ; and
- (iii) Order that the parties shall not use the information in any other proceeding, and the parties shall not use the information in any other proceeding.
- (h) *Protective orders.* A party or a person who has received a request for discovery may file a motion for protective order with the administrative law judge and shall serve a copy of the motion for protective order on each party. The party or person making the motion must show that the protective order is necessary to protect the party or the person from annoyance, embarrassment, oppression, or undue burden or expense. As part of the protective order, the administrative law judge may :
- (1) Deny the discovery request ;
- (2) Order that discovery be conducted only on specified terms and conditions, including a designation of the time or place for discovery or a determination of the method of discovery ; or
- (3) Limit the scope of discovery or preclude any inquiry into certain matters during discovery.
- (i) *Duty to supplement or amend responses.* A party who has responded to a discovery request has a duty to supplement or amend the response, as soon as the information is known, as follows :
- (1) A party shall supplement or amend any response to a question requesting the identity and location of any person having knowledge of discoverable matters.
- (2) A party shall supplement or amend any response to a question requesting the identity of each person who will be called to testify at the hearing as an expert witness and the subject matter and substance of that witness' testimony.
- (3) A party shall supplement or amend any response that was incorrect when made or any response that was correct when made but is no longer correct, accurate, or complete.
- (j) *Depositions.* The following rules apply to depositions taken pursuant to this section :

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- (1) The maximum rotational speed, which may not be greater than—
- (i) The maximum value determined by the rotor design ; or
- (ii) The maximum value demonstrated during the type tests ;
- (2) The maximum allowable gas temperature ; and
- (3) The maximum allowable torque.
- Amdt. 29-41, Eft. 11/28/97
- FAR 29.1522 : [Auxiliary power unit limitations.]**
- [If an auxiliary power unit that meets the requirements of TSO-C77 is installed in the rotorcraft, the limitations established for that auxiliary power unit under the TSO including the categories of operation must be specified as operating limitations for the rotorcraft.]
- Amdt. 29-17, Eft. 12/1/78
- FAR 29.1523 : Minimum flight crew.**
- The minimum flight crew must be established so that it is sufficient for safe operation, considering—
- (a) The workload on individual crewmembers ;
- (b) The accessibility and ease of operation of necessary controls by the appropriate crewmember ; and
- (c) The kinds of operation authorized under Sec. 29.1525.

FAR 29.1525 : Kinds of operations.

[The kinds of operations (such as VFR, IFR, day, night, or icing) for which the rotorcraft is approved are established by demonstrated compliance with the applicable certification requirements and by the installed equipment.]

Amdt. 29-24, Eft. 12/6/84

FAR 29.1527 : [Maximum operating altitude.]

[The maximum altitude up to which operation is allowed, as limited by flight, structural, powerplant, functional, or equipment characteristics, must be established.]

Amdt. 29-15, Eft. 3/1/78

FAR 29.1529 : [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 rotorcraft or issuance of a standard certificate of airworthiness, whichever occurs later.]

Amdt. 29-20, Eft. 10/14/80

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- (2) The maximum allowable gas temperature ;
 - (3) The maximum allowable torque ; and
 - (4) The maximum allowable oil temperature.
- (g) *Thirty-minute OEI power operation.* Unless otherwise authorized, the use of 30-minute OEI power must be limited to multiengine, turbine-powered rotorcraft for not longer than 30 minutes after failure of an engine. The use of 30-minute OEI power must also be limited by—
- (1) The maximum rotational speed which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or
 - (ii) The maximum value shown during the type tests ;
 - (2) The maximum allowable gas temperature ;
 - (3) The maximum allowable torque ; and
 - (4) The maximum allowable oil temperature.
- (h) *Continuous OEI power operation.* Unless otherwise authorized, the use of continuous OEI power must be limited to multiengine, turbine-powered rotorcraft for continued flight after failure of an engine. The use of continuous OEI power must also be limited by—
- (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or
 - (ii) The maximum value shown during the type tests ;
 - (2) The maximum allowable gas temperature ;
 - (3) The maximum allowable torque ; and
 - (4) The maximum allowable oil temperature.
- (i) *Rated 30-second OEI power operation.* Rated 30-second OEI power is permitted only on multiengine, turbine-powered rotorcraft, also certificated for the use of rated 2-minute OEI power, and can only be used for continued operation of the remaining engine(s) after a failure or precautionary shutdown of an engine. It must be shown that following application of 30-second OEI power, any damage will be readily detectable by the applicable inspections and other related procedures furnished in accordance with section A29.4 of appendix A of this part and section A33.4 of appendix A of part 33. The use of 30-second OEI power must be limited to not more than 30 seconds for any period in which that power is used, and by—
- (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or
 - (ii) The maximum value demonstrated during the type tests ;
 - (2) The maximum allowable gas temperature ; and
 - (3) The maximum allowable torque.
- (j) *Rated 2-minute OEI power operation.* Rated 2-minute OEI power is permitted only on multiengine, turbine-powered rotorcraft, also certificated for the use of rated 30-second OEI power, and can only be used for continued operation of the remaining engine(s) after a failure or precautionary shutdown of an engine. It must be shown that following application of 2-minute OEI power, any damage will be readily detectable by the applicable inspections and other related procedures furnished in accordance with section A29.4 of appendix A of this part and Section A33.4 of appendix A of part 33. The use of 2-minute OEI power must be limited to not more than 2 minutes for any period in which that power is used, and by—

- (1) *Form.* A deposition shall be taken on the record and reduced to writing. The person being deposed shall sign the deposition unless the parties agree to waive the requirement of a signature.
 - (2) *Administration of oaths.* Within the United States, or a territory or possession subject to the jurisdiction of the United States, a party shall take a deposition before a person authorized to administer oaths by the laws of the United States or authorized by the law of the place where the examination is held. In foreign countries, a party shall take a deposition in any manner allowed by the Federal Rules of Civil Procedure.
 - (3) *Notice of deposition.* A party shall serve a notice of deposition, stating the time and place of the deposition and the name and address of each person to be examined, on the person to be deposed, on the administrative law judge, on the hearing docket clerk, and on each party not later than 7 days before the deposition. A party may serve a notice of deposition less than 7 days before the deposition only with consent of the administrative law judge. If a subpoena *duces tecum* is to be served on the person to be examined, the party shall attach a copy of the subpoena *duces tecum* that describes the materials to be produced at the deposition to the notice of deposition.
 - (4) *Use of depositions.* A party may use any part or all of a deposition at a hearing authorized under this subpart only upon a showing of good cause. The deposition may be used against any party who was present or represented at the deposition or who had reasonable notice of the deposition.
- (k) *Interrogatories.* A party, the party's attorney, or the party's representative may sign the party's responses to interrogatories. A party shall answer each interrogatory separately and completely in writing. If a party objects to an interrogatory, the party shall state the objection and the reasons for the objection. An opposing party may use any part or all of a party's responses to interrogatories at a hearing authorized under this subpart to the extent that the response is relevant, material, and not repetitions.
- (1) A party shall not serve more than 30 interrogatories to each other party. Each subpart of an interrogatory shall be counted as a separate interrogatory.
 - (2) A party shall file a motion for leave to serve additional interrogatories on a party with the administrative law judge before serving additional interrogatories on a party. The administrative law judge shall grant the motion only if the party shows good cause for the party's failure to inquire about the information previously and that the information cannot reasonably be obtained using less burdensome discovery methods or be obtained from other sources.
- (l) *Requests for admission.* A party may serve a written request for admission of the truth of any matter within the scope of discovery under this section or the authenticity of any document described in the request. A party shall set forth each request for admission separately. A party shall serve copies of documents referenced in the request for admission unless the documents have been provided or are reasonably available for inspection and copying.
- (1) *Time.* A party's failure to respond to a request for admission, in writing and signed by the attorney or the party, not later than 30 days after service of the request, is deemed an admission of the truth of the statement or statements contained in the request for admission. The administrative law judge

may determine that a failure to respond to a request for admission is not deemed an admission of the truth if a party shows that the failure was due to circumstances beyond the control of the party or the party's attorney.

- (2) *Response.* A party may object to a request for admission and shall state the reasons for objection. A party may specifically deny the truth of the matter or describe the reasons why the party is unable to truthfully deny or admit the matter. If a party is unable to deny or admit the truth of the matter, the party shall show that the party has made reasonable inquiry into the matter or that the information known to, or readily obtainable by, the party is insufficient to enable the party to admit or deny the matter. A party may admit or deny any part of the request for admission. If the administrative law judge determines that a response does not comply with the requirements of this rule or that the response is insufficient, the matter is deemed admitted.

- (3) *Effect of admission.* Any matter admitted or deemed admitted under this section is conclusively established for the purpose of the hearing and appeal.

- (m) *Motion to compel discovery.* A party may make a motion to compel discovery if a person refuses to answer a question during a deposition, a party fails or refuses to answer an interrogatory, if a person gives an evasive or incomplete answer during a deposition or when responding to an interrogatory, or a party fails or refuses to produce documents or tangible items. During a deposition, the proponent of a question may complete the deposition or may adjourn the examination before making a motion to compel if a person refuses to answer.

- (n) *Failure to comply with a discovery order or order to compel.* If a party fails to comply with a discovery order or an order to compel, the administrative law judge, limited to the extent of the party's failure to comply with the discovery order or motion to compel, may :

- (1) Strike that portion of a party's pleadings ;
- (2) Preclude prehearing or discovery motions by that party ;
- (3) Preclude admission of that portion of a party's evidence at the hearing ; or
- (4) Preclude that portion of the testimony of that party's witnesses at the hearing.

FAR 13.221 : Notice of hearing.

- (a) *Notice.* The administrative law judge shall give each party at least 60 days notice of the date, time, and location of the hearing.
- (b) *Date, time, and location of the hearing.* The administrative law judge to whom the proceedings have been assigned shall set a reasonable date, time, and location for the hearing. The administrative law judge shall consider the need for discovery and any joint procedural or discovery schedule submitted by the parties when determining the hearing date. The administrative law judge shall give due regard to the convenience of the parties, the location where the majority of the witnesses reside or work, and whether the location is served by a scheduled air carrier.
- (c) *Earlier hearing.* With the consent of the administrative law judge, the parties may agree to hold the hearing on an earlier date than the date specified in the notice of hearing.

- (4) The maximum allowable power or torque for each engine, considering the power input limitations of the transmission with all engines operating ;
- (5) The maximum allowable power or torque for each engine considering the power input limitations of the transmission with one engine inoperative ;
- (6) The time limit for the use of the power corresponding to the limitations established in paragraphs (b)(1) through (5) of this section ; and
- (7) If the time limit established in paragraph (b)(6) of this paragraph exceeds 2 minutes—

- (i) The maximum allowable cylinder head or coolant outlet temperature (for reciprocating engines) ; and
- (ii) The maximum allowable engine and transmission oil temperatures.

- (c) *Continuous operation.* The continuous operation must be limited by—

- (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or
 - (ii) The maximum value shown during the type tests ;
- (2) The minimum rotational speed shown under the rotor speed requirements in Sec. 29.1509(c) ;
- (3) The maximum allowable manifold pressure (for reciprocating engines) ;
- (4) The maximum allowable turbine inlet or turbine outlet gas temperature (for turbine engines) ;
- (5) The maximum allowable power or torque for each engine, considering the power input limitations of the transmission with all engines operating ;
- (6) The maximum allowable power or torque for each engine, considering the power input limitations of the transmission with one engine inoperative ; and
- (7) The maximum allowable temperatures for—
 - (i) The cylinder head or coolant outlet (for reciprocating engines) ;
 - (ii) The engine oil ; and
 - (iii) The transmission oil.
- (d) *Fuel grade or designation.* The minimum fuel grade (for reciprocating engines) or fuel designation (for turbine engines) must be established so that it is not less than that required for the operation of the engines within the limitations in paragraphs (b) and (c) of this section.
- (e) *Ambient temperature.* Ambient temperature limitations (including limitations for winterization installations if applicable) must be established as the maximum ambient atmospheric temperature at which compliance with the cooling provisions of Secs. 29.1041 through 29.1049 is shown.
- (f) *Two and one-half minute OEL power operation.* Unless otherwise authorized, the use of $2\frac{1}{2}$ -minute OEL power must be limited to engine failure operation of multie engine, turbine-powered rotorcraft for not longer than $2\frac{1}{2}$ minutes for any period in which that power is used. The use of $2\frac{1}{2}$ -minute OEL power must also be limited by—
 - (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or
 - (ii) The maximum value shown during the type tests ;

- (iii) A constant airspeed for a portion of the altitude range for which certification is requested, and a constant amount less than power-on V_{NE} for the remainder of the altitude range.

Amdt. 29-24, Eff. 12/6/84

FAR 29.1509 : Rotor speed.

- (a) *Maximum power-off (autorotation).* The maximum power-off rotor speed must be established so that it does not exceed 95 percent of the lesser of—
- (1) The maximum design r.p.m. determined under Sec. 29.309(b); and
 - (2) The maximum r.p.m. shown during the type tests.
- (b) *Minimum power-off.* The minimum power-off rotor speed must be established so that it is not less than 105 percent of the greater of—
- (1) The minimum shown during the type tests; and
 - (2) The minimum determined by design substantiation.
- (c) *Minimum power-on.* The minimum power-on rotor speed must be established so that it is—
- (1) Not less than the greater of—
 - (i) The minimum shown during the type tests; and
 - (ii) The minimum determined by design substantiation; and
 - (2) Not more than a value determined under Sec. 29.33 (a)(1) and (c)(1).

FAR 29.1517 : Limiting height-speed envelope.

[For Category A rotorcraft, if a range of heights exists at any speed, including zero, within which it is not possible to make a safe landing following power failure, the range of heights and its variation with forward speed must be established, together with any other pertinent information, such as the kind of landing surface.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.1519 : Weight and center of gravity.

The weight and center of gravity limitations determined under Secs. 29.25 and 29.27 respectively, must be established as operating limitations.

FAR 29.1521 : Powerplant limitations.

- (a) *General.* The powerplant limitations prescribed in this section must be established so that they do not exceed the corresponding limits for which the engines are type certificated.
- (b) *Takeoff operation.* The powerplant takeoff operation must be limited by—
- (1) The maximum rotational speed which may not be greater than—
 - (i) [The maximum value determined by the rotor design; or]
 - (ii) The maximum value shown during the type tests;
 - (2) The maximum allowable manifold pressure (for reciprocating engines);
 - (3) The maximum allowable turbine inlet or turbine outlet gas temperature (for turbine engines);

FAR 13.222 : Evidence.

- (a) *General.* A party is entitled to present the party's case or defense by oral, documentary, or demonstrative evidence, to submit rebuttal evidence, and to conduct any cross-examination that may be required for a full and true disclosure of the facts.
- (b) *Admissibility.* A party may introduce any oral, documentary, or demonstrative evidence in support of the party's case or defense. The administrative law judge shall admit any oral, documentary, or demonstrative evidence introduced by a party but shall exclude irrelevant, immaterial, or unduly repetitious evidence.
- (c) *Hearsay evidence.* Hearsay evidence is admissible in proceedings governed by this subpart. The fact that evidence submitted by a party is hearsay goes only to the weight of the evidence and does not affect its admissibility.

FAR 13.223 : Standard of proof.

The administrative law judge shall issue an initial decision or shall rule in a party's favor only if the decision or ruling is supported by, and in accordance with, the reliable, probative, and substantial evidence contained in the record. In order to prevail, the party with the burden of proof shall prove the party's case or defense by a preponderance of reliable, probative, and substantial evidence.

FAR 13.224 : Burden of proof.

- (a) Except in the case of an affirmative defense, the burden of proof is on the agency.
- (b) Except as otherwise provided by statute or rule, the proponent of a motion, request, or order has the burden of proof.
- (c) A party who has asserted an affirmative defense has the burden of proving the affirmative defense.

FAR 13.225 : Offer of proof.

A party whose evidence has been excluded by a ruling of the administrative law judge may offer the evidence for the record on appeal.

FAR 13.226 : Public disclosure of evidence.

- (a) The administrative law judge may order that any information contained in the record be withheld from public disclosure. Any person may object to disclosure of information in the record by filing a written motion to withhold specific information with the administrative law judge and serving a copy of the motion on each party. The party shall state the specific grounds for nondisclosure in the motion.
- (b) The administrative law judge shall grant the motion to withhold information in the record if, based on the motion and any response to the motion, the administrative law judge determines that disclosure would be detrimental to aviation safety, disclosure would not be in the public interest, or that the information is not otherwise required to be made available to the public.

FAR 13.227 : Expert or opinion witnesses.

An employee of the agency may not be called as an expert or opinion witness, for any party other than the FAA, in any proceeding governed by this subpart. An employee of a respondent may not be called by an agency attorney as an expert or opinion witness for the FAA in any proceeding governed by this subpart to which the respondent is a party.

FAR 13.228 : Subpoenas.

(a) *Request for subpoena.* A party may obtain a subpoena to compel the attendance of a witness at a deposition or hearing or to require the production of documents or tangible items from the hearing docket clerk. The hearing docket clerk shall deliver the subpoena, signed by the hearing docket clerk or an administrative law judge but otherwise in blank, to the party. The party shall complete the subpoena, stating the title of the action and the date and time for the witness' attendance or production of documents or items. The party who obtained the subpoena shall serve the subpoena on the witness.

(b) *Motion to quash or modify the subpoena.* A party, or any person upon whom a subpoena has been served, may file a motion to quash or modify the subpoena with the administrative law judge at or before the time specified in the subpoena for compliance. The applicant shall describe, in detail, the basis for the application to quash or modify the subpoena including, but not limited to, a statement that the testimony, document, or tangible evidence is not relevant to the proceeding, that the subpoena is not reasonably tailored to the scope of the proceeding, or that the subpoena is unreasonable and oppressive. A motion to quash or modify the subpoena will stay the effect of the subpoena pending a decision by the administrative law judge on the motion.

(c) *Enforcement of subpoena.* Upon a showing that a person has failed or refused to comply with a subpoena, a party may apply to the local Federal district court to seek judicial enforcement of the subpoena in accordance with section 1004 of the Federal Aviation Act of 1958, as amended.

FAR 13.229 : Witness fees.

(a) *General.* Unless otherwise authorized by the administrative law judge, the party who applies for a subpoena to compel the attendance of a witness at a deposition or hearing, or the party at whose request a witness appears at a deposition or hearing, shall pay the witness fees described in this section.

(b) *Amount.* Except for an employee of the agency who appears at the direction of the agency, a witness who appears at a deposition or hearing is entitled to the same fees and mileage expenses as are paid to a witness in a court of the United States in comparable circumstances.

FAR 13.230 : Record.

(a) *Exclusive record.* The transcript of all testimony in the hearing, all exhibits received into evidence, and all motions, applications, requests, and rulings shall constitute the exclusive record for decision of the proceedings and the basis for the issuance of any orders in the proceeding. Any proceedings regarding the disqualification of an administrative law judge shall be included in the record.

FAR 29.1501 : General.

- (a) [Each operating limitation specified in Secs. 29.1503 through 29.1525 and other limitations and information necessary for safe operation must be established.
 - (b) The operating limitations and other information necessary for safe operation must be made available to the crewmembers as prescribed in Secs. 29.1541 through 29.1589.]
- Amdt. 29-15, EFF. 3/1/78

77.1 Operating Limitations

FAR 29.1503 : Airspeed limitations : general.

- (a) An operating speed range must be established.
- (b) When airspeed limitations are a function of weight, weight distribution, altitude, rotor speed, power, or other factors, airspeed limitations corresponding with the critical combinations of these factors must be established.

FAR 29.1505 : Never-exceed speed.

- (a) The never-exceed speed, V_{NE} , must be established so that it is—
 - (1) Not less than 40 knots (CAS) ; and
 - (2) Not more than the lesser of—
 - (i) 0.9 times the maximum forward speeds established under Sec. 29.309;
 - (ii) [0.9 times the maximum speed shown under Secs. 29.251 and 29.629; or
 - (iii) 0.9 times the maximum speed substantiated for advancing blade tip mach number effects under critical altitude conditions.]
- (b) V_{NE} may vary with altitude, r.p.m., temperature, and weight, if—
 - (1) No more than two of these variables (or no more than two instruments integrating more than one of these variables) are used at one time ; and
 - (2) The ranges of these variables (or of the indications on instruments integrating more than one of these variables) are large enough to allow an operationally practical and safe variation of V_{NE} .
- (c) For helicopters, a stabilized power-off V_{NE} denoted as V_{NE} power-off) may be established at a speed less than V_{NE} established pursuant to paragraph (a) of this section, if the following conditions are met :
 - (1) V_{NE} (power-off) is not less than a speed midway between the power-on V_{NE} and the speed used in meeting the requirements of—
 - (i) Sec. 29.67(a)(3) for Category A helicopters ;
 - (ii) Sec. 29.65(a) for Category B helicopters, except multi-engine helicopters meeting the requirements of Sec. 29.67(b) ; and
 - (iii) Sec. 29.67(b) for multi-engine Category B helicopters meeting the requirements of Sec. 29.67(b).
 - (2) V_{NE} (power-off) is—
 - (i) A constant airspeed ;
 - (ii) A constant amount less than power-on V_{NE} ; or

FAR 29.1587 : Performance information.	1074
FAR 29.1589 : Loading information.	1076

- (b) *Examination and copying of record.* Any person may examine the record at the Hearing Docket, Federal Aviation Administration, 800 Independence Avenue, SW, Room 924A, Washington, DC 20591. Any person may have a copy of the record after payment of reasonable costs to copy the record.

FAR 13.231 : Argument before the administrative law judge.

- (a) *Arguments during the hearing.* During the hearing, the administrative law judge shall give the parties a reasonable opportunity to present arguments on the record supporting or opposing motions, objections, and rulings if the parties request an opportunity for argument. The administrative law judge may request written arguments during the hearing if the administrative law judge finds that submission of written arguments would be reasonable.
- (b) *Final oral argument.* At the conclusion of the hearing and before the administrative law judge issues an initial decision in the proceedings, the parties are entitled to submit oral proposed findings of fact and conclusions of law, exceptions to rulings of the administrative law judge, and supporting arguments for the findings, conclusions, or exceptions. At the conclusion of the hearing, a party may waive final oral argument.
- (c) *Posthearing briefs.* The administrative law judge may request written posthearing briefs before the administrative law judge issues an initial decision in the proceedings if the administrative law judge finds that submission of written arguments would be reasonable. If a party files a written posthearing brief, the party shall include proposed findings of fact and conclusions of law, exceptions to rulings of the administrative law judge, and supporting arguments for the findings, conclusions, or exceptions. The administrative law judge shall give the parties a reasonable opportunity, not more than 30 days after receipt of the transcript, to prepare and submit the briefs.

FAR 13.232 : Initial decision.

- (a) *Contents.* The administrative law judge shall issue an initial decision at the conclusion of the hearing. In each oral or written decision, the administrative law judge shall include findings of fact and conclusions of law, and the grounds supporting those findings and conclusions, upon all material issues of fact, the credibility of witnesses, the applicable law, any exercise of the administrative law judge's discretion, the amount of any civil penalty found appropriate by the administrative law judge, and a discussion of the basis for any order issued in the proceedings. The administrative law judge is not required to provide a written explanation for rulings on objections, procedural motions, and other matters not directly relevant to the substance of the initial decision. If the administrative law judge refers to any previous unreported or unpublished initial decision, the administrative law judge shall make copies of that initial decision available to all parties and the FAA decisionmaker.
- (b) *Oral decision.* Except as provided in paragraph (c) of this section, at the conclusion of the hearing, the administrative law judge shall issue the initial decision and order orally on the record.
- (c) *Written decision.* The administrative law judge may issue a written initial decision not later than 30 days after the conclusion of the hearing or submission of the

last posthearing brief if the administrative law judge finds that issuing a written initial decision is reasonable. The administrative law judge shall serve a copy of any written initial decision on each party.

- (d) *Order assessing civil penalty.* Unless appealed pursuant to §13.233 of this subpart, the initial decision issued by the administrative law judge shall be considered an order assessing civil penalty if the administrative law judge finds that an alleged violation occurred and determines that a civil penalty, in an amount found appropriate by the administrative law judge, is warranted.

FAR 13.233 : Appeal from initial decision.

- (a) *Notice of appeal.* A party may appeal the initial decision, and any decision not previously appealed pursuant to §13.219, by filing a notice of appeal with the FAA decisionmaker. A party shall file the notice of appeal with the Federal Aviation Administration, 800 Independence Avenue, SW., Room 924A, Washington, DC 20591, Attention : Appellate Docket Clerk. A party shall file the notice of appeal not later than 10 days after entry of the oral initial decision on the record or service of the written initial decision on the parties and shall serve a copy of the notice of appeal on each party.
- (b) *Issues on appeal.* A party may appeal only the following issues :
- (1) Whether each filing of fact is supported by a preponderance of reliable, probative, and substantial evidence ;
- (2) Whether each conclusion of law is made in accordance with applicable law, precedent, and public policy ; and
- (3) Whether the administrative law judge committed any prejudicial errors during the hearing that support the appeal.
- (c) *Perfecting an appeal.* Unless otherwise agreed by the parties, a party shall perfect an appeal, not later than 50 days after entry of the oral initial decision on the record or service of the written initial decision on the party, by filing an appeal brief with the FAA decisionmaker.
- (1) *Extension of time by agreement of the parties.* The parties may agree to extend the time for perfecting the appeal with the consent of the FAA decisionmaker. If the FAA decisionmaker grants an extension of time to perfect the appeal, the appellate docket clerk shall serve a letter confirming the extension of time on each party.
- (2) *Written motion for extension.* If the parties do not agree to an extension of time for perfecting an appeal, a party desiring an extension of time may file a written motion for an extension with the FAA decisionmaker and shall serve a copy of the motion on each party. The FAA decisionmaker may grant an extension if good cause for the extension is shown in the motion.
- (d) *Appeal briefs.* A party shall file the appeal brief with the FAA decisionmaker and shall serve a copy of the appeal brief on each party.
- (1) A party shall set forth, in detail, the party's specific objections to the initial decision or rulings in the appeal brief. A party also shall set forth, in detail, the basis for the appeal, the reasons supporting the appeal, and the relief requested in the appeal. If the party relies on evidence contained in the record for the appeal, the party shall specifically refer to the pertinent evidence contained in the transcript in the appeal brief.

Chapitre 77

Subpart G : Operating Limitations and Information

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FAR 29.1461 : [Equipment containing high energy rotors.]

- (a) [Equipment containing high energy rotors must meet paragraph (b), (c), or (d) of this section.
- (b) High energy rotors contained in equipment must be able to withstand damage caused by malfunctions, vibration, abnormal speeds, and abnormal temperatures. In addition—
- (1) Auxiliary rotor cases must be able to contain damage caused by the failure of high energy rotor blades ; and
 - (2) Equipment control devices, systems, and instrumentation must reasonably ensure that no operating limitations affecting the integrity of high energy rotors will be exceeded in service.
- (c) It must be shown by test that equipment containing high energy rotors can contain any failure of a high energy rotor that occurs at the highest speed obtainable with the normal speed control devices inoperative.
- (d) Equipment containing high energy rotors must be located where rotor failure will neither endanger the occupants nor adversely affect continued safe flight.]

Amdt. 29-3, Eff. 2/25/68

- (2) The FAA decisionmaker may dismiss an appeal, on the FAA decisionmaker's own initiative or upon motion of any other party, where a party has filed a notice of appeal but fails to perfect the appeal by timely filing an appeal brief with the FAA decisionmaker.

(e) *Reply brief.* Unless otherwise agreed by the parties, any party may file a reply brief with the FAA decisionmaker not later than 35 days after the appeal brief has been served on that party. The party filing the reply brief shall serve a copy of the reply brief on each party. If the party relies on evidence contained in the record for the reply, the party shall specifically refer to the pertinent evidence contained in the transcript in the reply brief.

(1) *Extension of time by agreement of the parties.* The parties may agree to extend the time for filing a reply brief with the consent of the FAA decisionmaker. If the FAA decisionmaker grants an extension of time to file the reply brief, the appellate docket clerk shall serve a letter confirming the extension of time on each party.

(2) *Written motion for extension.* If the parties do not agree to an extension of time for filing a reply brief, a party desiring an extension of time may file a written motion for an extension with the FAA decisionmaker and shall serve a copy of the motion on each party. The FAA decisionmaker may grant an extension if good cause for the extension is shown in the motion.

(f) *Other briefs.* The FAA decisionmaker may allow any person to submit an amicus curiae brief in an appeal of an initial decision. A party may not file more than one appeal brief or reply brief. A party may petition the FAA decisionmaker, in writing, for leave to file an additional brief and shall serve a copy of the petition on each party. The party may not file the additional brief with the petition. The FAA decisionmaker may grant leave to file an additional brief if the party demonstrates good cause for allowing additional argument on the appeal. The FAA decisionmaker will allow a reasonable time for the party to file the additional brief.

(g) *Number of copies.* A party shall file the original appeal brief or the original reply brief, and two copies of the brief, with the FAA decisionmaker.

(h) *Oral argument.* The FAA decisionmaker has sole discretion to permit oral argument on the appeal. On the FAA decisionmaker's own initiative or upon written motion by any party, the FAA decisionmaker may find that oral argument will contribute substantially to the development of the issues on appeal and may grant the parties an opportunity for oral argument.

(i) *Waiver of objections on appeal.* If a party fails to object to any alleged error regarding the proceedings in an appeal or a reply brief, the party waives any objection to the alleged error. The FAA decisionmaker is not required to consider any objection in an appeal brief or any argument in the reply brief if a party's objection is based on evidence contained on the record and the party does not specifically refer to the pertinent evidence from the record in the brief.

(j) *FAA decisionmaker's decision on appeal.* The FAA decisionmaker will review the briefs on appeal and the oral argument, if any, to determine if the administrative law judge committed prejudicial error in the proceedings or that the initial decision should be affirmed, modified, or reversed. The FAA decisionmaker may affirm, modify, or reverse the initial decision, make any necessary findings, or may remand the case for any proceedings that the FAA decisionmaker determines may be necessary.

- (1) The FAA decisionmaker may raise any issue, on the FAA decisionmaker's own initiative, that is required for proper disposition of the proceedings. The FAA decisionmaker will give the parties a reasonable opportunity to submit arguments on the new issues before making a decision on appeal. If an issue raised by the FAA decisionmaker requires the consideration of additional testimony or evidence, the FAA decisionmaker will remand the case to the administrative law judge for further proceedings and an initial decision related to that issue. If an issue raised by the FAA decisionmaker is solely an issue of law or the issue was addressed at the hearing but was not raised by a party in the briefs on appeal, a remand of the case to the administrative law judge for further proceedings is not required but may be provided in the discretion of the FAA decisionmaker.
- (2) The FAA decisionmaker will issue the final decision and order of the Administrator on appeal in writing and will serve a copy of the decision and order on each party. Unless a petition for review is filed pursuant to §13.235, a final decision and order of the Administrator shall be considered an order assessing civil penalty if the FAA decisionmaker finds that an alleged violation occurred and a civil penalty is warranted.
- (3) A final decision and order of the Administrator after appeal is precedent in any other civil penalty action. Any issue, finding or conclusion, order, ruling, or initial decision of an administrative law judge that has not been appealed to the FAA decisionmaker is not precedent in any other civil penalty action.

FAAR 13.234 : Petition to reconsider or modify a final decision and order of the FAA decisionmaker on appeal.

- (a) *General.* Any party may petition the FAA decisionmaker to reconsider or modify a final decision and order issued by the FAA decisionmaker on appeal from an initial decision. A party shall file a petition to reconsider or modify with the FAA decisionmaker not later than 30 days after service of the FAA decisionmaker's final decision and order on appeal and shall serve a copy of the petition on each party. The FAA decisionmaker will not reconsider or modify an initial decision and order issued by an administrative law judge that has not been appealed by any party to the FAA decisionmaker.
- (b) *Form and number of copies.* A party shall file a petition to reconsider or modify, in writing, with the FAA decisionmaker. The party shall file the original petition with the FAA decisionmaker and shall serve a copy of the petition on each party.
- (c) *Contents.* A party shall state briefly and specifically the alleged errors in the final decision and order on appeal, the relief sought by the party, and the grounds that support, the petition to reconsider or modify.
 - (1) If the petition is based, in whole or in part, on allegations regarding the consequences of the FAA decisionmaker's decision, the party shall describe these allegations and shall describe, and support, the basis for the allegations.
 - (2) If the petition is based, in whole or in part, on new material not previously raised in the proceedings, the party shall set forth the new material and include affidavits of prospective witnesses and authenticated documents that would be introduced in support of the new material. The party shall explain, in detail, why the new material was not discovered through due diligence prior to the hearing.

- (e) The record container must be located and mounted to minimize the probability of rupture of the container as a result of crash impact and consequent heat damage to the record from fire.
- (f) If the cockpit voice recorder has a bulk erasure device, the installation must be designed to minimize the probability of inadvertent operation and actuation of the device during crash impact.
- (g) Each recorder container must be either bright orange or bright yellow.]

Amdt. 29-6, EFF. 7/8/70

FAAR 29.1459 : [Flight recorder.]

- (a) [Each flight recorder required by the operating rules of Subchapter G of this chapter must be installed so that—
 - (1) It is supplied with airspeed, altitude, and directional data obtained from sources that meet the accuracy requirements of Secs. 29.1323, 29.1325, and 29.1327 of this part, as applicable;
 - (2) The vertical acceleration sensor is rigidly attached, and located longitudinally within the approved center gravity limits of the rotorcraft;
 - (3) It receives its electrical power from the bus that provides the maximum reliability for operation of the flight recorder without jeopardizing service to essential or emergency loads;
 - (4) There is an aural or visual means for preflight checking of the recorder for proper recording of data in the storage medium; and
 - (5) Except for recorders powered solely by the engine-driven electrical generator system, there is an automatic means to simultaneously stop a recorder that has a data erasure feature and prevent such erasure feature from functioning, within 10 minutes after any crash impact.
- (b) Each nonjectable recorder container must be located and mounted so as to minimize the probability of container rupture resulting from crash impact and subsequent damage to the record from fire.
- (c) A correlation must be established between the flight recorder readings of airspeed, altitude, and heading and the corresponding readings (taking into account correction factors) of the first pilot's instruments. This correlation must cover the airspeed range over which the aircraft is to be operated, the range of altitude to which the aircraft is limited, and 360 degrees of heading. Correlation may be established on the ground as appropriate.
- (d) Each recorder container must—
 - (1) Be either bright orange or bright yellow;
 - (2) Have a reflective tape affixed to its external surface to facilitate its location under water; and
 - (3) Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such a manner that it is not likely to be separated during crash impact.]

Amdt. 29-25, EFF. 10/11/88

- (5) Voice communications of flight crewmembers using the passenger loudspeaker system, if there is such a system, and if the fourth channel is available in accordance with the requirements of subdivision (c)(4)(ii) of this section.
- (b) The recording requirements of subparagraph (a)(2) of this section may be met—
- (1) By installing a cockpit-mounted area microphone, located in the best position for recording voice communications originating at the first and second pilot stations and voice communications of other crewmembers on the flight deck when directed to those stations; or
 - (2) By installing a continually energized or voice-actuated lip microphone at the first and second pilot stations.
- The microphone specified in paragraph (b) must be so located and, if necessary, the preamplifiers and filters of the recorder must be so adjusted or supplemented, that the recorded communications are intelligible when recorded under flight cockpit noise conditions and played back. The level of intelligibility must be approved by the Administrator. Repeated aural or visual playback of the record may be used in evaluating intelligibility.
- (c) Each cockpit voice recorder must be installed so that the part of the communication or audio signals specified in paragraph (a) of this section obtained from each of the following sources is recorded on a separate channel :
- (1) For the first channel, from each microphone, headset, or speaker used at the first pilot station.
 - (2) For the second channel, from each microphone, headset, or speaker used at the second pilot station.
 - (3) For the third channel, from the cockpit-mounted area microphone, or the continually energized or voice-actuated lip microphones at the first and second pilot stations.
 - (4) For the fourth channel, from—
 - (i) Each microphone, headset, or speaker used at the stations for the third and fourth crewmembers; or
 - (ii) If the stations specified in subdivision (i) or this subparagraph are not required or if the signal at such a station is picked up by another channel, each microphone on the flight deck that is used with the passenger loudspeaker system if its signals are not picked up by another channel.
 - (iii) Each microphone on the flight deck that is used with the rotorcraft's loudspeaker system if its signals are not picked up by another channel.
- (d) Each cockpit voice recorder must be installed so that—
- (1) It receives its electric power from the bus that provides the maximum reliability for operation of the cockpit voice recorder without jeopardizing service to essential or emergency loads;
 - (2) There is an automatic means to simultaneously stop the recorder and prevent each erasure feature from functioning, within 10 minutes after crash impact; and
 - (3) There is an aural or visual means for preflight checking of the recorder for proper operation.

- (d) *Repetitious and frivolous petitions.* The FAA decisionmaker will not consider repetitious or frivolous petitions. The FAA decisionmaker may summarily dismiss repetitious or frivolous petitions to reconsider or modify.
- (e) *Reply petitions.* Any other party may reply to a petition to reconsider or modify, not later than 10 days after service of the petition on that party, by filing a reply with the FAA decisionmaker. A party shall serve a copy of the reply on each party.
- (f) *Effect of filing petition.* Unless otherwise ordered by the FAA decisionmaker, filing of a petition pursuant to this section will not stay or delay the effective date of the FAA decisionmaker's final decision and order on appeal and shall not toll the time allowed for judicial review.
- (g) *FAA decisionmaker's decision on petition.* The FAA decisionmaker has sole discretion to grant or deny a petition to reconsider or modify. The FAA decisionmaker will grant or deny a petition to reconsider or modify within a reasonable time after receipt of the petition or receipt of the reply petition, if any. The FAA decisionmaker may affirm, modify, or reverse the final decision and order on appeal, or may remand the case for any proceedings that the FAA decisionmaker determines may be necessary.

FAR 13.235 : Judicial review of a final decision and order.

A person may seek judicial review of a final decision and order of the Administrator as provided in section 1006 of the Federal Aviation Act of 1958, as amended. A party seeking judicial review of a final decision and order shall file a petition for review not later than 60 days after the final decision and order has been served on the party.

- (3) There must be means to indicate the pressure in each main hydraulic power system.
- (4) There must be means to ensure that no pressure in any part of the system will exceed a safe limit above the maximum operating pressure of the system, and to prevent excessive pressures resulting from any fluid volumetric change in lines likely to remain closed long enough for such a change to take place. The possibility of detrimental transient (surge) pressures during operation must be considered.
- (5) Each hydraulic line, fitting, and component must be installed and supported to prevent excessive vibration and to withstand inertia loads. Each element of the installation must be protected from abrasion, corrosion, and mechanical damage.
- (6) Means for providing flexibility must be used to connect points, in a hydraulic fluid line, between which relative motion or differential vibration exists.
- (b) *Tests.* Each element of the system must be tested to a proof pressure of 1.5 times the maximum pressure to which that element will be subjected in normal operation, without failure, malfunction, or detrimental deformation of any part of the system.
- (c) *Fire protection.* Each hydraulic system using flammable hydraulic fluid must meet the applicable requirements of Secs. 29.861, 29.1183, 29.1185, and 29.1189.

FAR 29.1439 : Protective breathing equipment.

- (a) If one or more cargo or baggage compartments are to be accessible in flight, protective breathing equipment must be available for an appropriate crewmember.
- (b) For protective breathing equipment required by paragraph (a) of this section or by any operating rule of this chapter–
 - (1) That equipment must be designed to protect the crew from smoke, carbon dioxide, and other harmful gases while on flight deck duty;
 - (2) That equipment must include–
 - (i) Masks covering the eyes, nose, and mouth ; or
 - (ii) Masks covering the nose and mouth, plus accessory equipment to protect the eyes; and
 - (3) That equipment must supply protective oxygen of 10 minutes duration per crewmember at a pressure altitude of 8,000 feet with a respiratory minute volume of 30 liters per minute BTPD.

FAR 29.1457 : [Cockpit voice recorders.]

- (a) [Each cockpit voice recorder required by the operating rules of this chapter must be approved, and must be installed so that it will record the following :
 - (1) Voice communications transmitted from or received in the rotorcraft by radio.
 - (2) Voice communications of flight crewmembers on the flight deck.
 - (3) Voice communications of flight crewmembers on the flight deck, using the rotorcraft's interphone system.
 - (4) Voice or audio signals identifying navigation or approach aids introduced into a headset or speaker.

- (1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.
- (2) Flight dry air tests of the ice protection system as a whole, or its individual components.
- (3) Flight tests of the rotorcraft or its components in measured simulated icing conditions.
- (4) The ice protection provisions of this section are considered to be applicable primarily to the airframe. Powerplant installation requirements are contained in Subpart E of this Part.
- (e) A means must be identified or provided for determining the formation of ice on critical parts of the rotorcraft. Unless otherwise restricted, the means must be available for nighttime as well as daytime operation. The rotorcraft flight manual must describe the means of determining ice formation and must contain information necessary for safe operation of the rotorcraft in icing conditions.]

Amdt. 29-21, Eff. 3/2/83

76.6 Miscellaneous Equipment

FAR 29.1431 : Electronic equipment.

- (a) Radio communication and navigation equipment installations must be free from hazards in themselves, in their method of operation, and in their effects on other components, under any critical environmental conditions.
- (b) Radio communication and navigation equipment, controls, and wiring must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other radio or electronic unit, or system of units, required by this chapter.

FAR 29.1433 : Vacuum systems.

- (a) There must be means, in addition to the normal pressure relief, to automatically relieve the pressure in the discharge lines from the vacuum air pump when the delivery temperature of the air becomes unsafe.
- (b) Each vacuum air system line and fitting on the discharge side of the pump that might contain flammable vapors or fluids must meet the requirements of Sec. 29.1183 if they are in a designated fire zone.
- (c) Other vacuum air system components in designated fire zones must be at least fire resistant.

FAR 29.1435 : Hydraulic systems.

- (a) *Design.* Each hydraulic system must be designed as follows :
 - (1) Each element of the hydraulic system must be designed to withstand, without detrimental, permanent deformation any structural loads that may be imposed simultaneously with the maximum operating hydraulic loads.
 - (2) Each element of the hydraulic system must be designed to withstand pressures sufficiently greater than those prescribed in paragraph (b) of this section to show that the system will not rupture under service conditions.

Chapitre 11

Subpart H : Civil Monetary
Penalty Inflation Adjustment

Sommaire

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FAR 13.301 : Scope and purpose.

(a) This subpart provides a mechanism for the regular adjustment for inflation of civil monetary penalties in conformity with the Federal Civil Penalties Inflation Adjustment Act of 1990, 28 U.S.C. 2461 (note), as amended by the Debt Collection Improvement Act of 1996, Public Law 104-134, April 26, 1996, in order to maintain the deterrent effect of civil monetary penalties and to promote compliance with the law. This subpart also sets out the current adjusted maximum civil monetary penalties or range of minimum and maximum civil monetary penalties for each statutory civil penalty subject to the FAA's jurisdiction.

(b) Each adjustment to the maximum civil monetary penalty or the range of minimum and maximum civil monetary penalties, as applicable, made in accordance with this subpart applies prospectively from the date it becomes effective to actions initiated under this part, notwithstanding references to a specific maximum civil monetary penalty or range of minimum and maximum civil monetary penalties contained elsewhere in this part.

FAR 13.303 : Definitions.

(a) *Civil Monetary Penalty* means any penalty, fine, or other sanction that :

(1) Is for a specific monetary amount as provided by Federal law or has a maximum amount provided by Federal law ;

(2) Is assessed or enforced by the FAA pursuant to Federal law ; and

(3) Is assessed or enforced pursuant to an administrative proceeding or a civil action in the Federal courts.

(b) *Consumer Price Index* means the Consumer Price Index for all urban consumers published by the Department of Labor.

FAR 13.305 : Cost of living adjustments of civil monetary penalties.

(a) Except for the limitation to the initial adjustment to statutory maximum civil monetary penalties or range of minimum and maximum civil monetary penalties set forth in paragraph (c) of this section, the inflation adjustment under this subpart is determined by increasing the maximum civil monetary penalty or range of minimum and maximum civil monetary penalty for each civil monetary penalty by the cost-of-living adjustment. Any increase determined under paragraph (a) of this section is rounded to the nearest :

(1) Multiple of \$10 in the case of penalties less than or equal to \$100 ;

(2) Multiple of \$100 in the case of penalties greater than \$100 but less than or equal to \$1,000 ;

(3) Multiple of \$1,000 in the case of penalties greater than \$1,000 but less than or equal to \$10,000 ;

(4) Multiple of \$5,000 in the case of penalties greater than \$10,000 but less than or equal to \$100,000 ;

(5) Multiple of \$10,000 in the case of penalties greater than \$100,000 but less than or equal to \$200,000 ; and

(6) Multiple of \$25,000 in the case of penalties greater than \$200,000.

(d) *Lifelines*. Liferafts must be stowed near exits through which the rafts can be launched during an unplanned ditching. Rafts automatically or remotely released outside the rotorcraft must be attached to the rotorcraft by the static line prescribed in Sec. 29.1415.

(e) *Long-range signaling device*. The stowage provisions for the long-range signaling device required by Sec. 29.1415 must be near an exit available during an unplanned ditching.

(f) *Life preservers*. Each life preserver must be within easy reach of each occupant while seated.

FAR 29.1413 : Safety belts : passenger warning device.

(a) [If there are means to indicate to the passengers when safety belts should be fastened, they must be installed to be operated from either pilot seat.

(b) Each safety belt must be equipped with a metal to metal latching device.]

Amdt. 29-16, Eff. 12/4/78

FAR 29.1415 : Ditching equipment.

(a) Emergency flotation and signaling equipment required by any operating rule of this chapter must meet the requirements of this section.

(b) Each liferaft and each life preserver must be approved. In addition—

(1) Provide not less than two rafts, of an approximately equal rated capacity and buoyancy to accommodate the occupants of the rotorcraft ; and

(2) Each raft must have a trailing line, and must have a static line designed to hold the raft near the rotorcraft but to release it if the rotorcraft becomes totally submerged.

(c) Approved survival equipment must be attached to each liferaft.

(d) [There must be an approved survival type emergency locator transmitter for use in one life raft.]

Amdt. 29-33, Eff. 6/21/94

FAR 29.1419 : [Ice protection.]

(a) [To obtain certification for flight into icing conditions, compliance with this section must be shown.

(b) It must be demonstrated that the rotorcraft can be safely operated in the continuous maximum and intermittent maximum icing conditions determined under Appendix C of this Part within the rotorcraft altitude envelope. An analysis must be performed to establish, on the basis of the rotorcraft's operational needs, the adequacy of the ice protection system for the various components of the rotorcraft.

(c) In addition to the analysis and physical evaluation prescribed in paragraph (b) of this section, the effectiveness of the ice protection system and its components must be shown by flight tests of the rotorcraft or its components in measured natural atmospheric icing conditions and by one or more of the following tests as found necessary to determine the adequacy of the ice protection system.

(c) *Flashing characteristics.* The arrangement of the system, that is, the number of light sources, beam width, speed of rotation, and other characteristics, must give an effective flash frequency of not less than 40, nor more than 100, cycles per minute. The effective flash frequency is the frequency at which the rotorcraft's complete anticollision light system is observed from a distance, and applies to each sector of light including any overlaps that exist when the system consists of more than one light source. In overlaps, flash frequencies may exceed 100, but not 180, cycles per minute.

(d) *Color.* Each anticollision light must be [aviation red] and must meet the applicable requirements of Sec. 29.1397.

(e) *Light intensity.* The minimum light intensities in any vertical plane, measured with the red filter (if used) and expressed in terms of "effective" intensities, must meet the requirements of paragraph (f) of this section. The following relation must be assumed :

$$I_e = \frac{\int_{t_1}^{t_2} I(t) dt}{0.2 + (t_2 - t_1)}$$

where :

I_e	effective intensity	(candles)
$I(t)$	instantaneous intensity as a function of time	(candles)
$t_2 - t_1$	flash time interval	(seconds)

Normally, the maximum value of effective intensity is obtained when t_2 and t_1 are chosen so that the effective intensity is equal to the instantaneous intensity at t_2 and t_1 .

(f) *Minimum effective intensities for anticollision lights.* Each anticollision light effective intensity must equal or exceed the applicable values in the following table :

Angle above or below the horizontal plane :	Effective intensity (candles)
0° to 5°	400
5° to 10°	240
10° to 20°	80
20° to 30°	40

Amdt. 29-11, Eff. 2/5/76

76.5 Safety Equipment

FAR 29.1411 : General.

- (a) *Accessibility.* Required safety equipment to be used by the crew in an emergency, such as automatic liferaft releases, must be readily accessible.
- (b) *Stowage provisions.* Stowage provisions for required emergency equipment must be furnished and must—
- (1) Be arranged so that the equipment is directly accessible and its location is obvious; and
 - (2) Protect the safety equipment from inadvertent damage.
- (c) *Emergency exit descent device.* The stowage provisions for the emergency exit descent device required by Sec. 29.809(f) must be at the exits for which they are intended.

- (b) For purposes of paragraph (a) of this section, the term "cost-of-living adjustment" means the percentage (if any) for each civil monetary penalty by which the Consumer Price Index for the month of June of the calendar year preceding the adjustment exceeds the Consumer Price Index for the month of June of the calendar year in which the amount of such civil monetary penalty was last set or adjusted pursuant to law.
- (c) Limitation on initial adjustment. The initial adjustment of maximum civil penalty or range of minimum and maximum civil monetary penalties made pursuant to this subpart does not exceed 10 percent of the statutory maximum civil penalty before an adjustment under this subpart is made. This limitation applies only to the initial adjustment, effective on January 21, 1997.
- (d) Inflation adjustment. Minimum and maximum civil monetary penalties within the jurisdiction of the FAA are adjusted for inflation as follows : Minimum and Maximum Civil Penalties – Adjusted for Inflation, Effective March 13, 2002.

United States Code citation	Civil monetary penalty description	Minimum penalty amount as of 10/23/96	New adjusted penalty amount	Maximum penalty amount as of 10/26/96	New maximum penalty amount
49 U.S.C. 5123(a) (changed 1990)	Violations of hazardous materials transportation law, regulations, or orders.	\$250 per violation per day	\$250 per violation per day	\$25,000 per violation per day	\$27,500 per violation per day
49 U.S.C. 46301(a)(1) (1958)	Violations of FAA statute or regulations by a person.	N/A	N/A	\$1,000 per violation per day or per flight	\$1,100 per violation per day or per flight
49 U.S.C. 46301(a)(2) (changed 1987)	Violations of FAA statute or regulations by a person operating an aircraft for the transportation of passengers or property for compensation	N/A	N/A	\$10,000 per violation per day or per flight	\$11,000 per violation per day or per flight
49 U.S.C. 46301(a)(3) (1974)	Violations of FAA statute involving the transportation of hazardous materials by air	N/A	N/A	\$10,000 per violation per day or per flight	\$11,000 per violation per day or per flight
49 U.S.C. 46301(a)(3) (1988)	Violations of FAA statute involving the registration or recordation under chapter 441 of aircraft not used to provide air transportation	N/A	N/A	\$10,000 per violation per day or per flight	\$11,000 per violation per day or per flight
49 U.S.C. 46301(b) (1987)	Tampering with a smoke alarm device	N/A	N/A	\$2,000 per violation	\$2,200 per violation
49 U.S.C. 46302	Knowingly providing false information about alleged violations involving the special aircraft jurisdiction of the United States.	N/A	N/A	\$10,000 per violation	\$11,000 per violation
49 U.S.C. 46303	Carrying a concealed deadly or dangerous weapon.	N/A	N/A	\$10,000 per violation	\$11,000 per violation

- (b) Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 20 degrees.

FAR 29.1397 : Color specifications.

Each position light color must have the applicable International Commission on Illumination chromaticity coordinates as follows :

(a) Aviation red—

- "x" is not greater than 0.335; and
- "y" is not greater than 0.002.

(b) Aviation green—

- "x" is not greater than 0.440–0.320y;
- "x" is not greater than y–0.170; and
- "y" is not less than 0.390–0.17x.

(c) [Aviation white—

- "x" is not less than 0.300 and not greater than 0.540;
- "y" is not less than "x–0.040" or y0–0.010", whichever is the smaller; and
- "y" is not greater than "x+0.020" nor "0.636–0.400x";

Where "Y0" is the "Y" coordinate of the Planckian radiator for the value of "x" considered.]

Amtd. 29-7, EFF. 8/1/71

FAR 29.1399 : Riding light.

- (a) Each riding light required for water operation must be installed so that it can—
 - (1) Show a white light for at least two miles at night under clear atmospheric conditions; and
 - (2) Show a maximum practicable unbroken light with the rotorcraft on the water.
- (b) Externally hung lights may be used.

FAR 29.1401 : Anticollision light system.

- (a) *General.* If certification for night operation is requested, the rotorcraft must have an anticollision light system that—
 - (1) Consists of one or more approved anticollision lights located so that their emitted light will not impair the crew's vision or detract from the conspicuity of the position lights; and
 - (2) Meets the requirements of paragraphs (b) through (f) of this section.
- (b) *Field of coverage.* The system must consist of enough lights to illuminate the vital areas around the rotorcraft, considering the physical configuration and flight characteristics of the rotorcraft. The field of coverage must extend in each direction within at least 30° above the 30° below the horizontal plane of the rotorcraft, except that there may be solid angles of obstructed visibility totaling not more than 0.5 steradians.

the overlap intensities in relation to the main beam intensities do not adversely affect signal clarity.

FAR 29.1391 : Minimum intensities in the horizontal plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table :

Dihedral angle (light included)	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity (candles)
L and R (forward red and green).	0° to 10°	40
	10° to 20°	30
	20° to 110°	5
A (rear white)	110° to 180°	20

FAR 29.1393 : Minimum intensities in any vertical plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table :

Angle above or below the horizontal plane :	Intensity
0°	1.00 I.
0° to 5°	0.90 I.
5° to 10°	0.80 I.
10° to 15°	0.70 I.
15° to 20°	0.50 I.
20° to 30°	0.30 I.
30° to 40°	0.10 I.
40° to 90°	0.05 I.

FAR 29.1395 : Maximum intensities in overlapping beams of forward and rear position lights.

No position light intensity may exceed the applicable values in the following table, except as provided in Sec. 29.1389 (b)(3).

Overlaps	Maximum intensity	
	Area A (candles)	Area B (candles)
Green in dihedral angle L	10	1
Red in dihedral angle R	10	1
Green in dihedral angle A	5	1
Red in dihedral angle A	5	1
Rear white in dihedral angle L	5	1
Rear white in dihedral angle R	5	1

Where-

- (a) Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 10 degrees but less than 20 degrees ; and

Chapitre 12

Subpart I : Flight Operational Quality Assurance Programs

Sommaire

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FAR 13.401 : Flight Operational Quality Assurance program : Prohibition against use of data for enforcement purposes.

- (a) *Applicability.* This section applies to any operator of an aircraft who operates such aircraft under an approved Flight Operational Quality Assurance (FOQA) program.
- (b) *Definitions.* For the purpose of this section, the terms –
 - (1) *Flight Operational Quality Assurance (FOQA) program* means an FAA-approved program for the routine collection and analysis of digital flight data gathered during aircraft operations, including data currently collected pursuant to existing regulatory provisions, when such data is included in an approved FOQA program.
 - (2) *FOQA data* means any digital flight data that has been collected from an individual aircraft pursuant to an FAA-approved FOQA program, regardless of the electronic format of that data.
 - (3) *Aggregate FOQA data* means the summary statistical indices that are associated with FOQA event categories, based on an analysis of FOQA data from multiple aircraft operations.
 - (c) *Requirements.* In order for paragraph (e) of this section to apply, the operator must submit, maintain, and adhere to a FOQA Implementation and Operation Plan that is approved by the Administrator and which contains the following elements :
 - (1) A description of the operator's plan for collecting and analyzing flight recorded data from line operations on a routine basis, including identification of the data to be collected;
 - (2) Procedures for taking corrective action that analysis of the data indicates is necessary in the interest of safety ;
 - (3) Procedures for providing the FAA with aggregate FOQA data ;
 - (4) Procedures for informing the FAA as to any corrective action being undertaken pursuant to paragraph (c)(2) of this section.
 - (d) *Submission of aggregate data.* The operator will provide the FAA with aggregate FOQA data in a form and manner acceptable to the Administrator.
 - (e) *Enforcement.* Except for criminal or deliberate acts, the Administrator will not use an operator's FOQA data or aggregate FOQA data in an enforcement action against that operator or its employees when such FOQA data or aggregate FOQA data is obtained from a FOQA program that is approved by the Administrator.
 - (f) *Disclosure.* FOQA data and aggregate FOQA data, if submitted in accordance with an order designating the information as protected under part 193 of this chapter, will be afforded the nondisclosure protections of part 193 of this chapter.
 - (g) *Withdrawal of program approval.* The Administrator may withdraw approval of a previously approved FOQA program for failure to comply with the requirements of this chapter. Grounds for withdrawal of approval may include, but are not limited to –
 - (1) Failure to implement corrective action that analysis of available FOQA data indicates is necessary in the interest of safety ; or
 - (2) Failure to correct a continuing pattern of violations following notice by the agency ; or also
 - (3) Willful misconduct or willful violation of the FAA regulations in this chapter.

FAR 29.1387 : Position light system dihedral angles.

- (a) [Except as provided in paragraph (e) of this section, each forward and rear position light must, as installed, show unbroken light within the dihedral angles described in this section.]
- (b) Dihedral angle *L* (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the rotorcraft, and the other at 110° to the left of the first, as viewed when looking forward along the longitudinal axis.
- (c) Dihedral angle *R* (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the rotorcraft, and the other at 110° to the right of the first, as views when looking forward along the longitudinal axis.
- (d) Dihedral angle *A* (aft) is formed by two intersecting vertical planes making angles of 70° to the right and to the left, respectively, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.
- (e) [If the rear position light, when mounted as far aft as practicable in accordance with Sec. 29.1385(c), cannot show unbroken light within dihedral angle *A* (as defined in paragraph (d) of this section), a solid angle or angles of obstructed visibility totaling not more than 0.04 steradians is allowable within that dihedral angle, if such solid angle is within a cone whose apex is at the rear position light and whose elements make an angle of 30° with a vertical line passing through the rear position light.]

Amtd. 29-9, EF 11/5/71

FAR 29.1389 : Position light distribution and intensities.

- (a) *General.* The intensities prescribed in this section must be provided by new equipment with light covers and color filters in place. Intensities must be determined with the light source operating at a steady value equal to the average luminous output of the source at the normal operating voltage of the rotorcraft. The light distribution and intensity of each position light must meet the requirements of paragraph (b) of this section.
- (b) *Forward and rear position lights.* The light distribution and intensities of forward and rear position lights must be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane, and maximum intensities in overlapping beams, within dihedral angles, *L*, *R*, and *A*, and must meet the following requirements :
 - (1) *Intensities in the horizontal plane.* Each intensity in the horizontal plane (the plane containing the longitudinal axis of the rotorcraft and perpendicular to the plane of symmetry of the rotorcraft), must equal or exceed the values in Sec. 29.1391.
 - (2) *Intensities in any vertical plane.* Each intensity in any vertical plane (the plane perpendicular to the horizontal plane) must equal or exceed the appropriate value in Sec. 29.1393 where *I* is the minimum intensity prescribed in Sec. 29.1391 for the corresponding angles in the horizontal plane.
 - (3) *Intensities in overlaps between adjacent signals.* No intensity in any overlap between adjacent signals may exceed the values in Sec. 29.1395, except that higher intensities in overlaps may be used with the use of main beam intensities substantially greater than the minima specified in Secs. 29.1391 and 29.1393 if

- (b) For each flight condition that cannot be simulated adequately in the laboratory or by ground tests on the rotorcraft, flight tests must be made.

76.4 Lights

FAR 29.1381 : Instrument lights.

The instrument lights must—

- (a) Make each instrument, switch, and other device for which they are provided easily readable; and
- (b) Be installed so that—
 - (1) Their direct rays are shielded from the pilot's eyes; and
 - (2) No objectionable reflections are visible to the pilot.

FAR 29.1383 : Landing lights.

- (a) Each required landing or hovering light must be approved.
- (b) Each landing light must be installed so that—
 - (1) No objectionable glare is visible to the pilot;
 - (2) The pilot is not adversely affected by halation; and
 - (3) It provides enough light for night operation, including hovering and landing.
- (c) At least one separate switch must be provided, as applicable—
 - (1) For each separately installed landing light; and
 - (2) For each group of landing lights installed at a common location.

FAR 29.1385 : Position light system installation.

- (a) *General.* Each part of each position light system must meet the applicable requirements of this section and each system as a whole must meet the requirements of Secs. 29.1387 through 29.1397.
- (b) *Forward position lights.* Forward position lights must consist of a red and a green light spaced laterally as far apart as practicable and installed forward on the rotorcraft so that, with the rotorcraft in the normal flying position, the red light is on the left side, and the green light is on the right side. Each light must be approved.
- (c) *Rear position light.* The rear position light must be a white light mounted as far aft as practicable, and must be approved.
- (d) *Circuit.* The two forward position lights and the rear position light must make a single circuit.
- (e) *Light covers and color filters.* Each light cover or color filter must be at least flame resistant and may not change color or shape or lose any appreciable light transmission during normal use.

Quatrième partie

FAR 21- Certification

procedures for products and parts

Amdt. 29-24, Eff. 12/6/84

FAR 29.1357 : Circuit protective devices.

- (a) Automatic protective devices must be used to minimize distress to the electrical system and hazard to the rotorcraft in the event of wiring faults or serious malfunction of the system or connected equipment.
- (b) [The protective and control devices in the generating system must be designed to de-energize and disconnect faulty power sources and power transmission equipment from their associated buses with sufficient rapidity to provide protection from hazardous overvoltage and other malfunctioning.]
- (c) Each resettable circuit protective device must be designed so that, when an overload or circuit fault exists, it will open the circuit regardless of the position of the operating control.
- (d) [If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be located and identified so that it can be readily reset or replaced in flight.
- (e) Each essential load must have individual circuit protection. However, individual protection for each circuit in an essential load system (such as each position light circuit in a system) is not required.]
- (f) If fuses are used, there must be spare fuses for use in flight equal to at least 50 percent of the number of fuses of each rating required for complete circuit protection.
- (g) [Automatic reset circuit breakers may be used as integral protectors for electrical equipment provided there is circuit protection for the cable supplying power to the equipment.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.1359 : Electrical system fire and smoke protection.

- (a) Components of the electrical system must meet the applicable fire and smoke protection provisions of Secs. 29.831 and 29.863.
- (b) Electrical cables, terminals, and equipment, in designated fire zones, and that are used in emergency procedures, must be at least fire resistant.
- (c) [Insulation on electrical wire and cable installed in the rotorcraft must be self-extinguishing when tested in accordance with Appendix F, Part I(a)(3), of part 25 of this chapter.]

Amdt. 29-42, Eff. 9/8/98

FAR 29.1363 : Electrical system tests.

- (a) When laboratory tests of the electrical system are conducted—
 - (1) The tests must be performed on a mock-up using the same generating equipment used in the rotorcraft;
 - (2) The equipment must simulate the electrical characteristics of the distribution wiring and connected loads to the extent necessary for valid test results; and
 - (3) Laboratory generator drives must simulate the prime movers on the rotorcraft with respect to their reaction to generator loading, including loading due to faults.

FAR 29.1353 : Electrical equipment and installations.

- (a) Electrical equipment, controls, and wiring must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other electrical unit or system essential to safe operation.
- (b) Cables must be grouped, routed, and spaced so that damage to essential circuits will be minimized if there are faults in heavy current-carrying cables.
- (c) Storage batteries must be designed and installed as follows :
 - (1) Safe cell temperatures and pressures must be maintained during any probable charging and discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge)–
 - (i) At maximum regulated voltage or power ;
 - (ii) During the flight of maximum duration ; and
 - (iii) Under the most adverse cooling condition likely in service.
 - (2) Compliance with subparagraph (1) of this paragraph must be shown by test unless experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.
 - (3) No explosive or toxic gases emitted by any battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation, may accumulate in hazardous quantities within the rotorcraft.
 - (4) No corrosive fluids or gases that may escape from the battery may damage surrounding structures or adjacent essential equipment.
 - (5) Each nickel cadmium battery installation capable of being used to start an engine or auxiliary power unit must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.
 - (6) [Nickel cadmium battery installations capable of being used to start an engine or auxiliary power unit must have–
 - (i) A system to control the charging rate of the battery automatically so as to prevent battery overheating ;
 - (ii) A battery temperature sensing and over-temperature warning system with a means for disconnecting the battery from its charging source in the event of an over-temperature condition ; or
 - (iii) A battery failure sensing and warning system with a means for disconnecting the battery from its charging source in the event of battery failure.]

Amdt. 29-15, Eff. 3/1/78

FAR 29.1355 : Distribution system.

- (a) The distribution system includes the distribution busses, their associated feeders, and each control and protective device.
- (b) [If two independent sources of electrical power for particular equipment or systems are required by this chapter, in the event of the failure of one power source for such equipment or system, another power source (including its separate feeder) must be provided automatically or be manually selectable to maintain equipment or system operation.]

Chapitre 13

Subpart A—General

Sommaire

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FAR 21.1 : Applicability.

- (a) This Part prescribes—
- (1) Procedural requirements for the issue of type certificates and changes to those certificates; the issue of production certificates; the issue of airworthiness certificates; and the issue of export airworthiness approvals;
 - (2) Rules governing the holders of any certificate specified in subparagraph (1); and
 - (3) Procedural requirements for the approval of certain materials, parts, processes, and appliances.
- (b) For the purposes of this Part, the word "product" means an aircraft, aircraft engine, or propeller. In addition, for the purposes of Subpart L only, it includes components and parts of aircraft, of aircraft engines, and of propellers; also parts, materials, and appliances, approved under the Technical Standard Order system.

FAR 21.2 : [Falsification of applications, reports, or records.]

- (a) [No person shall make or cause to be made—
- (1) Any fraudulent or intentionally false statement on any application for a certificate or approval under this part;
 - (2) Any fraudulent or intentionally false entry in any record or report that is required to be kept, made, or used to show compliance with any requirement for the issuance or the exercise of the privileges of any certificate or approval issued under this part;
 - (3) Any reproduction for a fraudulent purpose of any certificate or approval issued under this part.
 - (4) Any alteration of any certificate or approval issued under this part.
- (b) The commission by any person of an act prohibited under paragraph (a) of this section is a basis for suspending or revoking any certificate or approval issued under this part and held by that person.]

Amdt. 21-70, EF. 12/31/92

FAR 21.3 : Reporting of failures, malfunctions, and defects.

- (a) Except as provided in paragraph (d) of this section, the holder of a Type Certificate (including a Supplemental Type Certificate), a Parts Manufacturer Approval (PMA), or a TSO authorization, or the licensee of a Type Certificate shall report any failure, malfunction, or defect in any product, part, process, or article manufactured by it that it determines has resulted in any of the occurrences listed in paragraph (c) of this section.
- (b) The holder of a Type Certificate (including a Supplemental Type Certificate), a Parts Manufacturer Approval (PMA), or a TSO authorization, or the licensee of a Type Certificate shall report any defect in any product, part, or article manufactured by it that has left its quality control system and that it determines could result in any of the occurrences listed in paragraph (c) of this section.
- (c) The following occurrences must be reported as provided in paragraphs (a) and (b) of this section :

- (1) Power sources function properly when independent and when connected in combination ;
 - (2) No failure or malfunction of any power source can create a hazard or impair the ability of remaining sources to supply essential loads ;
 - (3) The system voltage and frequency (as applicable) at the terminals of essential load equipment can be maintained within the limits for which the equipment is designed, during any probable operating condition ;
 - (4) System transients due to switching, fault clearing, or other causes do not make essential loads inoperative, and do not cause a smoke or fire hazard ;
 - (5) There are means accessible in flight to appropriate crewmembers for the individual and collective disconnection of the electrical power sources from the main bus ; and
 - (6) There are means to indicate to appropriate crewmembers the generating system quantities essential for the safe operation of the system, such as the voltage and current supplied by each generator.
- (c) *External power.* If provisions are made for connecting external power to the rotorcraft, and that external power can be electrically connected to equipment other than that used for engine starting, means must be provided to ensure that no external power supply having a reverse polarity, or a reverse phase sequence, can supply power to the rotorcraft's electrical system.
- (d) *Operation with the normal electrical power generating system inoperative.*
- (1) It must be shown by analysis, tests, or both, that the rotorcraft can be operated safely in VFR conditions for a period of not less than 5 minutes, with the normal electrical power generating system (electrical power sources excluding the battery) inoperative, with critical type fuel (from the standpoint of flameout and restart capability), and with the rotorcraft initially at the maximum certificated altitude. Parts of the electrical system may remain on if—
 - (i) A single malfunction, including a wire bundle or junction box fire, cannot result in loss of the part turned off and the part turned on ;
 - (ii) The parts turned on are electrically and mechanically isolated from the parts turned off ; and]
 - (2) Additional requirements for Category A Rotorcraft.
 - (i) Unless it can be shown that the loss of normal electrical power generating system is extremely improbable, an emergency electrical power system, independent of the normal electrical power generating system, must be provided, with sufficient capacity to power all systems necessary for continued safe flight and landing.
 - (ii) Failures, including junction box, control panel, or wire bundle fires, which would result in the loss of the normal and emergency systems, must be shown to be extremely improbable.
 - (iii) Systems necessary for immediate safety must continue to operate following the loss of the normal electrical power generating system, without the need for flight crew action.

Amdt. 29-42, EF. 9/8/98

- (3) Each powerplant and auxiliary power unit instrument that utilizes flammable fluids must be installed and located so that the escape of fluid would not create a hazard.

- (b) *Fuel quantity indicator.* There must be means to indicate to the flight crewmembers the quantity, in gallons or equivalent units, or usable fuel in each tank during flight. In addition—

- (1) Each fuel quantity indicator must be calibrated to read "zero" during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under Sec. 29.959 ;
- (2) When two or more tanks are closely interconnected by a gravity feed system and vented, and when it is impossible to feed from each tank separately, at least one fuel quantity indicator must be installed ;
- (3) Tanks with interconnected outlets and airspaces may be treated as one tank and need not have separate indicators ; and
- (4) Each exposed sight gauge used as a fuel quantity indicator must be protected against damage.

- (c) *Fuel flowmeter system.* If a fuel flowmeter system is installed, each metering component must have a means for bypassing the fuel supply if malfunction of that component severely restricts fuel flow.

- (d) *Oil quantity indicator.* There must be a stick gauge or equivalent means to indicate the quantity of oil—

- (1) In each tank, and
- (2) In each transmission gearbox.

- (e) [Rotor drive system transmissions and gearboxes utilizing ferromagnetic materials must be equipped with chip detectors designed to indicate the presence of ferromagnetic particles resulting from damage or excessive wear within the transmission or gearbox. Each chip detector must—

- (1) Be designed to provide a signal to the indicator required by Sec. 29.1305(a)(22) ; and
- (2) Be provided with a means to allow crewmembers to check, in flight, the function of each detector electrical circuit and signal.]

Amdt. 29-26, Eff. 10/3/88

76.3 Electrical Systems and Equipment

FAR 29.1351 : General.

- (a) *Electrical system capacity.* The required generating capacity and the number and kind of power sources must—

- (1) Be determined by an electrical load analysis ; and
- (2) Meet the requirements of Sec. 29.1309.

- (b) *Generating system.* The generating system includes electrical power sources, main power buses, transmission cables, and associated control, regulation, and protective devices. It must be designed so that—

- (1) Fires caused by a system or equipment failure, malfunction, or defect.
 - (2) An engine exhaust system failure, malfunction, or defect which causes damage to the engine, adjacent aircraft structure, equipment, or components.
 - (3) The accumulation or circulation of toxic or noxious gases in the crew compartment or passenger cabin.
 - (4) A malfunction, failure, or defect of a propeller control system.
 - (5) A propeller or rotorcraft hub or blade structural failure.
 - (6) Flammable fluid leakage in areas where an ignition source normally exists.
 - (7) A brake system failure caused by structural or material failure during operation.
 - (8) A significant aircraft primary structural defect or failure caused by any autogenous condition (fatigue, understrength, corrosion, etc.).
 - (9) Any abnormal vibration or buffeting caused by a structural or system malfunction, defect, or failure.
 - (10) An engine failure.
 - (11) Any structural or flight control system malfunction, defect, or failure which causes an interference with normal control of the aircraft or which derogates the flying qualities.
 - (12) A complete loss of more than one electrical power generating system or hydraulic power system during a given operation of the aircraft.
 - (13) A failure or malfunction of more than one attitude, airspeed, or altitude instrument during a given operation of the aircraft.
- (d) The requirements of paragraph (a) of this section do not apply to—
- (1) Failures, malfunctions or defects that the holder of a Type Certificate (including a Supplemental Type Certificate), Parts Manufacturer Approval (PMA), or TSO authorization, or the licensee of a Type Certificate—
 - (i) Determines were caused by improper maintenance, or improper usage ;
 - (ii) Knows were reported to the FAA by another person under the Federal Aviation Regulations ; or
 - (iii) Has already reported under the accident reporting provisions of Part 430 of the regulations of the National Transportation Safety Board.
 - (2) Failures, malfunctions or defects in products, parts, or articles manufactured by a foreign manufacturer under a U.S. Type Certificate issued under Sec. 21.29 or Sec. 21.617, or exported to the United States under Sec. 21.502.
- (e) Each report required by this section—
- (1) Shall be made to the [Aircraft Certification Office] in the region in which the person required to make the report is located within 24 hours after it has determined that the failure, malfunction, or defect required to be reported has occurred. However, a report that is due on a Saturday or a Sunday may be delivered on the following Monday and one that is due on a holiday may be delivered on the next workday ;
 - (2) Shall be transmitted in a manner and form acceptable to the Administrator and by the most expeditious method available ; and

(3) Shall include as much of the following information as is available and applicable :

- (i) Aircraft serial number.
- (ii) When the failure, malfunction, or defect is associated with an article approved under a TSO authorization, the article serial number and model designation, as appropriate.
- (iii) When the failure, malfunction, or defect is associated with an engine or propeller, the engine or propeller serial number, as appropriate.
- (iv) Product model.
- (v) Identification of the part, component, or system involved. The identification must include the part number.
- (vi) Nature of the failure, malfunction, or defect.

(f) Whenever the investigation of an accident or service difficulty report shows that an article manufactured under a TSO authorization is unsafe because of a manufacturing or design defect, the manufacturer shall, upon request of the Administrator, report to the Administrator the results of its investigation and any action taken or proposed by the manufacturer to correct that defect. If action is required to correct the defect in existing articles, the manufacturer shall submit the data necessary for the issuance of an appropriate airworthiness directive to the Manager of the Aircraft Certification Office for the geographic area] in which it is located.

Amdt. 21-67, Eff. 10/25/89

FAR 21.5 : [Airplane or Rotorcraft Flight Manual.]

(a) [With each airplane or rotorcraft that was not type certificated with an Airplane or Rotorcraft Flight Manual and that has had no flight time prior to March 1, 1979, the holder of a Type Certificate (including a Supplemental Type Certificate) or the licensee of a Type Certificate shall make available to the owner at the time of delivery of the aircraft a current approved Airplane or Rotorcraft Flight Manual.

(b) The Airplane or Rotorcraft Flight Manual required by paragraph (a) of this section must contain the following information :

- (1) The operating limitations and information required to be furnished in an Airplane or Rotorcraft Flight Manual or in manual material, markings, and placards, by the applicable regulations under which the airplane or rotorcraft was type certificated.
- (2) The maximum ambient atmospheric temperature for which engine cooling was demonstrated must be stated in the performance information section of the Flight Manual, if the applicable regulations under which the aircraft was type certificated do not require ambient temperature or engine cooling operating limitations in the Flight Manual.]

Amdt. 21-46, Eff. 3/1/78

(3) [A visual means integral with each instrument to indicate when the power adequate to sustain proper instrument performance is not being supplied. The power must be measured at or near the point where it enters the instrument. For electrical instruments, the power is considered to be adequate when the voltage is within the approved limits; and]

(b) The installation and power supply system must be such that failure of any flight instrument connected to one source, or of the energy supply from one source, or a fault in any part of the power distribution system does not interfere with the proper supply of energy from any other source.

Amdt. 29-24, Eff. 12/6/84

FAR 29.1333 : Instrument systems.

[For systems that operate the required flight instruments which are located at each pilot's station, the following apply :

- (a) Only the required flight instruments for the first pilot may be connected to that operating system.
- (b) The equipment, systems, and installations must be designed so that one display of the information essential to the safety of flight which is provided by the flight instruments remains available to a pilot, without additional crewmember action, after any single failure or combination of failures that are not shown to be extremely improbable.
- (c) Additional instruments, systems, or equipment may not be connected to the operating system for a second pilot unless provisions are made to ensure the continued normal functioning of the required flight instruments in the event of any malfunction of the additional instruments, systems, or equipment which is not shown to be extremely improbable.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.1335 : [Flight director systems.]

[If a flight director system is installed, means must be provided to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.]

Amdt. 29-14, Eff. 9/1/77

FAR 29.1337 : Powerplant instruments.

(a) *Instruments and instrument lines.*

- (1) Each powerplant and auxiliary power unit instrument line must meet the requirements of Secs. 29.993 and 29.1183.
- (2) Each line carrying flammable fluids under pressure must—
 - (i) Have restricting orifices or other safety devices at the source of pressure to prevent the escape of excessive fluid if the line fails; and
 - (ii) Be installed and located so that the escape of fluids would not create a hazard.

- (1) When either source is selected, the other is blocked off; and
- (2) Both sources cannot be blocked off simultaneously.
- (h) For unpressurized rotorcraft, paragraph (g)(1) of this section does not apply if it can be demonstrated that the static pressure system calibration, when either static pressure source is selected, is not changed by the other static pressure source being open or blocked.

Amdt. 29-24, Eff. 12/6/84

FAR 29.1327 : Magnetic direction indicator.

- (a) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the rotorcraft's vibration or magnetic fields.
- (b) The compensated installation may not have a deviation, in level flight, greater than 10 degrees on any heading.

FAR 29.1329 : Automatic pilot system.

- (a) Each automatic pilot system must be designed so that the automatic pilot can—
 - (1) Be sufficiently overpowered by one pilot to allow control of the rotorcraft; and
 - (2) Be readily and positively disengaged by each pilot to prevent it from interfering with the control of the rotorcraft.
- (b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.
- (c) Each manually operated control for the system's operation must be readily accessible to the pilots.
- (d) The system must be designed and adjusted so that, within the range of adjustment available to the pilot, it cannot produce hazardous deviations in the flight path, under any flight condition appropriate to its use, either during normal operation or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.
- (e) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation.
- (f) [If the automatic pilot system can be coupled to airborne navigation equipment, means must be provided to indicate to the pilots the current mode of operation. Selector switch position is not acceptable as a means of indication.]

Amdt. 29-42, Eff. 9/8/98

FAR 29.1331 : Instruments using a power supply.

For category A rotorcraft—

- (a) Each required flight instrument using a power supply must have—
 - (1) Two independent sources of power;
 - (2) A means of selecting either power source; and

Chapitre 14

Subpart B—Type Certificates

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FAR 21.11 : Applicability.

This subpart prescribes—

- (a) Procedural requirements for the issue of type certificates for aircraft, aircraft engines, and propellers; and
- (b) Rules governing the holders of those certificates.

FAR 21.13 : Eligibility.

[Any interested person may apply for a type certificate.]

Amdt. 21-25, Eff. 10/5/69

FAR 21.15 : Application for type certificate.

- (a) An application for a type certificate is made on a form and in a manner prescribed by the Administrator and is submitted to the appropriate [Aircraft Certification Office].
- (b) An application for an aircraft type certificate must be accompanied by a three-view drawing of that aircraft and available preliminary basic data.
- (c) An application for an aircraft engine type certificate must be accompanied by a description of the engine design features, the engine operating characteristics, and the proposed engine operating limitations.

Amdt. 21-67, Eff. 10/25/89

FAR 21.16 : Special conditions.

[If the Administrator finds that the airworthiness regulations of this subchapter do not contain adequate or appropriate safety standards for an aircraft, aircraft engine, or propeller because of a novel or unusual design feature of the aircraft, aircraft engine or propeller, he prescribes special conditions and amendments thereto for the product. The special conditions are issued in accordance with Part 11 of this chapter and contain such safety standards for the aircraft, aircraft engine or propeller as the Administrator finds necessary to establish a level of safety equivalent to that established in the regulations.]

Amdt. 21-51, Eff. 10/14/80

FAR 21.17 : Designation of applicable regulations.

- (a) Except as provided in Sec. 23.2, Sec. 25.2, Sec. 27.2, Sec. 29.2, and in parts 34 and 36 of this chapter, an applicant for a type certificate must show that the aircraft, aircraft engine, or propeller concerned meets—
 - (1) The applicable requirements of this subchapter that are effective on the date of application for that certificate unless—
 - (i) Otherwise specified by the Administrator; or
 - (ii) Compliance with later effective amendments is elected or required under this section; and
 - (2) Any special conditions prescribed by the Administrator.

- (ii) Avoidance of the critical areas of the height-velocity envelope as established under Sec. 29.87.

(c) For Category A rotorcraft—

- (1) The indication must allow consistent definition of the [takeoff] decision point; and
- (2) The system error, excluding the airspeed instrument calibration error, may not exceed—
 - (i) Three percent or 5 knots, whichever is greater, in level flight at speeds above 80 percent of takeoff safety speed; and
 - (ii) Ten knots in climb at speeds from 10 knots below takeoff safety speed to 10 knots above V_Y.
- (d) For Category B rotorcraft, the system error, excluding the airspeed instrument calibration error, may not exceed 3 percent or 5 knots, whichever is greater, in level flight at speeds above 80 percent of the climbout speed attained at 50 feet when complying with Sec. 29.63.
- (e) Each system must be arranged, so far as practicable, to prevent malfunction or serious error due to the entry of moisture, dirt, or other substances.
- (f) Each system must have a heated pilot tube or an equivalent means of preventing malfunction due to icing.

Amdt. 29-44, Eff. 11/17/99

FAR 29.1325 : Static pressure and pressure altimeter systems.

- (a) Each instrument with static air case connections must be vented to the outside atmosphere through an appropriate piping system.
- (b) Each vent must be located where its orifices are least affected by airflow variation, moisture, or other foreign matter.
- (c) Each static pressure port must be designed and located in such manner that the correlation between air pressure in the static pressure system and true ambient atmospheric static pressure is not altered when the rotorcraft encounters icing conditions. An anti-icing means or an alternate source of static pressure may be used in showing compliance with this requirement. If the reading of the altimeter, when on the alternate static pressure system, differs from the reading of the altimeter when on the primary static system by more than 50 feet, a correction card must be provided for the alternate static system.
- (d) Except for the vent into the atmosphere, each system must be airtight.
- (e) Each pressure altimeter must be approved and calibrated to indicate pressure altitude in a standard atmosphere with a minimum practicable calibration error when the corresponding static pressures are applied.
- (f) [Each system must be designed and installed so that an error in indicated pressure altitude, at sea level, with a standard atmosphere, excluding instrument calibration error, does not result in an error of more than ± 30 feet per 100 knots speed. However, the error need not be less than ± 30 feet.]
- (g) Except as provided in paragraph (h) of this section, if the static pressure system incorporates both a primary and an alternate static pressure source, the means for selecting one or the other source must be designed so that—

- (3) The instrument that most effectively indicates airspeed must be adjacent to and to the left of the attitude instrument ; and
- (4) The instrument that most effectively indicates altitude or is most frequently utilized in control of altitude must be adjacent to and to the right of the attitude instrument.]
- (c) Other required powerplant instruments must be closely grouped on the instrument panel.
- (d) Identical powerplant instruments for the engines must be located so as to prevent any confusion as to which engine each instrument relates.
- (e) Each powerplant instrument vital to safe operation must be plainly visible to appropriate crewmembers.
- (f) Instrument panel vibration may not damage, or impair the readability or accuracy of, any instrument.
- (g) If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.

Amdt. 29-21, Eff. 3/2/83

76.2 Instruments : Installation

FAR 29.1322 : Warning, caution, and advisory lights.

[If warning, caution or advisory lights are installed in the cockpit they must, unless otherwise approved by the Administrator, be—

- (a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action) ;
- (b) Amber, for caution lights (lights indicating the possible need for future corrective action) ;
- (c) Green, for safe operation lights ; and
- (d) Any other color, including white, for lights not described in paragraphs (a) through (c) of this section, provided the color differs sufficiently from the colors prescribed in paragraphs (a) through (c) of this section to avoid possible confusion.]

Amdt. 29-12, Eff. 2/1/77

FAR 29.1323 : Airspeed indicating system.

For each airspeed indicating system, the following apply :

- (a) Each airspeed instrument must be calibrated to indicate true airspeed (at sea level with a standard atmosphere) with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied.
- (b) Each system must be calibrated to determine system error excluding airspeed instrument error. This calibration must be determined—
 - (1) In level flight at speeds of 20 knots and greater, and over an appropriate range of speeds for flight conditions of climb and autorotation ; and
 - (2) During takeoff, with repeatable and readable indications that ensure—
- (i) Consistent realization of the field lengths specified in the Rotorcraft Flight Manual ; and

- (b) For special classes of aircraft, including the engines and propellers installed thereon (e.g., gliders, airships, and other nonconventional aircraft), for which airworthiness standards have not been issued under this subchapter, the applicable requirements will be the portions of those other airworthiness requirements contained in Parts 23, 25, 27, 29, 31, 33, and 35 found by the Administrator to be appropriate for the aircraft and applicable to a specific type design, or such airworthiness criteria as the Administrator may find provide an equivalent level of safety to those parts.
- (c) An application for type certification of a transport category aircraft is effective for five years and an application for any other type certificate is effective for three years, unless an applicant shows at the time of application that his product requires a longer period of time for design, development, and testing, and the Administrator approves a longer period.

- (d) In a case where a type certificate has not been issued, or it is clear that a type certificate will not be issued, within the time limit established under paragraph (c) of this section, the applicant may—

- (1) File a new application for a type certificate and comply with all the provisions of paragraph (a) applicable to an original application ; or
- (2) File for an extension of the original application and comply with the applicable airworthiness requirements of this subchapter that were effective on a date, to be selected by the applicant, not earlier than the date which precedes the date of issue of the type certificate by the time limit established under paragraph (c) for the original application.

- (e) If an applicant elects to comply with an amendment to this subchapter that is effective after the filing of the application for a type certificate, he must also comply with any other amendment that the Administrator finds is directly related.

- (f) [For primary category aircraft, the requirements are :

- (1) The applicable airworthiness requirements contained in parts 23, 27, 31, 33, and 35 of this subchapter, or such other airworthiness criteria as the Administrator may find appropriate and applicable to the specific design and intended use and provide a level of safety acceptable to the Administrator.
- (2) The noise standards of part 36 applicable to primary category aircraft.]

Amdt. 21-70, Eff. 12/31/92

FAR 21.19 : Changes requiring a new type certificate.

[Each person who proposes to change a product must apply for a new type certificate if the Administrator finds that the proposed change in design, power, thrust, or weight is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.]

Amdt. 21-77, Eff. 6/10/2003

FAR 21.21 : Issue of type certificate : normal, utility, acrobatic, commuter, and transport category aircraft ; manned free balloons ; special classes of aircraft ; aircraft engines ; propellers.

An applicant is entitled to a type certificate for an aircraft in the normal, utility, acrobatic, commuter, or transport category, or for a manned free balloon, special class of aircraft, or an aircraft engine or propeller, if—

- (a) The product qualifies under Sec. 21.27 ; or
- (b) The applicant submits the type design, test reports, and computations necessary to show that the product to be certificated meets the applicable [airworthiness, aircraft noise, fuel venting, and exhaust emission] requirements of the Federal Aviation Regulations and any special conditions prescribed by the Administrator, and the Administrator finds—
 - (1) Upon examination of the type design, and after completing all tests and inspections, that the type design and the product meet the applicable [noise, fuel venting, and emissions] requirements of the Federal Aviation Regulations, and further finds that they meet the applicable airworthiness requirements of the Federal Aviation Regulations or that any airworthiness provisions not complied with are compensated for by factors that provide an equivalent level of safety ; and
 - (2) For an aircraft, that no feature or characteristic makes it unsafe for the category in which certification is requested.

Amdt. 21-68, Eff. 9/10/90

FAR 21.23 : [Reserved.]

[Reserved.]

Amdt. 21-60, Eff. 4/13/87

FAR 21.24 : Issuance of type certificate : [Primary] category aircraft.

- (a) The applicant is entitled to a type certificate for an aircraft in the primary category if—
 - (1) The aircraft—
 - (i) Is unpowered ; is an airplane powered by a single, naturally aspirated engine with a 61-knot or less V_{SO} stall speed as defined in Sec. 23.49 ; or is a rotorcraft with a 6-pound per square foot main rotor disc loading limitation, under sea level standard day conditions ;
 - (ii) Weighs not more than 2,700 pounds ; or, for seaplanes, not more than 3,375 pounds ;
 - (iii) Has a maximum seating capacity of not more than four persons, including the pilot ; and
 - (iv) Has an unpressurized cabin.
 - (2) The applicant has submitted—
 - (i) Except as provided by paragraph (c), a statement, in a form and manner acceptable to the Administrator, certifying that : the applicant has completed the engineering analysis necessary to demonstrate compliance with the applicable airworthiness requirements ; the applicant has conducted appropriate flight, structural, propulsion, and systems tests necessary to show that the aircraft, its components, and its equipment are reliable and function properly ; the type design complies with the airworthiness standards and noise requirements established for the aircraft under Sec. 21.17(f) ; and no feature or characteristic makes it unsafe for its intended use ;

- (3) The resulting effects on the rotorcraft and occupants, considering the stage of flight and operating conditions ; and
- (4) The crew warning cues, corrective action required, and the capability of detecting faults.
- (e) For Category A rotorcraft, each installation whose functioning is required by this subchapter and which requires a power supply is an "essential load" on the power supply. The power sources and the system must be able to supply the following power loads in probable operating combinations and for probable durations :
 - (1) Loads connected to the system with the system functioning normally.
 - (2) Essential loads, after failure of any one prime mover, power converter, or energy storage device.
 - (3) Essential loads, after failure of—
 - (i) Any one engine, on rotorcraft with two engines ; and
 - (ii) Any two engines, on rotorcraft with three or more engines.
- (f) In determining compliance with paragraphs (e)(2) and (3) of this section, the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operations authorized. Loads not required for controlled flight need not be considered for the two-engine-inoperative condition on rotorcraft with three or more engines.
- (g) In showing compliance with paragraphs (a) and (b) of this section with regard to the electrical system and to equipment design and installation, critical environmental conditions must be considered. For electrical generation, distribution, and utilization equipment required by or used in complying with this subchapter, except equipment covered by Technical Standard Orders containing environmental test procedures, the ability to provide continuous, safe service under foreseeable environmental conditions may be shown by environmental tests, design analysis, or reference to previous comparable service experience on other aircraft.
- (h) [In showing compliance with paragraphs (a) and (b) of this section, the effects of lightning strikes on the rotorcraft must be considered.]

Amdt. 29-40, Eff. 8/8/96

FAR 29.1321 : Arrangement and visibility.

- (a) Each flight, navigation, and powerplant instrument for use by any pilot must be easily visible to him from his station with the minimum practicable deviation from his normal position and line of vision when he is looking forward along the flight path.
- (b) [Each instrument necessary for safe operation, including the airspeed indicator, gyroscopic direction indicator, gyroscopic bank-and-pitch indicator, slip-skid indicator, altimeter, rate-of-climb indicator, rotor tachometers, and the indicator most representative of engine power, must be grouped and centered as nearly as practicable about the vertical plane of the pilot's forward vision. In addition, for rotorcraft approved for IFR flight—
 - (1) The instrument that most effectively indicates attitude must be on the panel in the top center position ;
 - (2) The instrument that most effectively indicates direction of flight must be adjacent to and directly below the attitude instrument ;

(2) An independent fuel pressure warning device for each engine or a master warning device for all engines with provision for isolating the individual warning device from the master warning device;

(3) Fire warning indicators.

(c) For category B rotorcraft—

(1) An individual oil pressure indicator for each engine; and

(2) Fire warning indicators, when fire detection is required.

Amdt. 29-40, Eff. 8/8/96

FAR 29.1307 : Miscellaneous equipment.

The following is required miscellaneous equipment :

(a) An approved seat for each occupant.

(b) A master switch arrangement for electrical circuits other than ignition.

(c) Hand fire extinguishers.

(d) A windshield wiper or equivalent device for each pilot station.

(e) A two-way radio communication system.

Amdt. 29-12, Eff. 2/1/77

FAR 29.1309 : Equipment, systems, and installations.

(a) The equipment, systems, and installations whose functioning is required by this subchapter must be designed and installed to ensure that they perform their intended functions under any foreseeable operating condition.

(b) The rotorcraft systems and associated components, considered separately and in relation to other systems, must be designed so that—

(1) For Category B rotorcraft, the equipment, systems, and installations must be designed to prevent hazards to the rotorcraft if they malfunction or fail ; or

(2) For Category A rotorcraft—

(i) The occurrence of any failure condition which would prevent the continued safe flight and landing of the rotorcraft is extremely improbable; and

(ii) The occurrence of any other failure conditions which would reduce the capability of the rotorcraft or the ability of the crew to cope with adverse operating conditions is improbable.

(c) Warning information must be provided to alert the crew to unsafe system operating conditions and to enable them to take appropriate corrective action. Systems, controls, and associated monitoring and warning means must be designed to minimize crew errors which could create additional hazards.

(d) Compliance with the requirements of paragraph (b)(2) of this section must be shown by analysis and, where necessary, by appropriate ground, flight, or simulator tests. The analysis must consider—

(1) Possible modes of failure, including malfunctions and damage from external sources ;

(2) The probability of multiple failures and undetected failures ;

(ii) The flight manual required by Sec. 21.5(b), including any information required to be furnished by the applicable airworthiness standards ;

(iii) Instructions for continued airworthiness in accordance with Sec. 21.50(b) ; and

(iv) A report that : summarizes how compliance with each provision of the type certification basis was determined ; lists the specific documents in which the type certification data information is provided ; lists all necessary drawings and documents used to define the type design ; and lists all the engineering reports on tests and computations that the applicant must retain and make available under Sec. 21.49 to substantiate compliance with the applicable airworthiness standards.

(3) The Administrator finds that—

(i) The aircraft complies with those applicable airworthiness requirements approved under Sec. 21.17(f) of this part ; and

(ii) The aircraft has no feature or characteristic that makes it unsafe for its intended use.

(b) An applicant may include a special inspection and preventive maintenance program as part of the aircraft's type design or supplemental type design.

(c) For aircraft manufactured outside of the United States in a country with which the United States has a bilateral airworthiness agreement for the acceptance of these aircraft, and from which the aircraft is to be imported into the United States—

(1) The statement required by paragraph (a)(2)(i) of this section must be made by the civil airworthiness authority of the exporting country ; and

(2) The required manuals, placards, listings, instrument markings, and documents required by paragraphs (a) and (b) of this section must be submitted in English.

Amdt. 21-75, Eff. 2/23/98

FAR 21.25 : Issue of type certificate : restricted category aircraft.

(a) [An applicant is entitled to a type certificate for an aircraft in the restricted category for special purpose operations if he shows compliance with the applicable noise requirements of Part 36 of this chapter, and if he shows that no feature or characteristic of the aircraft makes it unsafe when it is operated under the limitations prescribed for its intended use, and that the aircraft—]

(1) Meets the airworthiness requirements of an aircraft category except those requirements that the Administrator finds inappropriate for the special purpose for which the aircraft is to be used ; or

(2) Is of a type that has been manufactured in accordance with the requirements of and accepted for use by, an Armed Force of the United States and has been later modified for a special purpose.

(b) For the purposes of this section, "special purpose operations" includes—

(1) Agricultural (spraying, dusting, and seeding, and livestock and predatory animal control) ;

(2) Forest and wildlife conservation ;

(3) Aerial surveying (photography, mapping, and oil and mineral exploration) ;

- (4) Patrolling (pipelines, power lines, and canals);
- (5) Weather control (cloud seeding);
- (6) Aerial advertising (skywriting, banner towing, airborne signs and public address systems); and
- (7) Any other operation specified by the Administrator.

Amdt. 21-42, Eff. 2/7/75

FAR 21.27 : Issue of type certificate : surplus aircraft of the Armed Forces.

- (a) Except as provided in paragraph (b) of this section, an applicant is entitled to a type certificate for an aircraft in the normal, utility, acrobatic, [commuter] or transport category that was designed and constructed in the United States, accepted for operational use, and declared surplus by, an Armed Force of the United States, and that is shown to comply with the applicable certification requirements in paragraph (f) of this section.
- (b) An applicant is entitled to a type certificate for a surplus aircraft of the Armed Forces of the United States that is a counterpart of a previously type certificated civil aircraft, if he shows compliance with the regulations governing the original civil aircraft type certificate.
- (c) Aircraft engines, propellers, and their related accessories installed in surplus Armed Forces aircraft, for which a type certificate is sought under this section, will be approved for use on those aircraft if the applicant shows that on the basis of the previous military qualifications acceptance, and service record, the product provides substantially the same level of airworthiness as would be provided if the engines or propellers were type certificated under Parts 33 or 35 of the Federal Aviation Regulations.
- (d) The Administrator may relieve an applicant from strict compliance with a specific provision of the applicable requirements in paragraph (f) of this section, if the Administrator finds that the method of compliance proposed by the applicant provides substantially the same level of airworthiness and that strict compliance with those regulations would impose a severe burden on the applicant. The Administrator may use experience that was satisfactory to an Armed Force of the United States in making such a determination.
- (e) The Administrator may require an applicant to comply with special conditions and later requirements than those in paragraphs (c) and (f) of this section, if the Administrator finds that compliance with the listed regulations would not ensure an adequate level of airworthiness for the aircraft.
- (f) Except as provided in paragraphs (b) through (e) of this section, an applicant for a type certificate under this section must comply with the appropriate regulations listed in the following table :

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- [(15)] | A free power turbine tachometer for each turbine engine;
 - [(16)] | A means, for each turbine engine, to indicate power for that engine;
 - [(17)] | For each turbine engine, an indicator to indicate the functioning of the powerplant ice protection system;
 - [(18)] | An indicator for the filter required by Sec. 29.997 to indicate the occurrence of contamination of the filter to the degree established in compliance with Sec. 29.955;
 - [(19)] | For each turbine engine, a warning means for the oil strainer or filter required by Sec. 29.1019, if it has no bypass, to warn the pilot of the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with Sec. 29.1019(a)(2);
 - [(20)] | An indicator to indicate the functioning of any selectable or controllable heater used to prevent ice clogging of fuel system components;
 - [(21)] | An individual fuel pressure indicator for each engine, unless the fuel system which supplies that engine does not employ any pumps, filters, or other components subject to degradation or failure which may adversely affect fuel pressure at the engine;
 - [(22)] | A means to indicate to the flightcrew the failure of any fuel pump installed to show compliance with Sec. 29.955;
 - [(23)] | Warning or caution devices to signal to the flightcrew when ferromagnetic particles are detected by the chip detector required by Sec. 29.1337(e); and
 - [(24)] | For auxiliary power units, an individual indicator, warning or caution device, or other means to advise the flightcrew that limits are being exceeded, if exceeding these limits can be hazardous, for—
 - (i) Gas temperature;
 - (ii) Oil pressure; and
 - (iii) Rotor speed.
 - [(25)] | For rotorcraft for which a 30-second/2-minute OEI power rating is required, a means must be provided to alert the pilot when the engine is at the 30-second and 2-minute OEI power levels, when the event begins, and when the time interval expires.
 - [(26)] | For each turbine engine utilizing 30-second/2-minute OEI power, a device or system must be provided for use by ground personnel which—
 - (i) Automatically records each usage and duration of power at the 30-second and 2-minute OEI levels;
 - (ii) Permits retrieval of the recorded data;
 - (iii) Can be reset only by ground maintenance personnel; and
 - (iv) Has a means to verify proper operation of the system or device.]
- (b) For category A rotorcraft—
- (1) An individual oil pressure indicator for each engine, and either an independent warning device for each engine or a master warning device for the engines with means for isolating the individual warning circuit from the master warning device; and

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- (j) [For Category A rotorcraft, a speed warning device when V_{NE} is less than the speed at which unmistakable overspeed warning is provided by other pilot cues. The speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots whenever the indicated speed exceeds V_{NE} plus 3 knots and must operate satisfactorily throughout the approved range of altitudes and temperatures.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.1305 : Powerplant instruments.

The following are required powerplant instruments :

- (a) For each rotorcraft—

- (1) A carburetor air temperature indicator for each reciprocating engine ;
- (2) A cylinder head temperature indicator for each air-cooled reciprocating engine, and a coolant temperature indicator for each liquid-cooled reciprocating engine ;
- (3) A fuel quantity indicator for each fuel tank ;
- (4) A low fuel warning device for each fuel tank which feeds an engine. This device must—
 - (i) Provide a warning to the crew when approximately 10 minutes of usable fuel remains in the tank ; and
 - (ii) Be independent of the normal fuel quantity indicating system.
- (5) A manifold pressure indicator, for each reciprocating engine of the altitude type ;
- (6) [An oil pressure indicator for each pressure-lubricated gearbox.
- (7)] An oil pressure warning device for each pressure-lubricated gearbox to indicate when the oil pressure falls below a safe value ;
- (8)] An oil quantity indicator for each oil tank and each rotor drive gearbox, if lubricant is self-contained ;
- (9)] An oil temperature indicator for each engine ;
- (10)] An oil temperature warning device to indicate unsafe oil temperatures in each main rotor drive gearbox, including gearboxes necessary for rotor phasing ;
- (11)] A gas temperature indicator for each turbine engine ;
- (12)] A gas producer rotor tachometer for each turbine engine ;
- (13)] A tachometer for each engine that, if combined with the applicable instrument required by paragraph [(a)(14)] of this section, indicates rotor r.p.m. during autorotation.
- (14)] At least one tachometer to indicate, as applicable—
 - (i) The r.p.m. of single main rotor ;
 - (ii) The common r.p.m. of any main rotors whose speeds cannot vary appreciably with respect to each other ; and
 - (iii) The r.p.m. of each main rotor whose speed can vary appreciably with respect to that of another main rotor ;

<i>Type of aircraft</i>	<i>Date accepted for operational use by the Armed Forces of the United States.</i>	<i>Regulations that apply¹.</i>
Small engine powered airplanes	Before May 16, 1956 After May 15, 1956	CAR Part 3, as effective May 15, 1956. CAR Part 3 or FAR Part 23.
Small turbine engine-powered airplanes	Before Oct. 2, 1959 After Oct. 1, 1959	CAR Part 3, as effective Oct. 1, 1959. CAR Part 3 or FAR Part 23.
[Commuter category airplanes] Large reciprocating-engine powered airplanes	[After Feb. 17, 1987] Before Aug. 26, 1955 After Aug. 25, 1955	[FAR Part 23 as of Feb. 17, 1987.] CAR Part 4b, as effective Aug. 25, 1955. CAR Part 4b or FAR Part 25.
Large turbine engine-powered airplanes	Before Oct. 2, 1959 After Oct. 1, 1959	CAR Part 4b, as effective Oct. 1, 1959. CAR Part 4b or FAR Part 25.
Rotorcraft with maximum certificated takeoff weight of : 6,000 pounds or less	Before Oct. 2, 1959 After Oct. 1, 1959	CAR Part 6, as effective Oct. 1, 1959.
Over 6,000 pounds	After Oct. 1, 1959 Before Oct. 2, 1959 After Oct. 1, 1959	CAR Part 6 or FAR Part 27. CAR Part 7, as effective Oct. 1, 1959. CAR Part 7 or FAR Part 29.

¹Where no specific date is listed, the applicable regulations are those in effect on the date that the first aircraft of the particular model was accepted for operational use by the Armed Force.

Amdt. 21-59, Eff. 2/17/87

FAR 21.29 : Issue of type certificate : import products.

- (a) A type certificate may be issued for a product that is manufactured in a foreign country with which the United States has an agreement for the acceptance of these products for export and import and that is to be imported into the United States if—
- (1) The country in which the product was manufactured certifies that the product has been examined, tested, and found to meet—
 - (i) [The applicable aircraft noise, fuel venting and exhaust emissions requirements of this subchapter as designated in Sec. 21.17, or the applicable aircraft noise, fuel venting and exhaust emissions requirements of the country in which the product was manufactured, and any other requirements the

Administrator may prescribe to provide noise, fuel venting and exhaust emission levels no greater than those provided by the applicable aircraft noise, fuel venting, and exhaust emission requirements of this subchapter as designated in Sec. 21.17; and]

- (ii) The applicable airworthiness requirements of this subchapter as designated in Sec. 21.17, or the applicable airworthiness requirements of the country in which the product was manufactured and any other requirements the Administrator may prescribe to provide a level of safety equivalent to that provided by the applicable airworthiness requirements of this subchapter as designated in Sec. 21.17;

- (2) The applicant has submitted the technical data, concerning aircraft noise and airworthiness, respecting the product required by the Administrator; and

- (3) The manuals, placards, listings, and instrument markings required by the applicable airworthiness (and noise, where applicable) requirements are presented in the English language.

- (b) [A product type certificated under this section is considered to be type certificated under the noise standards of part 36, and the fuel venting and exhaust emission standards of part 34, of the Federal Aviation Regulations where compliance therewith is certified under paragraph (a)(1)(i) of this section, and under the airworthiness standards of that part of the Federal Aviation Regulations with which compliance is certified under paragraph (a)(1)(ii) of this section or to which an equivalent level of safety is certified under paragraph (a)(1)(ii) of this section.]

Amdt. 21-68, Eff. 9/10/90

FAR 21.31 : Type design.

The type design consists of—

- (a) The drawings and specifications, and a listing of those drawings and specifications, necessary to define the configuration and the design features of the product shown to comply with the requirements of that part of this subchapter applicable to the product ;

- (b) Information on dimensions, materials, and processes necessary to define the structural strength of the product ;

- (c) The Airworthiness Limitations section of the Instructions for Continued Airworthiness as required by Parts 23, 25, 27, 29, 31, 33, and 35 of this [chapter, or as otherwise required by the Administrator]; and as specified in the applicable airworthiness criteria for special classes of aircraft defined in Sec. 21.17(b); and

- (d) [For primary category aircraft, if desired, a special inspection and preventive maintenance program designed to be accomplished by an appropriately rated and trained pilot-owner.

- (e) Any other data necessary to allow, by comparison, the determination of the airworthiness, noise characteristics, fuel venting, and exhaust emissions (where applicable) of later products of the same type.]

Amdt. 21-70, Eff. 12/31/92

76.1 General

FAR 29.1301 : Function and installation.

Each item of installed equipment must—

- (a) Be of a kind and design appropriate to its intended function;
- (b) Be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors;
- (c) Be installed according to limitations specified for that equipment ; and
- (d) Function properly when installed.

FAR 29.1303 : Flight and navigation instruments.

The following are required flight and navigational instruments :

- (a) [an airspeed indicator. For Category A rotorcraft with V_{NE} less than a speed at which unmistakable pilot cues provide overspeed warning, a maximum allowable airspeed indicator must be provided. If maximum allowable airspeed varies with weight, altitude, temperature, or r.p.m., the indicator must show that variation.]
- (b) A sensitive altimeter.
- (c) A magnetic direction indicator.
- (d) A clock displaying hours, minutes, and seconds with a sweep-second pointer or digital presentation.
- (e) A free-air temperature indicator.
- (f) A non-tumbling gyroscopic bank and pitch indicator.
- (g) A gyroscopic rate-of-turn indicator combined with an integral slip-skid indicator (turn-and-bank indicator) except only a slip-skid indicator is required on rotorcraft with a third attitude instrument system that—
 - (1) Is usable through flight attitudes of ± 80 degrees of pitch and ± 120 degrees of roll ;
 - (2) Is powered from a source independent of the electrical generating system ;
 - (3) Continues reliable operation for a minimum of 30 minutes after total failure of the electrical generating system ;
 - (4) Operates independently of any other attitude indicating system ;
 - (5) Is operative without selection after total failure of the electrical generating system ;
 - (6) Is located on the instrument panel in a position acceptable to the Administrator that will make it plainly visible to and usable by any pilot at his station ; and
 - (7) Is appropriately lighted during all phases of operation.
- (h) A gyroscopic direction indicator.
- (i) A rate-of-climb (vertical speed) indicator.

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FAR 21.33 : Inspection and tests.

(a) Each applicant must allow the Administrator to make any inspection and any flight and ground test necessary to determine compliance with the applicable requirements of the Federal Aviation Regulations. However, unless otherwise authorized by the Administrator—

- (1) No aircraft, aircraft engine, propeller, or part thereof may be presented to the Administrator for test unless compliance with paragraphs (b)(2) through (b)(4) of this section has been shown for that aircraft, aircraft engine, propeller, or part thereof; and
- (2) No change may be made to an aircraft, aircraft engine, propeller, or part thereof between the time that compliance with paragraphs (b)(2) through (b)(4) of this section is shown for that aircraft, aircraft engine, propeller, or part thereof and the time that it is presented to the Administrator for test.

(b) Each applicant must make all inspections and tests necessary to determine—

- (1) Compliance with the applicable [airworthiness, aircraft noise, fuel venting, and exhaust emission] requirements;
- (2) That materials and products conform to the specifications in the type design;
- (3) That parts of the products conform to the drawings in the type design; and
- (4) That the manufacturing processes, construction and assembly conform to those specified in the type design.

Andt. 21-68, Eff. 9/10/90

FAR 21.35 : Flight tests.

(a) Each applicant for an aircraft type certificate (other than under Secs. [21.24] through 21.29) must make the tests listed in paragraph (b) of this section. Before making the tests the applicant must show—

- (1) Compliance with the applicable structural requirements of this subchapter;
- (2) Completion of necessary ground inspections and tests;
- (3) That the aircraft conforms with the type design; and
- (4) That the Administrator received a flight test report from the applicant (signed, in the case of aircraft to be certificated under Part 25 of this chapter, by the applicant's test pilot) containing the results of his tests.

(b) Upon showing compliance with paragraph (a) of this section, the applicant must make all flight tests that the Administrator finds necessary—

- (1) To determine compliance with the applicable requirements of this subchapter; and
- (2) For aircraft to be certificated under this subchapter, except gliders and except airplanes of 6,000 lbs. or less maximum certificated weight that are to be certificated under Part 23 of this chapter, to determine whether there is reasonable assurance that the aircraft, its components, and its equipment are reliable and function properly.

(c) Each applicant must, if practicable, make the tests prescribed in paragraph (b)(2) of this section upon the aircraft that was used to show compliance with—

- (1) Paragraph (b)(1) of this section; and

- (2) For rotorcraft, the rotor drive endurance tests prescribed in Sec. 27.923 or Sec. 29.923 of this chapter, as applicable.
- (d) Each applicant must show for each flight test (except in a glider or a manned free balloon) that adequate provision is made for the flight test crew for emergency egress and the use of parachutes.
- (e) Except in gliders and manned free balloons, an applicant must discontinue flight tests under this section until he shows that corrective action has been taken, whenever—
 - (1) The applicant's test pilot is unable or unwilling to make any of the required flight tests ; or
 - (2) Items of noncompliance with requirements are found that may make additional test data meaningless or that would make further testing unduly hazardous.
- (f) The flight tests prescribed in paragraph (b)(2) of this section must include—
 - (1) For aircraft incorporating turbine engines of a type not previously used in a type certificated aircraft, at least 300 hours of operation with a full complement of engines that conform to a type certificate ; and
 - (2) For all other aircraft, at least 150 hours of operation.

Amdt. 21-70, Eff. 12/31/92

FAR 21.37 : Flight test pilot.

Each applicant for a normal, utility, acrobatic, [commuter] or transport category aircraft type certificate must provide a person holding an appropriate pilot certificate to make the flight tests required by this part.

Amdt. 21-59, Eff. 2/17/87

FAR 21.39 : Flight test instrument calibration and correction report.

- (a) Each applicant for a normal, utility, acrobatic, [commuter] or transport category aircraft type certificate must submit a report to the Administrator showing the computations and tests required in connection with the calibration of instruments used for test purposes and in the correction of test results to standard atmospheric conditions.
- (b) Each applicant must allow the Administrator to conduct any flight tests that he finds necessary to check the accuracy of the report submitted under paragraph (a) of this section.

Amdt. 21-59, Eff. 2/17/87

FAR 21.41 : Type certificate.

Each type certificate is considered to include the type design, the operating limitations, the certificate data sheet, the applicable regulations of this subchapter with which the Administrator records compliance, and any other conditions or limitations prescribed for the product in this subchapter.

FAR 21.43 : Location of manufacturing facilities.

Except as provided in Sec. 21.29, the Administrator does not issue a type certificate if the manufacturing facilities for the product are located outside of the United States, unless the Administrator finds that the location of the manufacturer's facilities places no undue burden on the FAA in administering applicable airworthiness requirements.

Chapitre 76

Subpart F : Equipment

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FAR 21.45 : Privileges.

The holder or licensee of a type certificate for a product may—

- (a) In the case of aircraft, upon compliance with Secs. 21.173 through 21.189, obtain airworthiness certificates ;
- (b) In the case of aircraft engines, or propellers, obtain approval for installation on certified aircraft ; and
- (c) In the case of any product, upon compliance with Secs. 21.133 through 21.163, obtain a production certificate for the type certificated product.
- (d) Obtain approval of replacement parts for that product.

FAR 21.47 : Transferability.

A type certificate may be transferred to or made available to third persons by licensing agreements. Each grantor shall, within 30 days after the transfer of a certificate or execution or termination of a licensing agreement, notify in writing the appropriate [Aircraft Certification Office]. The notification must state the name and address of the transferee or licensee, date of the transaction, and in the case of a licensing agreement, the extent of authority granted the licensee.
Amdt. 21-67, Eff. 10/25/89

FAR 21.49 : Availability.

The holder of a type certificate shall make the certificate available for examination upon the request of the Administrator or the [National Transportation Safety Board.]
Amdt. 21-15A, Eff. 4/1/67

FAR 21.50 : Instructions for Continued Airworthiness and Manufacturer's Maintenance Manuals having Airworthiness Limitations sections.

- (a) The holder of a type certificate for a rotorcraft for which a Rotorcraft Maintenance Manual containing an "Airworthiness Limitations" section has been issued under Sec. 27.1529 (a)(2) or Sec. 29.1529 (a)(2), and who obtains approval of changes to any replacement time, inspection interval, or related procedure in that section of the manual, shall make those changes available upon request to any operator of the same type of rotorcraft.
- (b) [The holder of design approval, including either the type certificate or supplemental type certificate for an aircraft, aircraft engine, or propeller for which application was made after January 28, 1981, shall furnish at least one set of complete Instructions for Continued Airworthiness, prepared in accordance with Secs. 23.1529, 25.1529, 27.1529, 29.1529, 31.82, 33.4, or 35.4 of this chapter, or as specified in the applicable airworthiness criteria for special classes of aircraft defined in Sec. 21.17(b), as applicable, to the owner of each type aircraft, aircraft engine, or propeller upon its delivery, or upon issuance of the first standard airworthiness certificate of airworthiness for the affected aircraft, whichever occurs later, and thereafter make those instructions available to any other person required by this chapter to comply with any of the terms of those instructions. In addition, changes to the Instructions for Continued Airworthiness shall be made available to any person required by this chapter to comply with any of those instructions.]
Amdt. 21-60, Eff. 4/13/87

FAR 21.51 : Duration.

A type certificate is effective until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator.

FAR 21.53 : Statement of conformity.

- (a) [Each applicant must submit a statement of conformity (FAA Form 317) to the Administrator for each aircraft engine and propeller presented to the Administrator for type certification. This statement of conformity must include a statement that the aircraft engine or propeller conforms to the type design therefor.
- (b) Each applicant must submit a statement of conformity to the Administrator for each aircraft or part thereof presented to the Administrator for tests. This statement of conformity must include a statement that the applicant has complied with Sec. 21.33(a) (unless otherwise authorized under that paragraph).]

Amdt. 21-17, Eff. 1/26/68

FAR 29.1201 : Fire extinguishing system materials.

- (a) No materials in any fire extinguishing system may react chemically with any extinguishing agent so as to create a hazard.
- (b) Each system component in an engine compartment must be fireproof.

FAR 29.1203 : Fire detector systems.

- (a) [For each turbine engine powered rotorcraft and Category A reciprocating engine powered rotorcraft, and for each Category B reciprocating engine powered rotorcraft with engines of more than 900 cubic inches displacement, there must be approved, quick-acting fire detectors in designated fire zones and in the combustor, turbine, and tailpipe sections of turbine installations (whether or not such sections are designated fire zones) in numbers and locations ensuring prompt detection of fire in those zones.]
- (b) Each fire detector must be constructed and installed to withstand any vibration, inertia, and other loads to which it would be subjected in operation.
- (c) No fire detector may be affected by any oil, water, other fluids, or fumes that might be present.
- (d) There must be means to allow crewmembers to check, in flight, the functioning of each fire detector system electrical circuit.
- (e) The wiring and other components of each fire detector system in an engine compartment must be at least fire resistant.
- (f) No fire detector system component for any fire zone may pass through another fire zone, unless—
 - (1) It is protected against the possibility of false warnings resulting from fires in zones through which it passes; or
 - (2) The zones involved are simultaneously protected by the same detector and extinguishing systems.

Amdt. 29-3, Eff. 2/25/68

- (b) For multiengine powered rotorcraft, the fire extinguishing system, the quantity of extinguishing agent, and the rate of discharge must—
- (1) For each auxiliary power unit and combustion equipment, provide at least one adequate discharge; and
- (2) For each other designated fire zone, provide two adequate discharges.
- (c) For single engine rotorcraft, the quantity of extinguishing agent and the rate of discharge must provide at least one adequate discharge for the engine compartment.
- (d) [It must be shown by either actual or simulated flight tests that under critical airflow conditions in flight the discharge of the extinguishing agent in each designated fire zone will provide an agent concentration capable of extinguishing fires in that zone and of minimizing the probability of reignition.]

Amdt. 29-17, Eff. 12/1/78

FAR 29.1197 : Fire extinguishing agents.

- (a) Fire extinguishing agents must—
- (1) Be capable of extinguishing flames emanating from any burning of fluids or other combustible materials in the are protected by the fire extinguishing system ; and
- (2) Have thermal stability over the temperature range likely to be experienced in the compartment in which they are stored.
- (b) [If any toxic extinguishing agent is used it must be shown by test that entry of harmful concentrations of fluid or fluid vapors into any personnel compartment (due to leakage during normal operation of the rotorcraft, or discharge on the ground or in flight) is prevented, even though a defect may exist in the extinguishing system.

- (c) [Deleted.]

Amdt. 29-13, Eff. 5/2/77

FAR 29.1199 : Extinguishing agent containers.

- (a) Each extinguishing agent container must have a pressure relief to prevent bursting of the container by excessive internal pressures.
- (b) [The discharge end of each discharge line from a pressure relief connection must be located so that discharge of the fire extinguishing agent would not damage the rotorcraft. The line must also be located or protected to prevent clogging caused by ice or other foreign matter.
- (c) There must be a means for each fire extinguishing agent container to indicate that the container has discharged or that the charging pressure is below the established minimum necessary for proper functioning.]
- (d) The temperature of each container must be maintained, under intended operating conditions, to prevent the pressure in the container from—
- (1) Falling below that necessary to provide an adequate rate of discharge ; or
- (2) Rising high enough to cause premature discharge.

Amdt. 29-13, Eff. 5/2/77

Chapitre 15

Subpart C—Provisional Type Certificates

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FAR 21.71 : Applicability.

This subpart prescribes—

- (a) Procedural requirements for the issue of provisional type certificates, amendments to provisional type certificates, and provisional amendments to type certificates; and
- (b) Rules governing the holders of those certificates.

FAR 21.73 : Eligibility.

- (a) Any manufacturer of aircraft manufactured within the United States who is a United States citizen may apply for Class I or Class II provisional type certificates, for amendments to provisional type certificates held by him, and for provisional amendments to type certificates held by him.
 - (b) Any manufacturer of aircraft manufactured in a foreign country with which the United States has an agreement for the acceptance of those aircraft for export and import may apply for a Class II provisional type certificate, for amendments to provisional type certificates held by him, and for provisional amendments to type certificates held by him.
 - (c) An aircraft engine manufacturer who is a United States citizen and who has altered a type certificated aircraft by installing different type certificated aircraft engines manufactured by him within the United States may apply for a Class I provisional type certificate for the aircraft, and for amendments to Class I provisional type certificates held by him, if the basic aircraft, before alteration, was type certificated in the normal, utility, acrobatic, [commuter], or transport category.
- Amdt. 21-59, Eff. 2/17/87

FAR 21.75 : Application.

[Applications for provisional type certificates, for amendments thereto, and for provisional amendments to type certificates must be submitted to the Manager of the Aircraft Certification Office for the geographic area in which the applicant is located (or in the case of European, African, Middle East Region, the Manager, Aircraft Engineering Division), and must be accompanied by the pertinent information specified in this subpart.]

Amdt. 21-67, Eff. 10/25/89

FAR 21.77 : Duration.

- (a) Unless sooner surrendered, superseded, revoked, or otherwise terminated, provisional type certificates and amendments thereto are effective for the periods specified in this section.
- (b) [A Class I provisional type certificate is effective for 24 months after the date of issue.]
- (c) A Class II provisional type certificate is effective for twelve months after the date of issue.
- (d) An amendment to a Class I or Class II provisional type certificate is effective for the duration of the amended certificate.

FAR 29.1193 : Cowling and engine compartment covering.

- (a) Each cowling and engine compartment covering must be constructed and supported so that it can resist the vibration, inertia, and air loads to which it may be subjected in operation.
 - (b) Cowling must meet the drainage and ventilation requirements of Sec. 29.1187.
 - (c) On rotorcraft with a diaphragm isolating the engine power section from the engine accessory section, each part of the accessory section cowling subject to flame in case of fire in the engine power section of the powerplant must—
 - (1) Be fireproof; and
 - (2) Meet the requirements of Sec. 29.1191.
 - (d) Each part of the cowling or engine compartment covering subject to high temperatures due to its nearness to exhaust system parts or exhaust gas impingement must be fireproof.
 - (e) Each rotorcraft must—
 - (1) Be designed and constructed so that no fire originating in any fire zone can enter, either through openings or by burning through external skin, any other zone or region where it would create additional hazards;
 - (2) Meet the requirements of subparagraph (1) of this paragraph with the landing gear retracted (if applicable); and
 - (3) Have fireproof skin in areas subject to flame if a fire starts in or burns out of any designated fire zone.
 - (f) [A means of retention for each operable or readily removable panel, cowling, or engine or rotor drive system covering must be provided to preclude hazardous damage to rotors or critical control components in the event of—
 - (1) Structural or mechanical failure of the normal retention means, unless such failure is extremely improbable; or
 - (2) Fire in a fire zone, if such fire could adversely affect the normal means of retention.]
- Amdt. 29-26, Eff. 10/3/88

FAR 29.1194 : [Other surfaces.]

[All surfaces aft of, and near, engine compartments and designated fire zones, other than tail surfaces not subject to heat, flames, or sparks emanating from a designated fire zone or engine compartment, must be at least fire resistant.]

Amdt. 29-3, Eff. 2/25/68

FAR 29.1195 : Fire extinguishing systems.

- (a) Each turbine engine powered rotorcraft and category A reciprocating engine powered rotorcraft, and each category B reciprocating engine powered rotorcraft with engines of more than 1,500 cubic inches must have a fire extinguishing system for the designated fire zones. The fire extinguishing system for a powerplant must be able to simultaneously protect all zones of the powerplant compartment for which protection is provided.

FAR 29.1189 : Shutoff means.

- (a) There must be means to shut off or otherwise prevent hazardous quantities of fuel, oil, de-icing fluid, and other flammable fluids from flowing into, within, or through any designated fire zone, except that this means need not be provided—
- (1) [For lines, fittings, and components forming an integral part of an engine;
- (2) For oil systems for turbine engine installations in which all components of the oil system, including oil tanks, are fireproof or located in areas not subject to engine fire conditions ; or]
- (3) For engine oil systems in category B rotorcraft using reciprocating engines of less than 500 cubic inches displacement.
- (b) The closing of any fuel shutoff valve for any engine may not make fuel unavailable to the remaining engines.
- (c) For category A rotorcraft, no hazardous quantity of flammable fluid may drain into any designated fire zone after shutoff has been accomplished, nor may the closing of any fuel shutoff valve for an engine make fuel unavailable to the remaining engines.
- (d) The operation of any shutoff may not interfere with the later emergency operation of any other equipment, such as the means for declutching the engine from the rotor drive.
- (e) [Each shutoff valve and its control must be designed, located, and protected to function properly under any condition likely to result from fire in a designated fire zone.
- (f) Except for ground-use-only auxiliary power unit installations, there must be means to prevent inadvertent operation of each shutoff and to make it possible to reopen it in flight after it has been closed.]

Amdt. 29-26, Eff. 10/3/88

FAR 29.1191 : Firewalls.

- (a) [Each engine, including the combustor, turbine, and tailpipe sections of turbine engine installations, must be isolated by a firewall, shroud, or equivalent means, from personnel compartments, structures, controls, rotor mechanisms, and other parts that are—
- (1) Essential to controlled flight and landing ; and
- (2) Not protected under Sec. 29.861.
- (b) Each auxiliary power unit, combustion heater, and other combustion equipment to be used in flight, must be isolated from the rest of the rotorcraft by firewalls, shrouds, or equivalent means.
- (c) Each firewall or shroud must be constructed so that no hazardous quantity of air, fluid, or flame can pass from any engine compartment to other parts of the rotorcraft.
- (d) Each opening in the firewall or shroud must be sealed with close-fitting fireproof grommets, bushings, or firewall fittings.
- (e) Each firewall and shroud must be fireproof and protected against corrosion.
- (f) In meeting this section, account must be taken of the probable path of a fire as affected by the airflow in normal flight and in autorotation.

Amdt. 29-3, Eff. 2/25/68

- (e) A provisional amendment to a type certificate is effective for six months after its approval or until the amendment of the type certificate is approved, whichever is first.

Amdt. 21-7, Eff. 11/16/65

FAR 21.79 : Transferability.

Provisional type certificates are not transferable.

FAR 21.81 : Requirements for issue and amendment of Class I provisional type certificates.

- (a) An applicant is entitled to the issue or amendment of a Class I provisional type certificate if he shows compliance with this section and the Administrator finds that there is no feature, characteristic, or condition that would make the aircraft unsafe when operated in accordance with the limitations established in paragraph (e) of this section and in Sec. [91.317] of this chapter.
- (b) The applicant must apply for the issue of a type or supplemental type certificate for the aircraft.
- (c) The applicant must certify that—
- (1) The aircraft has been designed and constructed in accordance with the airworthiness requirements applicable to the issue of the type or supplemental type certificate applied for ;
- (2) The aircraft substantially meets the applicable flight characteristic requirements for the type or supplemental type certificate applied for ; and
- (3) The aircraft can be operated safely under the appropriate operating limitations specified in paragraph (a) of this section.
- (d) The applicant must submit a report showing that the aircraft had been flown in all maneuvers necessary to show compliance with the flight requirements for the issue of the type or supplemental type certificate applied for, and to establish that the aircraft can be operated safely in accordance with the limitations contained in this subchapter.
- (e) The applicant must establish all limitations required for the issue of the type or supplemental type certificate applied for, including limitations on weights, speeds, flight maneuvers, loading, and operation of controls and equipment unless, for each limitation not so established, appropriate operating restrictions are established for the aircraft.
- (f) The applicant must establish an inspection and maintenance program for the continued airworthiness of the aircraft.
- (g) The applicant must show that a prototype aircraft has been flown for at least 50 hours under an experimental certificate issued under Secs. 21.191 through 21.195, or under the auspices of an Armed Force of the United States. However, in the case of an amendment to a provisional type certificate, the Administrator may reduce the number of required flight hours.

Amdt. 21-66, Eff. 8/18/90

FAR 21.83 : Requirements for issue and amendment of Class II provisional type certificates.

- (a) An applicant who manufactures aircraft within the United States is entitled to the issue or amendment of a Class II provisional type certificate if he shows compliance with this section and the Administrator finds that there is no feature, characteristic, or condition that would make the aircraft unsafe when operated in accordance with the limitations in paragraph (1i) of this section, and Secs. [91.317] and 121.207 of this chapter.
- (b) An applicant who manufactures aircraft in a country with which the United States has an agreement for the acceptance of those aircraft for export and import is entitled to the issue or amendment of a Class II provisional type certificate if the country in which the aircraft was manufactured certifies that the applicant has shown compliance with this section, that the aircraft meets the requirements of paragraph (f) of this section and that there is no feature, characteristic, or condition that would make the aircraft unsafe when operated in accordance with the limitations in paragraph (1i) of this section and Secs. [91.317] and 121.207 of this chapter.
- (c) The applicant must apply for a type certificate, in the transport category, for the aircraft.
- (d) The applicant must hold a U.S. type certificate for at least one other aircraft in the same transport category as the subject aircraft.
- (e) The FAA's official flight test program or the flight test program conducted by the authorities of the country in which the aircraft was manufactured, with respect to the issue of a type certificate for that aircraft, must be in progress.
- (f) The applicant or, in the case of a foreign manufactured aircraft, the country in which the aircraft was manufactured, must certify that—
 - (1) The aircraft has been designed and constructed in accordance with the airworthiness requirements applicable to the issue of the type certificate applied for;
 - (2) The aircraft substantially complies with the applicable flight characteristic requirements for the type certificate applied for; and
 - (3) The aircraft can be operated safely under the appropriate operating limitations in this subchapter.
- (g) The applicant must submit a report showing that the aircraft has been flown in all maneuvers necessary to show compliance with the flight requirements for the issue of the type certificate and to establish that the aircraft can be operated safely in accordance with the limitations in this subchapter.
- (h) The applicant must prepare a provisional aircraft flight manual containing all limitations required for the issue of the type certificate applied for, including limitations on weights, speeds, flight maneuvers, loading, and operation of controls and equipment unless, for each limitation not so established, appropriate operating restrictions are established for the aircraft.
- (i) The applicant must establish an inspection and maintenance program for the continued airworthiness of the aircraft.
- (j) The applicant must show that a prototype aircraft has been flown for at least 100 hours. In the case of an amendment to a provisional type certificate, the Administrator may reduce the number of required flight hours.

fireproof shield unless damage by fire to any non-fireproof part will not cause leakage or spillage of flammable fluid. Components must be shielded or located so as to safeguard against the ignition of leaking flammable fluid. An integral oil sump of less than [25-quart] capacity on a reciprocating engine need not be fireproof nor be enclosed by a fireproof shield.

- (b) Paragraph (a) of this section does not apply to—

- (1) [Lines, fittings, and components which are already approved as part of a type certificated engine; and]
- (2) Vent and drain lines, and their fittings, whose failure will not result in or add to, a fire hazard.

Amdt. 29-22, EFF. 3/26/84

FAR 29.1185 : Flammable fluids.

- (a) No tank or reservoir that is part of a system containing flammable fluids or gases may be in a designated fire zone unless the fluid contained, the design of the system, the materials used in the tank and its supports, the shutoff means, and the connections, lines, and controls provide a degree of safety equal to that which would exist if the tank or reservoir were outside such a zone.
- (b) Each fuel tank must be isolated from the engines by a firewall or shroud.
- (c) There must be at least one-half inch of clear airspace between each tank or reservoir and each firewall or shroud isolating a designated fire zone, unless equivalent means are used to prevent heat transfer from the fire zone to the flammable fluid.
- (d) Absorbent material close to flammable fluid system components that might leak must be covered or treated to prevent the absorption of hazardous quantities of fluids.

FAR 29.1187 : Drainage and ventilation of fire zones.

- (a) There must be complete drainage of each part of each designated fire zone to minimize the hazards resulting from failure or malfunction of any component containing flammable fluids. The drainage means must be—
 - (1) Effective under conditions expected to prevail when drainage is needed; and
 - (2) Arranged so that no discharged fluid will cause an additional fire hazard.
- (b) Each designated fire zone must be ventilated to prevent the accumulation of flammable vapors.
- (c) No ventilation opening may be where it would allow the entry of flammable fluids, vapors, or flame from other zones.
- (d) Ventilation means must be arranged so that no discharged vapors will cause an additional fire hazard.
- (e) For category A rotorcraft, there must be means to allow the crew to shut off the sources of forced ventilation in any fire zone (other than the engine power section of the powerplant compartment) unless the amount of extinguishing agent and the rate of discharge are based on the maximum airflow through that zone.

- (3) The condition of a completely depleted battery with the generator operating at idling speed, if there is only one battery.
- (d) Magneto ground wiring (for separate ignition circuits) that lies on the engine side of any firewall must be installed, located, or protected, to minimize the probability of the simultaneous failure of two or more wires as a result of mechanical damage, electrical fault, or other cause.
- (e) No ground wire for any engine may be routed through a fire zone of another engine unless each part of that wire within that zone is fireproof.
- (f) [Each ignition system must be independent of any electrical circuit that is not used for assisting, controlling, or analyzing the operation of that system.]
- (g) There must be means to warn appropriate crewmembers if the malfunctioning of any part of the electrical system is causing the continuous discharge of any battery necessary for engine ignition.

Amdt. 29-12, Eff. 2/1/77

75.10 Powerplant Fire Protection

FAR 29.1181 : Designated fire zones : regions included.

- (a) Designated fire zones are—
- (1) The engine power section of reciprocating engines;
 - (2) The engine accessory section of reciprocating engines;
 - (3) Any complete powerplant compartment in which there is no isolation between the engine power section and the engine accessory section, for reciprocating engines;
 - (4) Any auxiliary power unit compartment;
 - (5) Any fuel-burning heater and other combustion equipment installation described in Sec. 29.859;
 - (6) The compressor and accessory sections of turbine engines; and
 - (7) The combustor, turbine, and tailpipe sections of turbine engine installations except sections that do not contain lines and components carrying flammable fluids or gases and are isolated from the designated fire zone prescribed in paragraph (a)(6) of this section by a firewall that meets Sec. 29.1191.
- (b) [Each designated fire zone must meet the requirements of Secs. 29.1183 through 29.1203.]

Amdt. 29-26, Eff. 10/3/88

FAR 29.1183 : [Lines, fittings, and components.]

- (a) Except as provided in paragraph (b) of this section, each line, fitting, and other component carrying flammable fluid in any area subject to engine fire conditions and each component which conveys or contains flammable fluid in a designated fire zone must be fire resistant, except that flammable fluid tanks and supports in a designated fire zone must be fireproof or be enclosed by a

Amdt. 21-66, Eff. 8/18/90

FAR 21.85 : Provisional amendments to type certificates.

- (a) An applicant who manufactures aircraft within the United States is entitled to a provisional amendment to a type certificate if he shows compliance with this section and the Administrator finds that there is no feature, characteristic, or condition that would make the aircraft unsafe when operated under the appropriate limitations contained in this subchapter.
- (b) An applicant who manufactures aircraft in a foreign country with which the United States has an agreement for the acceptance of those aircraft for export and import is entitled to a provisional amendment to a type certificate if the country in which the aircraft was manufactured certifies that the applicant has shown compliance with this section, that the aircraft meets the requirements of paragraph (e) of this section and that there is no feature, characteristic, or condition that would make the aircraft unsafe when operated under the appropriate limitations contained in this subchapter.
- (c) The applicant must apply for an amendment to the type certificate.
- (d) The FAA's official flight test program or the flight test program conducted by the authorities of the country in which the aircraft was manufactured, with respect to the amendment of the type certificate, must be in progress.
- (e) The applicant or, in the case of foreign manufactured aircraft, the country in which the aircraft was manufactured, must certify that—
- (1) The modification involved in the amendment to the type certificate has been designed and constructed in accordance with the airworthiness requirements applicable to the issue of the type certificate for the aircraft;
 - (2) The aircraft substantially complies with the applicable flight characteristic requirements for the type certificate; and
 - (3) The aircraft can be operated safely under the appropriate operating limitations in this subchapter.
- (f) The applicant must submit a report showing that the aircraft incorporating the modifications involved has been flown in all maneuvers necessary to show compliance with the flight requirements applicable to those modifications and to establish that the aircraft can be operated safely in accordance with the limitations specified in Sec. [91.317] and Sec. 121.207 of this chapter.
- (g) The applicant must establish and publish, in a provisional aircraft flight manual or other document and on appropriate placards, all limitations required for the issue of the type certificate applied for, including weight, speed, flight maneuvers, loading, and operation of controls and equipment, unless, for each limitation not so established, appropriate operating restrictions are established for the aircraft.
- (h) The applicant must establish an inspection and maintenance program for the continued airworthiness of the aircraft.
- (i) The applicant must operate a prototype aircraft modified in accordance with the corresponding amendment to the type certificate for the number of hours found necessary by the Administrator.

Amdt. 21-66, Eff. 8/18/90

FAR 29.1151 : Rotor brake controls.

- (a) It must be impossible to apply the rotor brake inadvertently in flight.
- (b) There must be means to warn the crew if the rotor brake has not been completely released before takeoff.

FAR 29.1157 : Carburetor air temperature controls.

There must be a separate carburetor air temperature control for each engine.

FAR 29.1159 : Supercharger controls.

Each supercharger control must be accessible to—

- (a) The pilots ; or
- (b) (If there is a separate flight engineer station with a control panel) the flight engineer.

FAR 29.1163 : Powerplant accessories.

- (a) Each engine mounted accessory must—
 - (1) Be approved for mounting on the engine involved ;
 - (2) Use the provisions on the engine for mounting ; and
 - (3) Be sealed in such a way as to prevent contamination of the engine oil system and the accessory system.
- (b) Electrical equipment subject to arcing or sparking must be installed to minimize the probability of igniting flammable fluids or vapors.
- (c) If, continued rotation of an engine-driven cabin supercharger or any remote accessory driven by the engine will be a hazard if they malfunction, there must be means to prevent their hazardous rotation without interfering with the continued operation of the engine.
- (d) [Unless other means are provided, torque limiting means must be provided for accessory drives located on any component of the transmission and rotor drive system to prevent damage to these components from excessive accessory load.]

Amtd. 29-26, EF 10/3/88

FAR 29.1165 : Engine ignition systems.

- (a) Each battery ignition system must be supplemented with a generator that is automatically available as an alternate source of electrical energy to allow continued engine operation if any battery becomes depleted.
- (b) The capacity of batteries and generators must be large enough to meet the simultaneous demands of the engine ignition system and the greatest demands of any electrical system components that draw from the same source.
- (c) The design of the engine ignition system must account for—
 - (1) The condition of an inoperative generator ;
 - (2) The condition of a completely depleted battery with the generator running at its normal operating speed ; and

FAR 29.1143 : Engine controls.

- (a) There must be a separate power control for each engine.
- (b) Power controls must be arranged to allow ready synchronization of all engines by—
 - (1) Separate control of each engine ; and
 - (2) Simultaneous control of all engines.
- (c) Each power control must provide a positive and immediately responsive means of controlling its engine.
- (d) Each fluid injection control other than fuel system control must be in the corresponding power control. However, the injection system pump may have a separate control.
- (e) If a power control incorporates a fuel shutoff feature, the control must have a means to prevent the inadvertent movement of the control into the shutoff position. The means must—
 - (1) Have a positive lock or stop at the idle position ; and
 - (2) Require a separate and distinct operation to place the control in the shutoff position.
- (f) [For rotorcraft to be certificated for a 30-second OEI power rating, a means must be provided to automatically activate and control the 30-second OEI power and prevent any engine from exceeding the installed engine limits associated with the 30-second OEI power rating approved for the rotorcraft.]

Amdt. 29-34, Eff. 10/17/94

FAR 29.1145 : Ignition switches.

- (a) Ignition switches must control each ignition circuit on each engine.
- (b) There must be means to quickly shut off all ignition by the grouping of switches or by a master ignition control.
- (c) [Each group of ignition switches, except ignition switches for turbine engines for which continuous ignition is not required, and each master ignition control must have a means to prevent its inadvertent operation.]

Amdt. 29-13, Eff. 5/2/77

FAR 29.1147 : Mixture controls.

- (a) If there are mixture controls, each engine must have a separate control, and the controls must be arranged to allow—
 - (1) Separate control of each engine ; and
 - (2) Simultaneous control of all engines.
- (b) Each intermediate position of the mixture controls that corresponds to a normal operating setting must be identifiable by feel and sight.

Chapitre 16

Subpart D—Changes to Type Certificates

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FAR 21.91 : Applicability.

This subpart prescribes procedural requirements for the approval of changes to type certificates.

FAR 21.93 : Classification of changes in type design.

- (a) In addition to changes in type design specified in paragraph (b) of this section, changes in type design are classified as minor and major. A "minor change" is one that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product. All other changes are "major changes" (except as provided in paragraph (b) of this section).
- (b) For the purpose of complying with part 36 of this chapter, and except as provided in paragraphs (b)(2), (b)(3), and (b)(4) of this section, any voluntary change in the type design of an aircraft that may increase the noise levels of that aircraft is an "acoustical change" (in addition to being a minor or major change as classified in paragraph (a) of this section) for the following aircraft :
- (1) Transport category large airplanes.
 - (2) [Jet (Turbojet powered) airplanes (regardless of category). For airplanes to which this paragraph applies, "acoustical changes" do not include changes in type design that are limited to one of the following—]
 - (i) Gear down flight with one or more retractable landing gear down during the entire flight, or
 - (ii) Spare engine and nacelle carriage external to the skin of the airplane (and return of the pylon or other external mount), or
 - (iii) Time-limited engine and/or nacelle changes, where the change in type design specifies that the airplane may not be operated for a period of more than 90 days unless compliance with the applicable acoustical change provisions of part 36 of this chapter is shown for that change in type design.
 - (3) Propeller driven commuter category and small airplanes in the primary, normal, utility, acrobatic, transport, and restricted categories, except for airplanes that are :
 - (i) Designated for "agricultural aircraft operations" (as defined in Sec. 137.3 of this chapter, effective January 1, 1966) to which Sec. 36.1583 of this chapter does not apply, or
 - (ii) Designated for dispensing fire fighting materials to which Sec. 36.1583 of this chapter does not apply, or
 - (iii) U.S. registered, and that had flight time prior to January 1, 1955 or
 - (iv) Land configured aircraft, reconfigured with floats or skis. This reconfiguration does not permit further exception from the requirements of the section upon any acoustical change not enumerated in Sec. 21.93(b).
 - (4) Helicopters except :
 - (i) Those helicopters that are designated exclusively :
 - (A) for "agricultural aircraft operations", as defined in Sec. 137.3 of this chapter, as effective on January 1, 1966 ;

- (1) Each exchanger must be suitable for continued operation at high temperatures and resistant to corrosion from exhaust gases ;
 - (2) There must be means for inspecting the critical parts of each exchanger ;
 - (3) Each exchanger must have cooling provisions wherever it is subject to contact with exhaust gases ; and
 - (4) [No exhaust heat exchanger or muff may have stagnant areas or liquid traps that would increase the probability of ignition of flammable fluids or vapors that might be present in case of the failure or malfunction of components carrying flammable fluids.]
- (b) If an exhaust heat exchanger is used for heating ventilating air used by personnel—

- (1) There must be a secondary heat exchanger between the primary exhaust gas heat exchanger and the ventilating air system ; or
- (2) Other means must be used to prevent harmful contamination of the ventilating air.

Amtd. 29-41, Eff. 11/28/97

75.9 Powerplant Controls and Accessories**FAR 29.1141 : Powerplant controls : general.**

- (a) Powerplant controls must be located and arranged under Sec. 29.777 and marked under Sec. 29.1555.
- (b) Each control must be located so that it cannot be inadvertently operated by persons entering, leaving, or moving normally in the cockpit.
- (c) Each flexible powerplant control must be approved.
- (d) Each control must be able to maintain any set position without—
- (1) Constant attention ; or
 - (2) Tendency to creep due to control loads or vibration.
- (e) Each control must be able to withstand operating loads without excessive deflection.
- (f) [Controls of powerplant valves required for safety must have—]
- (1) For manual valves, positive steps or in the case of fuel valves suitable index provisions, in the open and closed position ; and
 - (2) For power-assisted valves, a means to indicate to the flight crew when the valve—
 - (i) Is in the fully open or fully closed position ; or
 - (ii) Is moving between the fully open and fully closed position.
- Amtd. 29-26, Eff. 10/3/88

FAR 29.1142 : [Auxiliary power unit controls.]

[Means must be provided on the flight deck for starting, stopping, and emergency shutdown of each installed auxiliary power unit.]

Amtd. 29-17, Eff. 12/1/78

75.8 Exhaust System

FAR 29.1121 : General.

[For powerplant and auxiliary power unit installations the following apply :]

- (a) Each exhaust system must ensure safe disposal of exhaust gases without fire hazard or carbon monoxide contamination in any personnel compartment.
- (b) [Each exhaust system part with a surface hot enough to ignite flammable fluids or vapors must be located or shielded so that leakage from any system carrying flammable fluids or vapors will not result in a fire caused by impingement of the fluids or vapors on any part of the exhaust system including shields for the exhaust system.
- (c) Each component upon which hot exhaust gases could impinge, or that could be subjected to high temperatures from exhaust system parts, must be fireproof. Each exhaust system component must be separated by a fireproof shield from adjacent parts of the rotorcraft that are outside the engine and auxiliary power unit compartments.]
- (d) No exhaust gases may discharge so as to cause a fire hazard with respect to any flammable fluid vent or drain.
- (e) No exhaust gases may discharge where they will cause a glare seriously affecting pilot vision at night.
- (f) Each exhaust system component must be ventilated to prevent points of excessively high temperature.
- (g) Each exhaust shroud must be ventilated or insulated to avoid, during normal operation, a temperature high enough to ignite any flammable fluids or vapors outside the shroud.
- (h) If significant traps exist, each turbine engine exhaust system must have drains discharging clear of the rotorcraft, in any normal ground and flight attitudes, to prevent fuel accumulation after the failure of an attempted engine start.

Amdt. 29-13, Eff. 5/3/77

FAR 29.1123 : Exhaust piping.

- (a) Exhaust piping must be heat and corrosion resistant, and must have provisions to prevent failure due to expansion by operating temperatures.
- (b) Exhaust piping must be supported to withstand any vibration and inertia loads to which it would be subjected in operation.
- (c) Exhaust piping connected to components between which relative motion could exist must have provisions for flexibility.

FAR 29.1125 : Exhaust heat exchangers.

For reciprocating engine powered rotorcraft the following apply :

- (a) Each exhaust heat exchanger must be constructed and installed to withstand the vibration, inertia, and other loads to which it would be subjected in operation. In addition—

- (B) for dispensing fire fighting materials; or

- (C) for carrying external loads, as defined in Sec. 133.1(b) of this chapter, as effective on December 20, 1976.

(ii) Those helicopters modified by installation or removal of external equipment. For purposes of this paragraph, "external equipment" means any instrument, mechanism, part, apparatus, appurtenance, or accessory that it attached to, or extends from, the helicopter exterior but is not used nor is intended to be used in operating or controlling a helicopter in flight and is not part of an airframe or engine. An "acoustical change" does not include :

- (A) addition or removal of external equipment ;

- (B) changes in the airframe made to accommodate the addition or removal of external equipment, to provide for an external load attaching means, to facilitate the use of external equipment or external loads, or to facilitate the safe operation of the helicopter with external equipment mounted to, or external loads carried by, the helicopter ;

- (C) reconfiguration of the helicopter by the addition or removal of floats and skis ;

- (D) flight with one or more doors and/or windows removed or in an open position ; or

- (E) any changes in the operational limitations placed on the helicopter as a consequence of the addition or removal of external equipment, floats, and skis, or flight operations with doors and/or windows removed or in an open position.

- (c) For purposes of complying with part 34 of this chapter, any voluntary change in the type design of the airplane or engine which may increase fuel venting or exhaust emissions is an "emissions change."

Amdt. 21-81, Eff. 8/7/2002

FAR 21.95 : Approval of minor changes in type design.

Minor changes in a type design may be approved under a method acceptable to the Administrator before submitting to the Administrator any substantiating or descriptive data.

FAR 21.97 : Approval of major changes in type design.

- (a) [In the case of a major change in type design, the applicant must submit substantiating data and necessary descriptive data for inclusion in the type design.

- (b) Approval of a major change in the type design of an aircraft engine is limited to the specific engine configuration upon which the change is made unless the applicant identifies in the necessary descriptive data for inclusion in the type design the other configurations of the same engine type for which approval is requested and shows that the change is compatible with the other configurations.]

Amdt. 21-40, Eff. 10/31/74

FAR 21.99 : [Required design changes.]

- (a) When an Airworthiness Directive is issued under Part 39 the holder of the type certificate for the product concerned must—
 - (1) If the Administrator finds that design changes are necessary to correct the unsafe condition of the product, and upon his request, submit appropriate design changes for approval; and
 - (2) Upon approval of the design changes, make available the descriptive data covering the changes to all operators of products previously certificated under the type certificate.
- (b) In a case where there are no current unsafe conditions, but the Administrator or the holder of the type certificate finds through service experience that changes in type design will contribute to the safety of the product, the holder of the type certificate may submit appropriate design changes for approval. Upon approval of the changes, the manufacturer shall make information on the design changes available to all operators of the same type of product.

Amdt. 21-3, Eff. 8/13/65

FAR 21.101 : Designation of applicable regulations.

- (a) [An applicant for a change to a type certificate must show that the changed product complies with the airworthiness requirements applicable to the category of the product in effect on the date of the application for the change and with parts 34 and 36 of this chapter. Exceptions are detailed in paragraphs (b) and (c) of this section.
- (b) If paragraphs (b)(1), (2), or (3) of this section apply, an applicant may show that the changed product complies with an earlier amendment of a regulation required by paragraph (a) of this section, and of any other regulation the Administrator finds is directly related. However, the earlier amended regulation may not precede either the corresponding regulation incorporated by reference in the type certificate, or any regulation in Secs. 23.2, 25.2, 27.2, or 29.2 of this chapter that is related to the change. The applicant may show compliance with an earlier amendment of a regulation for any of the following :
 - (1) A change that the Administrator finds not to be significant. In determining whether a specific change is significant, the Administrator considers the change in context with all previous relevant design changes and all related revisions to the applicable regulations incorporated in the type certificate for the product. Changes that meet one of the following criteria are automatically considered significant :
 - (i) The general configuration or the principles of construction are not retained.
 - (ii) The assumptions used for certification of the product to be changed do not remain valid.
 - (2) Each area, system, component, equipment, or appliance that the Administrator finds is not affected by the change.
 - (3) Each area, system, component, equipment, or appliance that is affected by the change, for which the Administrator finds that compliance with a regulation described in paragraph (a) of this section would not contribute materially to the level of safety of the changed product or would be impractical.

FAR 29.1103 : [Induction systems ducts and air duct systems.]

- (a) [Each induction system duct upstream of the first stage of the engine supercharger and of the auxiliary power unit compressor must have a drain to prevent the hazardous accumulation of fuel and moisture in the ground attitude. No drain may discharge where it might cause a fire hazard.]
- (b) Each duct must be strong enough to prevent induction system failure from normal backfire conditions.
- (c) Each duct connected to components between which relative motion could exist must have means for flexibility.
- (d) [Each duct within any fire zone for which a fire-extinguishing system is required must be at least—
 - (1) Fireproof, if it passes through any firewall; or
 - (2) Fire resistant, for other ducts, except that ducts for auxiliary power units must be fireproof within the auxiliary power unit fire zone.
- (e) Each auxiliary power unit induction system duct must be fireproof for a sufficient distance upstream of the auxiliary power unit compartment to prevent hot gas reverse flow from burning through auxiliary power unit ducts and entering any other compartment or area of the rotorcraft in which a hazard would be created resulting from the entry of hot gases. The materials used to form the remainder of the induction system duct and plenum chamber of the auxiliary power unit must be capable of resisting the maximum heat conditions likely to occur.
- (f) Each auxiliary power unit induction system duct must be constructed of materials that will not absorb or trap hazardous quantities of flammable fluids that could be ignited in the event of a surge or reverse flow condition.]

Amdt. 29-17, Eff. 12/1/78

FAR 29.1105 : Induction system screens.

- If induction system screens are used—
- (a) Each screen must be upstream of the carburetor;
 - (b) No screen may be in any part of the induction system that is the only passage through which air can reach the engine, unless it can be deiced by heated air;
 - (c) No screen may be deiced by alcohol alone; and
 - (d) It must be impossible for fuel to strike any screen.

FAR 29.1107 : Inter-coolers and after-coolers.

Each inter-cooler and after-cooler must be able to withstand the vibration, inertia, and air pressure loads to which it would be subjected in operation.

FAR 29.1109 : Carburetor air cooling.

It must be shown under Sec. 29.1043 that each installation using two-stage superchargers has means to maintain the air temperature, at the carburetor inlet, at or below the maximum established value.

FAR 29.1093 : Induction system icing protection.

(a) *Reciprocating engines.* Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of 30° F., and with the engines at 60 percent of maximum continuous power—

- (1) Each rotorcraft with sea level engines using conventional venturi carburetors has a preheater that can provide a heat rise of 90° F.;
- (2) Each rotorcraft with sea level engines using carburetors tending to prevent icing has a preheater that can provide a heat rise of 70° F.;
- (3) Each rotorcraft with altitude engines using conventional venturi carburetors has a preheater that can provide a heat rise of 120° F. ; and
- (4) Each rotorcraft with altitude engines using carburetors tending to prevent icing has a preheater that can provide a heat rise of 100° F.

(b) *Turbine engines.*

(1) [It must be shown that each turbine engine and its air inlet system can operate throughout the flight power range of the engine (including idling)—

- (i) Without accumulating ice on engine or inlet system components that would adversely affect engine operation or cause a serious loss of power under the icing conditions specified in Appendix C of this part ; and
- (ii) In snow, both falling and blowing, without adverse effect on engine operation, within the limitations established for the rotorcraft.]
- (2) Each turbine engine must idle for 30 minutes on the ground, with the air bleed available for engine icing protection at its critical condition, without adverse effect, in at atmosphere that is at a temperature between 15° and 30°F (between -9° and -1°C) and has a liquid water content not less than 0.3 grams per cubic meter in the form of drops having a mean effective diameter not less than 20 microns, followed by momentary operation at takeoff power or thrust. During the 30 minutes of idle operation, the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator.

(c) *Supercharged reciprocating engines.* For each engine having a supercharger to pressurize the air before it enters the carburetor, the heat rise in the air caused by that supercharging at any altitude may be utilized in determining compliance with paragraph (a) of this section if the heat rise utilized is that which will be available, automatically, for the applicable altitude and operation condition because of supercharging.

Amdt. 29-26, Eff. 10/3/88

FAR 29.1101 : Carburetor air preheater design.

Each carburetor air preheater must be designed and constructed to—

- (a) Ensure ventilation of the preheater when the engine is operated in cold air ;
- (b) Allow inspection of the exhaust manifold parts that it surrounds; and
- (c) Allow inspection of critical parts of the preheater itself.

(c) An applicant for a change to an aircraft (other than a rotorcraft) of 6,000 pounds or less maximum weight, or to a non-turbine rotorcraft of 3,000 pounds or less maximum weight may show that the changed product complies with the regulations incorporated by reference in the type certificate. However, if the Administrator finds that the change is significant in an area, the Administrator may designate compliance with an amendment to the regulation incorporated by reference in the type certificate that applies to the change and any regulation that the Administrator finds is directly related, unless the Administrator also finds that compliance with that amendment or regulation would not contribute materially to the level of safety of the changed product or would be impractical.

(d) If the Administrator finds that the regulations in effect on the date of the application for the change do not provide adequate standards with respect to the proposed change because of a novel or unusual design feature, the applicant must also comply with special conditions, and amendments to those special conditions, prescribed under the provisions of Sec. 21.16, to provide a level of safety equal to that established by the regulations in effect on the date of the application for the change.

(e) An application for a change to a type certificate for a transport category aircraft is effective for 5 years, and an application for a change to any other type certificate is effective for 3 years. If the change has not been approved, or if it is clear that it will not be approved under the time limit established under this paragraph, the applicant may do either of the following :

- (1) File a new application for a change to the type certificate and comply with all the provisions of paragraph (a) of this section applicable to an original application for a change.
- (2) File for an extension of the original application and comply with the provisions of paragraph (a) of this section. The applicant must then select a new application date. The new application date may not precede the date the change is approved by more than the time period established under this paragraph (e).
- (f) For aircraft certificated under Secs. 21.17(b), 21.24, 21.25, and 21.27 the airworthiness requirements applicable to the category of the product in effect on the date of the application for the change include each airworthiness requirement that the Administrator finds to be appropriate for the type certification of the aircraft in accordance with those sections.]

Amdt. 21-77, Eff. 6/10/2003

- (5) The cooling test must be conducted at an airspeed corresponding to normal operating practice for the configuration being tested. However, if the cooling provisions are sensitive to rotorcraft speed, the most critical airspeed must be used, but need not exceed the speed for best rate of climb with maximum continuous power.

Amtd. 29-26, Eff. 10/3/88

FAR 29.1049 : Hovering cooling test procedures.

The hovering cooling provisions must be shown—

- (a) At maximum weight or at the greatest weight at which the rotorcraft can hover (if less), at sea level, with the power required to hover but not more than maximum continuous power, in the ground effect in still air, until at least five minutes after the occurrence of the highest temperature recorded; and
- (b) With maximum continuous power, maximum weight, and at the altitude resulting in zero rate of climb for this configuration, until at least five minutes after the occurrence of the highest temperature recorded.

75.7 Induction System

FAR 29.1091 : Air induction.

- (a) [The air induction system for each engine and auxiliary power unit must supply the air required by that engine and auxiliary power unit under the operating conditions for which certification is requested.
- (b) Each engine and auxiliary power unit air induction system must provide air for proper fuel metering and mixture distribution with the induction system valves in any position.]
- (c) No air intake may open within the engine accessory section or within other areas of any powerplant compartment where emergence of backfire flame would constitute a fire hazard.
- (d) Each reciprocating engine must have an alternate air source.
- (e) Each alternate air intake must be located to prevent the entrance of rain, ice, or other foreign matter.
- (f) [For turbine engine powered rotorcraft and rotorcraft incorporating auxiliary power units—
- (1) There must be means to prevent hazardous quantities of fuel leakage or overflow from drains, vents, or other components of flammable fluid system from entering the engine or auxiliary power unit intake system; and]
- (2) The air ducts must be located or protected so as to minimize the ingestion of foreign matter during takeoff, landing, and taxiing.

Amtd. 29-17, Eff. 12/1/78

- (f) The climb or descent must be conducted at an airspeed representing a normal operational practice for the configuration being tested. However, if the cooling provisions are sensitive to rotorcraft speed, the most critical airspeed must be used, but need not exceed the speeds established under Sec. 29.67(a)(2) or Sec. 29.67(b). The climb cooling test may be conducted in conjunction with the takeoff cooling test of Sec. 29.1047.

Amdt. 29-26, Eff. 10/3/88

FAR 29.1047 : Takeoff cooling test procedures.

- (a) *Category A.* For each category A rotorcraft, cooling must be shown during takeoff and subsequent climb as follows :
- (1) Each temperature must be stabilized while hovering in ground effect with—
 - (i) The power necessary for hovering ;
 - (ii) The appropriate cowl flap and shutter settings ; and
 - (iii) The maximum weight.
 - (2) After the temperatures have stabilized, a climb must be started at the lowest practicable altitude and must be conducted with one engine inoperative.
 - (3) The operating engines must be at the greatest power for which approval is sought (or at full throttle when above the critical altitude) for the same period as this power is used in determining the takeoff climbout path under Sec. 29.59.
 - (4) At the end of the time interval prescribed in paragraph (b)(3) of this section, the power must be changed to that used in meeting Sec. 29.67(a)(2) and the climb must be continued for—
 - (i) [Thirty minutes, if 30-minute OEI power is used ; or
 - (ii) At least 5 minutes after the occurrence of the highest temperature recorded, if continuous OEI power or maximum continuous power is used.]
 - (5) The speeds must be those used in determining the takeoff flight path under Sec. 29.59.
- (b) *Category B.* For each category B rotorcraft, cooling must be shown during takeoff and subsequent climb as follows :
- (1) Each temperature must be stabilized while hovering in ground effect with—
 - (i) The power necessary for hovering ;
 - (ii) The appropriate cowl flap and shutter settings ; and
 - (iii) The maximum weight.
 - (2) After the temperatures have stabilized, a climb must be started at the lowest practicable altitude with takeoff power.
 - (3) Takeoff power must be used for the same time interval as takeoff power is used in determining the takeoff flight path under Sec. 29.63.
 - (4) At the end of the time interval prescribed in paragraph (a)(3) of this section, the power must be reduced to maximum continuous power and the climb must be continued for at least five minutes after the occurrence of the highest temperature recorded.

Chapitre 17

Subpart E—Supplemental Type Certificates

Sommaire

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FAR 21.111 : Applicability.

This subpart prescribes procedural requirements for the issue of supplemental type certificates.

FAR 21.113 : Requirement of supplemental type certificate.

Any person who alters a product by introducing a major change in type design, not great enough to require a new application for a type certificate under Sec. 21.19, shall apply to the Administrator for a supplemental type certificate, except that the holder of a type certificate for the product may apply for amendment of the original type certificate. The application must be made in a form and manner prescribed by the Administrator.

FAR 21.115 : Applicable requirements.

- (a) [Each applicant for a supplemental type certificate must show that the altered product meets applicable requirements specified in Sec. 21.101 and, in the case of an acoustical change described in Sec. 21.33(b), show compliance with the applicable noise requirements of part 36 of this chapter and, in the case of an emissions change described in Sec. 21.33(c), show compliance with the applicable fuel venting and exhaust emissions requirements of part 34 of this chapter.]
 - (b) Each applicant for a supplemental type certificate must meet Secs. 21.33 and 21.53 with respect to each change in the type design.
- Amdt. 21-77, Eff. 6/10/2003

FAR 21.117 : Issue of supplemental type certificates.

- (a) An applicant is entitled to a supplemental type certificate if he meets the requirements of Secs. 21.113 and 21.115.
- (b) A supplemental type certificate consists of—
 - (1) The approval by the Administrator of a change in the type design of the product; and
 - (2) The type certificate previously issued for the product.

FAR 21.119 : Privileges.

The holder of a supplemental type certificate may—

- (a) In the case of aircraft, obtain airworthiness certificates;
- (b) In the case of other products, obtain approval for installation on certificated aircraft; and
- (c) Obtain a production certificate for the change in the type design that was approved by that supplemental type certificate.

by adding to them the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum component or fluid temperature recorded during the cooling test.

- (d) *Correction factor for cylinder barrel temperatures.* Cylinder barrel temperatures must be corrected by adding to them 0.7 times the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum cylinder barrel temperature recorded during the cooling test.

Amdt. 29-26, Eff. 10/3/88

FAR 29.1045 : Climb cooling test procedures.

- (a) Climb cooling tests must be conducted under this section for—
 - (1) Category A rotorcraft; and
 - (2) Multiengine category B rotorcraft for which certification is requested under the category A powerplant installation requirements, and under the requirements of Sec. 29.861(a) at the steady rate of climb or descent established under Sec. 29.67(b).
- (b) The climb or descent cooling tests must be conducted with the engine inoperative that produces the most adverse cooling conditions for the remaining engines and powerplant components.
- (c) [Each operating engine must—
 - (1) For helicopters for which the use of 30-minute OEI power is requested, be at 30-minute OEI power for 30 minutes, and then at maximum continuous power (or at full throttle when above the critical altitude);
 - (2) For helicopters for which the use of continuous OEI power is requested, be at continuous OEI power (or at full throttle when above the critical altitude); and
 - (3) For other rotorcraft, be at maximum continuous power (or at full throttle when above the critical altitude).]
 - (d) After temperatures have stabilized in flight, the climb must be—
 - (1) Begun from an altitude not greater than the lower of—
 - (i) 1,000 feet below the engine critical altitude; and
 - (ii) 1,000 feet below the maximum altitude at which the rate of climb is 150 f.p.m.; and
 - (2) Continued for at least 5 minutes after the occurrence of the highest temperature recorded, or until the rotorcraft reaches the maximum altitude for which certification is requested.
 - (e) For category B rotorcraft without a positive rate of climb, the descent must begin at the all-engine-critical altitude and end at the higher of—
 - (1) The maximum altitude at which level flight can be maintained with one engine operative; and
 - (2) Sea level.

75.6 Cooling

FAR 29.1041 : General.

- (a) [The powerplant and auxiliary power unit cooling provisions must be able to maintain the temperatures of power plant components, engine fluids, and auxiliary power unit components and fluids within the temperature limits established for these components and fluids, under ground, water, and flight operating conditions for which certification is requested, and after normal engine or auxiliary power shutdown, or both.]
- (b) There must be cooling provisions to maintain the fluid temperatures in any power transmission within safe values under any critical surface (ground or water) and flight operating conditions.
- (c) [Except for ground-use-only auxiliary power units, compliance with paragraphs (a) and (b) of this section must be shown by flight tests in which the temperatures of selected powerplant component and auxiliary power unit component, engine, and transmission fluids are obtained under the conditions prescribed in those paragraphs.]

Amdt. 29-26, Eff. 10/3/88

FAR 29.1043 : Cooling tests.

- (a) General. For the tests prescribed in Sec. 29.1041(c), the following apply :
 - (1) If the tests are conducted under conditions deviating from the maximum ambient atmospheric temperature specified in paragraph (b) of this section, the recorded powerplant temperatures must be corrected under paragraphs (c) and (d) of this section, unless a more rational correction method is applicable.
 - (2) No corrected temperature determined under subparagraph (1) of this paragraph may exceed established limits.
 - (3) The fuel used during the cooling tests must be of the minimum grade approved for the engines, and the mixture settings must be those used in normal operation.
 - (4) The test procedures must be as prescribed in Secs. 29.1045 through 29.1049.
 - (5) [For the purposes of the cooling tests, a temperature is "stabilized" when its rate of change is less than 2°F per minute.]
- (b) *Maximum ambient atmospheric temperature.* A maximum ambient atmospheric temperature corresponding to sea level conditions of at least 100 degrees F. must be established. The assumed temperature lapse rate is 3.6 degrees F. per thousand feet of altitude above sea level until a temperature of -69.7 degrees F. is reached, above which altitude the temperature is considered constant at -69.7 degrees F. However, for winterization installations, the applicant may select a maximum ambient atmospheric temperature corresponding to sea level conditions of less than 100 degrees F.
- (c) *Correction factor (except cylinder barrels).* Unless a more rational correction applies, temperatures of engine fluids and powerplant components (except cylinder barrels) for which temperature limits are established, must be corrected

Chapitre 18
Subpart F—Production Under
Type Certificate Only

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FAR 21.121 : Applicability.

This subpart prescribes rules for production under a type certificate only.

FAR 21.123 : Production under type certificate.

Each manufacturer of a product being manufactured under a type certificate only shall—

- (a) Make each product available for inspection by the Administrator ;
- (b) Maintain at the place of manufacture the technical data and drawings necessary for the Administrator to determine whether the product and its parts conform to the type design ;
- (c) Except as otherwise authorized by the [Aircraft Certification Directorate Manager for the geographic area] in which the manufacturer is located, for products manufactured more than 6 months after the date of issue of the type certificate, establish and maintain an approved production inspection system that ensures that each product conforms to the type design and is in condition for safe operation ; and
- (d) Upon the establishment of the approved production inspection system (as required by paragraph (c) of this section) submit to the Administrator a manual that describes that system and the means for making the determinations required by Sec. 21.125(b).

Amdt. 21-67, Eff. 10/25/89

FAR 21.125 : Production inspection system : Materials Review Board.

- (a) Each manufacturer required to establish a production inspection system by Sec. 21.123 (c) shall—
 - (1) Establish a Materials Review Board (to include representatives from the inspection and engineering departments) and materials review procedures ; and
 - (2) Maintain complete records of Materials Review Board action for at least two years.
- (b) The production inspection system required in Sec. 21.123 (c) must provide a means for determining at least the following :
 - (1) Incoming materials, and bought or subcontracted parts, used in the finished product must be as specified in the type design data, or must be suitable equivalents.
 - (2) Incoming materials, and bought or subcontracted parts, must be properly identified if their physical or chemical properties cannot be readily and accurately determined.
 - (3) Materials subject to damage and deterioration must be suitably stored and adequately protected.
 - (4) Processes affecting the quality and safety of the finished product must be accomplished in accordance with acceptable industry or United States specifications.
 - (5) Parts and components in process must be inspected for conformity with the type design data at points in production where accurate determinations can be made.

FAR 29.1023 : Oil radiators.

- (a) Each oil radiator must be able to withstand any vibration, inertia, and oil pressure loads to which it would be subjected in operation.
- (b) Each oil radiator air duct must be located, or equipped, so that, in case of fire, and with the airflow as it would be with and without the engine operating, flames cannot directly strike the radiator.

FAR 29.1025 : Oil valves.

- (a) Each oil shutoff must meet the requirements of Sec. 29.1189.
- (b) The closing of oil shutoffs may not prevent autorotation.
- (c) Each oil valve must have positive stops or suitable index provisions in the "on" or "off" positions and must be supported so that no loads resulting from its operation or from accelerated flight conditions are transmitted to the lines attached to the valve.

FAR 29.1027 : [Transmission and gearboxes : General.]

- (a) [The oil system for components of the rotor drive system that require continuous lubrication must be sufficiently independent of the lubrication systems of the engine(s) to ensure—
 - (1) Operation with any engine inoperative ; and
 - (2) Safe autorotation.
- (b) Pressure lubrication systems for transmissions and gearboxes must comply with the requirements of Secs. 29.1013, paragraphs (c), (d), and (f) only, 29.1015, 29.1017, 29.1021, 29.1023, and 29.1337(d). In addition, the system must have—
 - (1) An oil strainer or filter through which all the lubricant flows, and must—
 - (i) Be designed to remove from the lubricant any contaminant which may damage transmission and drive system components or impede the flow of lubricant to a hazardous degree ; and
 - (ii) Be equipped with a bypass constructed and installed so that—
 - (A) The lubricant will flow at the normal rate through the rest of the system with the strainer or filter completely blocked ; and
 - (B) The release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flowpath ;
 - (ii) Be equipped with a means to indicate collection of contaminants on the filter or strainer at or before opening of the bypass ;
- (2) For each lubricant tank or sump outlet supplying lubrication to rotor drive systems and rotor drive system components, a screen to prevent entrance into the lubrication system of any object that might obstruct the flow of lubricant from the outlet to the filter required by paragraph (b)(1) of this section. The requirements of paragraph (b)(1) of this section do not apply to screens installed at lubricant tank or sump outlets.
- (c) Splash type lubrication systems for rotor drive system gearboxes must comply with Secs. 29.1021 and 29.1337(d).]

Amdt. 29-26, Eff. 10/3/88

FAR 29.1017 : Oil lines and fittings.

- (a) Each oil line must meet the requirements of Sec. 29.993.
- (b) Breather lines must be arranged so that—
 - (1) Condensed water vapor that might freeze and obstruct the line cannot accumulate at any point;
 - (2) The breather discharge will not constitute a fire hazard if foaming occurs, or cause emitted oil to strike the pilot's windshield; and
 - (3) The breather does not discharge into the engine air induction system.

FAR 29.1019 : Oil strainer or filter.

- (a) Each turbine engine installation must incorporate an oil strainer or filter through which all of the engine oil flows and which meets the following requirements :
 - (1) Each oil strainer or filter that has a bypass must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter completely blocked.
 - (2) The oil strainer or filter must have the capacity (with respect to operating limitation established for the engine) to ensure that engine oil system functioning is not impaired when the oil is contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine under Part 33 of this chapter.
 - (3) [The oil strainer or filter, unless it is installed at an oil tank outlet, must incorporate a means to indicate contamination before it reaches the capacity established in accordance with paragraph (a)(2) of this section.]
 - (4) The bypass of a strainer or filter must be constructed and installed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.
 - (5) An oil strainer or filter that has no bypass, except one that is installed at an oil tank outlet, must have a means to connect it to the warning system required in Sec. 29.1305(a)(18).

- (b) Each oil strainer or filter in a powerplant installation using reciprocating engines must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.

Amdt. 29-26, Eff. 10/3/88

FAR 29.1021 : Oil system drains.

[A drain [or drains] must be provided to allow safe drainage of the oil system. Each drain must—

- (a) Be accessible; and
 - (b) Have manual or automatic means for positive locking in the closed position.]
- Amdt. 29-22, Eff. 3/26/84

- (6) Current design drawings must be readily available to manufacturing and inspection personnel, and used when necessary.
- (7) Design changes, including material substitutions, must be controlled and approved before being incorporated in the finished product.
- (8) Rejected materials and parts must be segregated and identified in a manner that precludes installation in the finished product.
- (9) Materials and parts that are withheld because of departures from design data or specifications, and that are to be considered for installation in the finished product, must be processed through the Materials Review Board. Those materials and parts determined by the Board to be serviceable must be properly identified and reinspected if rework or repair is necessary. Materials and parts rejected by the Board must be marked and disposed of to ensure that they are not incorporated in the final product.
- (10) Inspection records must be maintained, identified with the completed product where practicable, and retained by the manufacturer for at least two years.

FAR 21.127 : Tests : aircraft.

- (a) Each person manufacturing aircraft under a type certificate only shall establish an approved production flight test procedure and flight check-off form, and in accordance with that form, flight test each aircraft produced.
- (b) Each production flight test procedure must include the following :
 - (1) An operational check of the trim, controllability, or other flight characteristics to establish that the production aircraft has the same range and degree of control as the prototype aircraft.
 - (2) An operational check of each part or system operated by the crew while in flight to establish that, during flight, instrument readings are within normal range.
 - (3) A determination that all instruments are properly marked, and that all placards and required flight manuals are installed after flight test.
 - (4) A check of the operational characteristics of the aircraft on the ground.
 - (5) A check on any other items peculiar to the aircraft being tested that can best be done during the ground or flight operation of the aircraft.

FAR 21.128 : Tests : aircraft engines.

- (a) Each person manufacturing aircraft engines under a type certificate only shall subject each engine (except rocket engines for which the manufacturer must establish a sampling technique) to an acceptable test run that includes the following :
 - (1) Break-in runs that include a determination of fuel and oil consumption and a determination of power characteristics at [rated maximum continuous power or thrust and, if applicable, at rated takeoff power or thrust.]
 - (2) At least five hours of operation at [rated maximum continuous power or thrust. For engines having a rated takeoff power or thrust higher than rated maximum continuous power or thrust, the five-hour run must include 30 minutes at rated takeoff power or thrust.]

- (b) The test runs required by paragraph (a) of this section may be made with the engine appropriately mounted and using current types of power and thrust measuring equipment.

Amdt. 21-15, Eff. 4/3/67

FAR 21.129 : Tests : propellers.

Each person manufacturing propellers under a type certificate only shall give each variable pitch propeller an acceptable functional test to determine if it operates properly throughout the normal range of operation.

FAR 21.130 : Statement of conformity.

[Each holder or licensee of a type certificate only, for a product manufactured in the United States, shall, upon the initial transfer by him of the ownership of such product manufactured under that type certificate, or upon application for the original issue of an aircraft airworthiness certificate or an aircraft engine or propeller airworthiness approval tag (FAA Form 8130-3), give the Administrator a statement of conformity (FAA Form 317). This statement must be signed by an authorized person who holds a responsible position in the manufacturing organization, and must include—]

- (a) For each product, a statement that the product conforms to its type certificate and is in condition for safe operation;
 - (b) For each aircraft, a statement that the aircraft has been flight checked; and
 - (c) For each aircraft engine or variable pitch propeller, a statement that the engine or propeller has been subjected by the manufacturer to a final operational check. However, in the case of a product manufactured for an Armed Force of the United States, a statement of conformity is not required if the product has been accepted by that Armed Force.]
- Amdt. 21-25, Eff. 10/5/69

- (1) [Each oil tank used with a reciprocating engine has an expansion space of not less than the greater of 10 percent of the tank capacity or 0.5 gallon, and each oil tank used with a turbine engine has an expansion space of not less than 10 percent of the tank capacity.]
 - (2) Each reserve oil tank not directly connected to any engine has an expansion space of not less than 2 percent of the tank capacity; and
 - (3) It is impossible to fill the expansion space inadvertently with the rotorcraft in the normal ground attitude.
 - (c) *Filler connection.* Each recessed oil tank filler connection that can retain any appreciable quantity of oil must have a drain that discharges clear of the entire rotorcraft. In addition—
 - (1) Each oil tank filler cap must provide an oil-tight seal under the pressure expected in operation;
 - (2) For category A rotorcraft, each oil tank filler cap or filler cap cover must incorporate features that provide a warning when caps are not fully locked or seated on the filler connection; and
 - (3) Each oil filler must be marked under Sec. 29.1557(c)(2).
 - (d) *Vent.* Oil tanks must be vented as follows :
 - (1) Each oil tank must be vented from the top part of the expansion space so that venting is effective under all normal flight conditions.
 - (2) Oil tank vents must be arranged so that condensed water vapor that might freeze and obstruct the line cannot accumulate at any point.
 - (e) *Outlet.* There must be means to prevent entrance into the tank itself, or into the tank outlet, of any object that might obstruct the flow of oil through the system. No oil tank outlet may be enclosed by a screen or guard that would reduce the flow of oil below a safe value at any operating temperature. There must be a shutoff valve at the outlet of each oil tank used with a turbine engine unless the external portion of the oil system (including oil tank supports) is fireproof.]
 - (f) *Flexible liners.* Each flexible oil tank liner must be approved or shown to be suitable for the particular installation.
- Amdt. 29-10, Eff. 10/31/74

FAR 29.1015 : Oil tank tests.

Each oil tank must be designed and installed so that—

- (a) It can withstand, without failure, any vibration, inertia, and fluid loads to which it may be subjected in operation; and
 - (b) [It meets the requirements of Sec. 29.965, except that instead of the pressure specified in Sec. 29.965(b)—
 - (1) For pressurized tanks used with a turbine engine, the test pressure may not be less than 5 p.s.i. plus the maximum operating pressure of the tank; and
 - (2) For all other tanks, the test pressure may not be less than 5 p.s.i.]
- Amdt. 29-10, Eff. 10/31/74

- (2) No hazard results from fuel or fuel vapors which impinge on any part of the rotorcraft during fuel jettisoning ; and
- (3) Controllability of the rotorcraft remains satisfactory throughout the fuel jettisoning operation.
- (c) Means must be provided to automatically prevent jettisoning fuel below the level required for an all-engine climb at maximum continuous power from sea level to 5,000 feet altitude and cruise thereafter for 30 minutes at maximum range engine power.
- (d) The controls for any fuel jettisoning system must be designed to allow flight personnel (minimum crew) to safely interrupt fuel jettisoning during any part of the jettisoning operation.
- (e) The fuel jettisoning system must be designed to comply with the powerplant installation requirements of Sec. 29.901(c).
- (f) An auxiliary fuel jettisoning system which meets the requirements of paragraphs (a), (b), (d), and (e) of this section may be installed to jettison additional fuel provided it has separate and independent controls.]

Amdt. 29-26, Eff. 10/3/88

75.5 Oil System

FAR 29.1011 : Engines : General.

- (a) Each engine must have an independent oil system that can supply it with an appropriate quantity of oil at a temperature not above that safe for continuous operation.
- (b) [The usable oil capacity of each system may not be less than the product of the endurance of the rotorcraft under critical operating conditions and the maximum allowable oil consumption of the engine under the same conditions, plus a suitable margin to ensure adequate circulation and cooling. Instead of a rational analysis of endurance and consumption, a usable oil capacity of one gallon for each 40 gallons of usable fuel may be used for reciprocating engine installations.
- (c) Oil-fuel ratios lower than those prescribed in paragraph (b) of this section may be used if they are substantiated by data on the oil consumption of the engine.
- (d) | The ability of the engine oil cooling provisions to maintain the oil temperature at or below the maximum established value must be shown under the applicable requirements of Secs. 29.1041 through 29.1049.

Amdt. 29-26, Eff. 10/3/88

FAR 29.1013 : Oil tanks.

- (a) [Installation. Each oil tank installation must meet the requirements of Sec. 29.967.]
- (b) Expansion space. Oil tank expansion space must be provided so that—

Chapitre 19

Subpart G—Production Certificates

Sommaire

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FAR 21.131 : Applicability.

This subpart prescribes procedural requirements for the issue of production certificates and rules governing the holders of those certificates.

FAR 21.133 : Eligibility.

(a) Any person may apply for a production certificate if he holds, for the product concerned, a—

- (1) Current type certificate;
 - (2) Right to the benefits of that type certificate under a licensing agreement; or
 - (3) Supplemental type certificate.
- (b) Each application for a production certificate must be made in a form and manner prescribed by the Administrator.

FAR 21.135 : Requirements for issuance.

An applicant is entitled to a production certificate if the Administrator finds, after examination of the supporting data and after inspection of the organization and production facilities, that the applicant has complied with Secs. 21.139 and 21.143.

FAR 21.137 : Location of manufacturing facilities.

The Administrator does not issue a production certificate if the manufacturing facilities concerned are located outside the United States, unless the Administrator finds no undue burden on the United States in administering the applicable requirements of the Federal Aviation Act of 1958 or of the Federal Aviation Regulations.

FAR 21.139 : Quality control.

The applicant must show that he has established and can maintain a quality control system for any product, for which he requests a production certificate, so that each article will meet the design provisions of the pertinent type certificate.

FAR 21.143 : Quality control data requirements; prime manufacturer.

- (a) Each applicant must submit, for approval, data describing the inspection and test procedures necessary to ensure that each article produced conforms to the type design and is in a condition for safe operation, including as applicable—
 - (1) A statement describing assigned responsibilities and delegated authority of the quality control organization, together with a chart indicating the functional relationship of the quality control organization to management and to other organizational components, and indicating the chain of authority and responsibility within the quality control organization;
 - (2) A description of inspection procedures for raw materials, purchased items, and parts and assemblies produced by [manufacturers' suppliers], including methods used to ensure acceptable quality of parts and assemblies that cannot be completely inspected for conformity and quality when delivered to the prime manufacturer's plant;

FAR 29.997 : Fuel strainer or filter.

[There must be a fuel strainer or filter between the fuel tank outlet and the inlet of the first fuel system component which is susceptible to fuel contamination, including but not limited to the fuel metering device or an engine positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must—]

- (a) Be accessible for draining and cleaning and must incorporate a screen or element which is easily removable;
- (b) Have a sediment trap and drain, except that it need not have a drain if the strainer or filter is easily removable for drain purposes;
- (c) Be mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter itself, unless adequate strength margins under all loading conditions are provided in the lines and connections; and
- (d) [Provide a means to remove from the fuel any contaminant which would jeopardize the flow of fuel through rotorcraft or engine fuel system components required for proper rotorcraft or engine fuel system operation]

Amld. 29-26, Eff. 10/3/88

FAR 29.999 : Fuel system drains.

- (a) [There must be at least one accessible drain at the lowest point in each fuel system to completely drain the system with the rotorcraft in any ground attitude to be expected in service.]
 - (b) Each drain required by paragraph (a) of this section including the drains prescribed in Sec. 29.971 must—
 - (1) Discharge clear of all parts of the rotorcraft;
 - (2) [Have manual or automatic means to ensure positive closure in the off position; and]
 - (3) Have a drain valve—
 - (i) That is readily accessible and which can be easily opened and closed; and
 - (ii) That is either located or protected to prevent fuel spillage in the vent of a landing with landing gear retracted.
- Amld. 29-26, Eff. 10/3/88
- FAR 29.1001 : [Fuel jettisoning.]**
- [If a fuel jettisoning system is installed, the following apply :
- (a) Fuel jettisoning must be safe during all flight regimes for which jettisoning is to be authorized.
 - (b) In showing compliance with paragraph (a) of this section, it must be shown that—
 - (1) The fuel jettisoning system and its operation are free from fire hazard;

75.4 Fuel System Components

FAR 29.991 : Fuel pumps.

- (a) [Compliance with Sec. 29.955 must not be jeopardized by failure of—
- (1) Any one pump except pumps that are approved and installed as parts of a type certificated engine; or
 - (2) Any component required for pump operation except the engine served by that pump.
- (b) The following fuel pump installation requirements apply :
- (1) When necessary to maintain the proper fuel pressure—
 - (i) A connection must be provided to transmit the carburetor air intake static pressure to the proper fuel pump relief valve connection; and
 - (ii) The gauge balance lines must be independently connected to the carburetor inlet pressure to avoid incorrect fuel pressure readings.
 - (2) The installation of fuel pumps having seals or diaphragms that may leak must have means for draining leaking fuel.
 - (3) Each drain line must discharge where it will not create a fire hazard.]

Amdt. 29-26, Eff. 10/3/88

FAR 29.993 : Fuel system lines and fittings.

- (a) Each fuel line must be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure, valve actuation, and accelerated flight conditions.
- (b) Each fuel line connected to components of the rotorcraft between which relative motion could exist must have provisions for flexibility.
- (c) Each flexible connection in fuel lines that may be under pressure or subjected to axial loading must use flexible hose assemblies.
- (d) Flexible hose must be approved.
- (e) No flexible hose that might be adversely affected by high temperatures may be used where excessive temperatures will exist during operation or after engine shutdown.

FAR 29.995 : Fuel valves.

In addition to meeting the requirements of Sec. 29.1189, each fuel valve must—

- (a) [[Reserved.]]
- (b) Be supported so that no loads resulting from their operation or from accelerated flight conditions are transmitted to the lines attached to the valve.

Amdt. 29-13, Eff. 5/2/77

- (3) A description of the methods used for production inspection of individual parts and complete assemblies, including the identification of any special manufacturing processes involved, the means used to control the processes, the final test procedure for the complete product, and, in the case of aircraft, a copy of the manufacturer's production flight test procedures and checkoff list ;
 - (4) An outline of the materials review system, including the procedure for recording review board decisions and disposing of rejected parts ;
 - (5) An outline of a system for informing company inspectors of current changes in engineering drawings, specifications, and quality control procedures; and
 - (6) A list or chart showing the location and type of inspection stations.
- (b) Each prime manufacturer shall make available to the Administrator information regarding all delegation of authority to [suppliers] to make major inspections of parts or assemblies for which the prime manufacturer is responsible.
- Amdt. 21-51, Eff. 10/14/80

FAR 21.147 : Changes in quality control system.

After the issue of a production certificate, each change to the quality control system is subject to review by the Administrator. The holder of a production certificate shall immediately notify the Administrator, in writing, of any change that may affect the inspection, conformity, or airworthiness of the product.

FAR 21.149 : Multiple products.

The Administrator may authorize more than one type certificated product to be manufactured under the terms of one production certificate, if the products have similar production characteristics.

FAR 21.151 : Production limitation record.

A production limitation record is issued as part of a production certificate. The record lists the type certificate of every product that the applicant is authorized to manufacture under the terms of the production certificate.

FAR 21.153 : Amendment of the production certificates.

The holder of a production certificate desiring to amend it to add a type certificate or model, or both, must apply therefor in a form and manner prescribed by the Administrator. The applicant must comply with the applicable requirements of Secs. 21.139, 21.143, and 21.147.

FAR 21.155 : Transferability.

A production certificate is not transferable.

FAR 21.157 : Inspections and tests.

Each holder of a production certificate shall allow the Administrator to make any inspections and tests necessary to determine compliance with the applicable regulations in this subchapter.

FAR 21.159 : Duration.

A production certificate is effective until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator, or the location of the manufacturing facility is changed.

FAR 21.161 : Display.

The holder of a production certificate shall display it prominently in the main office of the factory in which the product concerned is manufactured.

FAR 21.163 : Privileges.

(a) [The holder of a production certificate may—

(1) Obtain an aircraft airworthiness certificate without further showing, except that the Administrator may inspect the aircraft for conformity with the type design ; or

(2) In the case of other products, obtain approval for installation on type certified aircraft.

(b) Notwithstanding the provisions of Sec. 147.3 of this chapter, the holder of a production certificate for a primary category aircraft, or for a normal, utility, or acrobatic category aircraft of a type design that is eligible for a special airworthiness certificate in the primary category under Sec. 21.184(c), may—

(1) Conduct training for persons in the performance of a special inspection and preventive maintenance program approved as a part of the aircraft's type design under Sec. 21.24(b), provided the training is given by a person holding a mechanic certificate with appropriate airframe and powerplant ratings issued under part 65 of this chapter ; and

(2) Issue a certificate of competency to persons successfully completing the approved training program, provided the certificate specifies the aircraft make and model to which the certificate applies.]

Amdt. 21-70, Eff. 12/31/92

FAR 21.165 : Responsibility of holder.

The holder of a production certificate shall—

(a) Maintain the quality control system in conformity with the data and procedures approved for the production certificate ; and

(b) Determine that each part and each completed [product, including primary category aircraft assembled under a production certificate by another person from a kit provided by the holder of the production certificate.] submitted for airworthiness certification or approval conforms to the approved design and is in a condition for safe operation.

Amdt. 21-70, Eff. 12/31/92

(ii) From which fumes could enter personnel compartments ; and

(7) [The venting system must be designed to minimize spillage of fuel through the vents to an ignition source in the event of a rollover during landing, ground operations, or a survivable impact.]

(b) *Carburetor vapor vents.* Each carburetor with vapor elimination connections must have a vent line to lead vapors back to one of the fuel tanks. In addition—

(1) Each vent system must have means to avoid stoppage by ice ; and

(2) If there is more than one fuel tank, and it is necessary to use the tanks in a definite sequence, each vapor vent return line must lead back to the fuel tank used for takeoff and landing.

Amdt. 29-42, Eff. 9/8/98

FAR 29.977 Fuel tank outlet.

(a) [There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must—

(1) For reciprocating engine powered airplanes, have 8 to 16 meshes per inch ; and

(2) For turbine engine powered airplanes, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

(b) The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line.

(c) The diameter of each strainer must be at least that of the fuel tank outlet.

(d) Each finger strainer must be accessible for inspection and cleaning.]

Amdt. 29-12, Eff. 2/1/77

FAR 29.979 : Pressure refueling and fueling provisions below fuel level.

(a) Each fueling connection below the fuel level in each tank must have means to prevent the escape of hazardous quantities of fuel from that tank in case of malfunction of the fuel entry valve.

(b) For systems intended for pressure refueling, a means in addition to the normal means for limiting the tank content must be installed to prevent damage to the tank in case of failure of the normal means.

(c) [The rotorcraft pressure fueling system (not fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum surge pressure, including surge, that is likely to occur during fueling. The maximum surge pressure must be established with any combination of tank valves being either intentionally or inadvertently closed.

(d) The rotorcraft defueling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum permissible defueling pressure (positive or negative) at the rotorcraft fueling connection.]

Amdt. 29-12, Eff. 2/1/77

- (c) [Each fuel tank must allow drainage of hazardous quantities of water from each part of the tank to the sump with the rotorcraft in any ground attitude to be expected in service,]
- (d) Each fuel tank sump must have a drain that allows complete drainage of the sump on the ground.

Amdt. 29-26, Eff. 10/3/88

FAR 29.973 : Fuel tank filler connection.

- (a) [Each fuel tank filler connection must prevent the entrance of fuel into any part of the rotorcraft other than the tank itself during normal operations and must be crash resistant during a survivable impact in accordance with Sec. 29.952(c). In addition—
- (1) Each filler must be marked as prescribed in Sec. 29.1557(c)(1);
- (2) Each recessed filler connection that can retain any appreciable quantity of fuel must have a drain that discharges clear of the entire rotorcraft; and
- (3) Each filler cap must provide a fuel-tight seal under the fluid pressure expected in normal operation and in a survivable impact.
- (b) Each filler cap or filler cap cover must warn when the cap is not fully locked or seated on the filler connection,]

Amdt. 29-35, Eff. 11/2/94

FAR 29.975 : Fuel tank vents and carburetor vapor vents.

- (a) *Fuel tank vents.* Each fuel tank must be vented from the top part of the expansion space so that venting is effective under normal flight conditions. In addition—
- (1) The vents must be arranged to avoid stoppage by dirt or ice formation;
- (2) The vent arrangement must prevent siphoning of fuel during normal operation;
- (3) The venting capacity and vent pressure levels must maintain acceptable differences of pressure between the interior and exterior of the tank during—
- (i) Normal flight operation;
- (ii) Maximum rate of ascent and descent; and
- (iii) Refueling and defueling (where applicable);
- (4) Airspaces of tanks with interconnected outlets must be interconnected;
- (5) There may be no point in any vent line where moisture can accumulate with the rotorcraft in the ground attitude or the level flight attitude, unless drainage is provided;
- (6) No vent or drainage provision may end at any point—
- (i) Where the discharge of fuel from the vent outlet would constitute a fire hazard; or

Chapitre 20

Subpart H—Airworthiness Certificates

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FAR 21.171 : Applicability.

This subpart prescribes procedural requirements for the issue of airworthiness certificates.

FAR 21.173 : Eligibility.

[Any registered owner of a U.S.-registered aircraft (or the agent of the owner) may apply for an airworthiness certificate for that aircraft. An application for an airworthiness certificate must be made in a form and manner acceptable to the Administrator, and may be submitted to any FAA office.]
Amdt. 21-26, Eff. 9/30/69

FAR 21.175 : Airworthiness certificates : classification.

- (a) Standard airworthiness certificates are airworthiness certificates issued for aircraft type certificated in the normal, utility, acrobatic, commuter, or transport category, and for manned free balloons, and for aircraft designated by the Administrator as special classes of aircraft.
- (b) Special airworthiness certificates are [primary] restricted, limited, and provisional airworthiness certificates, special flight permits and experimental certificates.
Amdt. 21-70, Eff. 12/31/92

FAR 21.177 : Amendment or modification.

An airworthiness certificate may be amended or modified only upon application to the Administrator.

FAR 21.179 : Transferability.

An airworthiness certificate is transferred with the aircraft.

FAR 21.181 : Duration.

- (a) Unless sooner surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator, airworthiness certificates are effective as follows :
 - (1) Standard airworthiness certificates, [special airworthiness certificates-primary category], and airworthiness certificates issued for restricted or limited category aircraft are effective as long as the maintenance, preventive maintenance, and alterations are performed in accordance with Parts 43 and 91 of this chapter and the aircraft are registered in the United States.
 - (2) A special flight permit is effective for the period of time specified in the permit.
 - (3) An experimental certificate for research and development, showing compliance with regulations, crew training, or market surveys is effective for one year after the date of issue or renewal unless a shorter period is prescribed by the Administrator. The duration of amateur-built, exhibition, and air-racing experimental certificates will be unlimited unless the Administrator finds for good cause that a specific period should be established.
- (b) The owner, operator, or bailee of the aircraft shall, upon request, make it available for inspection by the Administrator.

Amdt. 29-13, Eff. 5/2/77

FAR 29.967 : Fuel tank installation.

- (a) Each fuel tank must be supported so that tank loads are not concentrated on unsupported tank surfaces. In addition—
 - (1) There must be pads, if necessary, to prevent chafing between each tank and its supports ;
 - (2) The padding must be nonabsorbent or treated to prevent the absorption of fuel ;
 - (3) If flexible tank liners are used, they must be supported so that they are not required to withstand fluid loads ; and
 - (4) Each interior surface of tank compartments must be smooth and free of projections that could cause wear of the liner, unless—
 - (i) There are means for protection of the liner at those points ; or
 - (ii) The construction of the liner itself provides such protection.
 - (b) Any spaces adjacent to tank surfaces must be adequately ventilated to avoid accumulation of fuel or fumes in those spaces due to minor leakage. If the tank is in a sealed compartment, ventilation may be limited to drain holes that prevent clogging and that prevent excessive pressure resulting from altitude changes. If flexible tank liners are installed, the venting arrangement for the spaces between the liner and its container must maintain the proper relationship to tank vent pressures for any expected flight condition.
 - (c) The location of each tank must meet the requirements of Sec. 29.1185(b) and (c).
 - (d) No rotorcraft skin immediately adjacent to a major air outlet from the engine compartment may act as the wall of an integral tank.
 - (e) [[Removed]]
Amdt. 29-35, Eff. 11/2/94
- FAR 29.969 : Fuel tank expansion space.**
- [Each fuel tank or each group of fuel tanks with interconnected vent systems must have an expansion space of not less than 2 percent of the combined tank capacity. It must be impossible to fill the fuel tank expansion space inadvertently with the rotorcraft in the normal ground attitude.]
Amdt. 29-26, Eff. 10/3/88
- FAR 29.971 : Fuel tank sump.**
- (a) Each fuel tank must have a sump with a capacity of not less than the greater of—
 - (1) 0.10 percent of the tank capacity or—
 - (2) One-sixteenth gallon.
 - (b) The capacity prescribed in paragraph (a) of this section must be effective with the rotorcraft in any normal attitude, and must be located so that the sump contents cannot escape through the tank outlet opening.

- (b) Each conventional metal tank, each nonmetallic tank with walls that are not supported by the rotorcraft structure, and each integral tank must be subjected to a pressure of 3.5 p.s.i. unless the pressure developed during maximum limit acceleration or emergency deceleration with a full tank exceeds this value, in which case a hydrostatic head, or equivalent test, must be applied to duplicate the acceleration loads as far as possible. However, the pressure need not exceed 3.5 p.s.i. on surfaces not exposed to the acceleration loading.
- (c) Each nonmetallic tank with walls supported by the rotorcraft structure must be subjected to the following tests :
- (1) A pressure test of at least 2.0 p.s.i. This test may be conducted on the tank alone in conjunction with the test specified in subparagraph (2) of this paragraph.
 - (2) A pressure test, with the tank mounted in the rotorcraft structure, equal to the load developed by the reaction of the contents, with the tank full, during maximum limit acceleration or emergency deceleration. However, the pressure need not exceed 2.0 p.s.i. on surfaces not exposed to the acceleration loading.
 - (d) Each tank with large unsupported or unstiffened flat areas, or with other features whose failure or deformation could cause leakage, must be subjected to the following test or its equivalent :
 - (1) Each complete tank assembly and its supports must be vibration tested while mounted to simulate the actual installation.
 - (2) The tank assembly must be vibrated for 25 hours while two-thirds full of any suitable fluid. The amplitude of vibration may not be less than one thirty-second of an inch unless otherwise substantiated.
 - (3) The test frequency of vibration must be as follows :
 - (i) If no frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, the test frequency of vibration, in number of cycles per minute, must, unless a frequency based on a more rational analysis is used, be the number obtained by averaging the maximum and minimum power-on engine speeds (r.p.m.) for reciprocating engine powered rotorcraft or 2,000 c.p.m. for turbine engine powered rotorcraft.]
 - (ii) If only one frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, that frequency of vibration must be the test frequency.
 - (iii) If more than one frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, the most critical of these frequencies must be the test frequency.
 - (4) Under subparagraph (3)(i) and (iii), the time of test must be adjusted to accomplish the same number of vibration cycles as would be accomplished in 25 hours at the frequency specified in subparagraph (3)(i).
 - (5) During the test, the tank assembly must be rocked at the rate of 16 to 20 complete cycles per minute through an angle of 15° on both sides of the horizontal (30° total), about the most critical axis, for 25 hours. If motion about more than one axis is likely to be critical, the tank must be rocked about each critical axis for 12 1/2 hours.

- (c) Upon suspension, revocation, or termination by order of the Administrator of an airworthiness certificate, the owner, operator, or bailee of an aircraft shall, upon request, surrender the certificate to the Administrator.
- Amdt. 21-70, Eff. 12/31/92

FAR 21.182 : Aircraft identification.

- (a) Except as provided in paragraph (b) of this section, each applicant for an airworthiness certificate under this subpart must show that his aircraft is identified as prescribed in Sec. 45.11.
- (b) Paragraph (a) of this section does not apply to applicants for the following :
- (1) A special flight permit.
 - (2) [An experimental certificate for an aircraft that is not amateur-built or kit-built].
 - (3) A change from one airworthiness classification to another, for an aircraft already identified as prescribed in Sec. 45.11.
- Amdt. 21-70, Eff. 12/31/92

FAR 21.183 : Issue of standard airworthiness certificates for normal, utility, acrobatic, commuter, and transport category aircraft ; manned free balloons ; and special classes of aircraft.

- (a) *New aircraft manufactured under a production certificate.* An applicant for a standard airworthiness certificate for a new aircraft manufactured under a production certificate is entitled to a standard airworthiness certificate without further showing, except that the Administrator may inspect the aircraft to determine conformity to the type design and condition for safe operation.
- (b) *New aircraft manufactured under type certificate only.* An applicant for a standard airworthiness certificate for a new aircraft manufactured under a type certificate only is entitled to a standard airworthiness certificate upon presentation, by the holder or licensee of the type certificate, of the statement of conformity prescribed in Sec. 21.130 if the Administrator finds after inspection that the aircraft conforms to the type design and is in condition for safe operation.
- (c) *Import aircraft.* An applicant for a standard airworthiness certificate for an import aircraft type certificated in accordance with Sec. 21.29 of this Part is entitled to an airworthiness certificate if the country in which the aircraft was manufactured certifies, and the Administrator finds, that the aircraft conforms to the type design and is in condition for safe operation.
- (d) *Other aircraft.* An applicant for a standard airworthiness certificate for aircraft not covered by paragraphs (a) through (c) of this section is entitled to a standard airworthiness certificate if—
- (1) He presents evidence to the Administrator that the aircraft conforms to a type design approved under a type certificate or a supplemental type certificate and to applicable Airworthiness Directives ;
 - (2) The aircraft (except an experimentally certificated aircraft that previously had been issued a different airworthiness certificate under this section) has been inspected in accordance with the performance rules for 100-hour inspections set forth in Sec. 43.15 of this chapter and found airworthy by—

- (i) The manufacturer;
 - (ii) The holder of a repair station certificate as provided in Part 145 of this chapter;
 - (iii) The holder of a mechanic certificate as authorized in Part 65 of this chapter; or
 - (iv) The holder of a certificate issued under Part 121 of this chapter, and having a maintenance and inspection organization appropriate to the aircraft type; and
- (3) The Administrator finds after inspection, that the aircraft conforms to the type design, and is in condition for safe operation.
- (e) *Noise requirements.* Notwithstanding all other provisions of this section, the following must be complied with for the original issuance of a standard airworthiness certificate :
- (1) For transport category large airplanes and turbojet powered airplanes that have not had any flight time before the dates specified in Sec. 36.1(d), no standard airworthiness certificate is originally issued under this section unless the Administrator finds that the type design complies with the noise requirements in Sec. 36.1(d) in addition to the applicable airworthiness requirements in this section. For import airplanes, compliance with this paragraph is shown if the country in which the airplane was manufactured certifies, and the Administrator finds, that Sec. 36.1(d) (or the applicable airplane noise requirements of the country in which the airplane was manufactured and any other requirements the Administrator may prescribe to provide noise levels no greater than those provided by compliance with Sec. 36.1(d) and paragraph (c) of this section are complied with.
 - (2) For normal, utility, acrobatic, commuter, or transport category propeller driven small airplanes (except for airplanes that are designed for "agricultural aircraft operations" (as defined in Sec. 137.3 of this chapter, as effective on January 1, 1966) or for dispensing fire fighting materials to which Sec. 36.1583 of this chapter does not apply) that have not had any flight time before the applicable date specified in Part 36 of this chapter, no standard airworthiness certificate is originally issued under this section unless the applicant shows that the design complies with the applicable noise requirements of Part 36 of this chapter in addition to the applicable airworthiness requirements in this section. For import airplanes, compliance with this paragraph is shown if the country in which the airplane was manufactured certifies, and the Administrator finds, that the applicable requirements of Part 36 of this chapter (or the applicable airplane noise requirements of the country in which the airplane was manufactured and any other requirements the Administrator may prescribe to provide noise levels no greater than those provided by compliance with the applicable requirements of Part 36 of this chapter) and paragraph (c) of this section are complied with.
 - (f) *Passenger emergency exit requirements.* Notwithstanding all other provisions of this section, each applicant for issuance of a standard airworthiness certificate for a transport category airplane manufactured after October 16, 1987, must show that the airplane meets the requirements of Sec. 25.807(c)(7) in effect on July 24, 1989. For the purposes of this paragraph, the date of manufacture of an airplane is the

- (1) The design of the vents and the fuel transfer system must prevent structural damage to tanks from overfilling; and
- (2) There must be means to warn the crew before overflow through the vents occurs.

FAR 29.959 : Unusable fuel supply.

The unusable fuel supply for each tank must be established as not less than the quantity at which the first evidence of malfunction occurs under the most adverse fuel feed condition occurring under any intended operations and flight maneuvers involving that tank.

FAR 29.961 : Fuel system hot weather operation.

[Each suction lift fuel system and other fuel systems conducive to vapor formation must be shown to operate satisfactorily (within certification limits) when using fuel at the most critical temperature for vapor formation under critical operating conditions including, if applicable, the engine operating conditions defined by Sec. 29.927(b)(1) and (b)(2).]
Amdt. 29-26, Eff. 10/3/88

FAR 29.963 : Fuel tanks : General.

- (a) Each fuel tank must be able to withstand, without failure, the vibration, inertia, fluid, and structural loads to which it may be subjected in operation.
 - (b) [Each flexible fuel tank bladder or liner must be approved or shown to be suitable for the particular application and must be puncture resistant. Puncture resistance must be shown by meeting the ISO-C80, paragraph 16.0, requirements using a minimum puncture force of 370 pounds.
 - (c) Each integral fuel tank liner must have facilities for inspection and repair of its interior.
 - (d) The maximum exposed surface temperature of all components in the fuel tank must be less by a safe margin than the lowest expected autoignition temperature of the fuel or fuel vapor in the tank. Compliance with this requirement must be shown under all operating conditions and under all normal or malfunction conditions of all components inside the tank.
 - (e) Each fuel tank installed in personnel compartments must be isolated by flame-proof and fuel-proof enclosures that are drained and vented to the exterior of the rotorcraft. The design and construction of the enclosures must provide necessary protection for the tank, must be crash resistant during a survivable impact in accordance with Sec. 29.952, and must be adequate to withstand loads and abrasions to be expected in personnel compartments.]
Amdt. 29-35, Eff. 11/2/94
- FAR 29.965 : Fuel tank tests.**
- (a) Each fuel tank must be able to withstand the applicable pressure tests in this section without failure or leakage. If practicable, test pressures may be applied in a manner simulating the pressure distribution in service.

FAR 29.955 : Fuel flow.

- (a) [General. The fuel system for each engine must provide the engine with at least 100 percent of the fuel required under all operating and maneuvering conditions to be approved for the rotorcraft, including, as applicable, the fuel required to operate the engines under the test conditions required by Sec. 29.977. Unless equivalent methods are used, compliance must be shown by test during which the following provisions are met, except that combinations of conditions which are shown to be improbable need not be considered.
- (1) The fuel pressure, corrected for accelerations (load factors), must be within the limits specified by the engine type certificate data sheet.
 - (2) The fuel level in the tank may not exceed that established as the unusable fuel supply for that tank under Sec. 29.959, plus that necessary to conduct the test.
 - (3) The fuel head between the tank and the engine must be critical with respect to rotorcraft flight attitudes.
 - (4) The fuel flow transmitter, if installed, and the critical fuel pump (for pump-fed systems) must be installed to produce (by actual or simulated failure) the critical restriction to fuel flow to be expected from component failure.
 - (5) Critical values of engine rotational speed, electrical power, or other sources of fuel pump motive power must be applied.
 - (6) Critical values of fuel properties which adversely affect fuel flow are applied during demonstrations of fuel flow capability.
 - (7) The fuel filter required by sec. 29.997 is blocked to the degree necessary to simulate the accumulation of fuel contamination required to activate the indicator required by Sec. 29.1305(a)(17).
 - (b) *Fuel transfer system.* If normal operation of the fuel system requires fuel to be transferred to another tank, the transfer must occur automatically via a system which has been shown to maintain the fuel level in the receiving tank within acceptable limits during flight or surface operation of the rotorcraft.
 - (c) *Multiple fuel tanks.* If an engine can be supplied with fuel from more than one tank, the fuel system, in addition to having appropriate manual switching capability, must be designed to prevent interruption of fuel flow to the engine, without attention by the flightcrew, when any tank supplying fuel to that engine is depleted of usable fuel during normal operation and any other tank that normally supplies fuel to that engine alone contains usable fuel.]

Amdt. 29-26, Eff. 10/3/88

FAR 29.957 : Flow between interconnected tanks.

- (a) Where tank outlets are interconnected and allow fuel to flow between them due to gravity or flight accelerations, it must be impossible for fuel to flow between tanks in quantities great enough to cause overflow from the tank vent in any sustained flight condition.
- (b) If fuel can be pumped from one tank to another in flight—

date the inspection acceptance records reflect that the airplane is complete and meets the FAA-approved type design data.

- (g) *Fuel venting and exhaust emission requirements.* Notwithstanding all other provisions of this section, and irrespective of the date of application, no airworthiness certificate is issued, on and after the dates specified in part 34 for the airplanes specified therein, unless the airplane complies with the applicable requirements of that part.

Amdt. 21-81, Eff. 6/18/2002

FAR 21.184 : [Issue of special airworthiness certificates for primary category aircraft.]

- (a) [New primary category aircraft manufactured under a production certificate. An applicant for an original, special airworthiness certificate-primary category for a new aircraft that meets the criteria of Sec. 21.24(a)(1), manufactured under a production certificate, including aircraft assembled by another person from a kit provided by the holder of the production certificate and under the supervision and quality control of that holder, is entitled to a special airworthiness certificate without further showing, except that the Administrator may inspect the aircraft to determine conformity to the type design and condition for safe operation.
- (b) *Imported aircraft.* An applicant for a special airworthiness certificate-primary category for an imported aircraft type certificated under Sec. 21.29 is entitled to a special airworthiness certificate if the civil airworthiness authority of the country in which the aircraft was manufactured certifies, and the Administrator finds after inspection, that the aircraft conforms to an approved type design that meets the criteria of Sec. 21.24(a)(1) and is in a condition for safe operation.
- (c) *Aircraft having a current standard airworthiness certificate.* An applicant for a special airworthiness certificate-primary category, for an aircraft having a current standard airworthiness certificate that meets the criteria of Sec. 21.24(a)(1), may obtain the primary category certificate in exchange for its standard airworthiness certificate through the supplemental type certification process. For the purposes of this paragraph, a current standard airworthiness certificate means that the aircraft conforms to its approved normal, utility, or acrobatic type design, complies with all applicable airworthiness directives, has been inspected and found airworthy within the last 12 calendar months in accordance with Sec. 91.409(a)(1) of this chapter, and is found to be in a condition for safe operation by the Administrator.
- (d) *Other aircraft.* An applicant for a special airworthiness certificate-primary category for an aircraft that meets the criteria of Sec. 21.24(a)(1), and is not covered by paragraph (a), (b), or (c) of this section, is entitled to a special airworthiness certificate if—
 - (1) The applicant presents evidence to the Administrator that the aircraft conforms to an approved primary, normal, utility, or acrobatic type design, including compliance with all applicable airworthiness directives ;
 - (2) The aircraft has been inspected and found airworthy within the past 12 calendar months in accordance with Sec. 91.409(a)(1) of this chapter and ;
 - (3) The aircraft is found by the Administrator to conform to an approved type design and to be in a condition for safe operation.

- (e) *Multiple-category airworthiness certificates* in the primary category and any other category will not be issued; a primary category aircraft may hold only one airworthiness certificate.]

Amdt. 21-70, EFF. 12/31/92

FAR 21.185 : Issue of airworthiness certificates for restricted category aircraft.

- (a) *Aircraft manufactured under a production certificate or type certificate only.* An applicant for the original issue of a restricted category airworthiness certificate for an aircraft type certificated in the restricted category, that was not previously type certificated in any other category, must comply with the appropriate provisions of Sec. 21.183.

- (b) *Other aircraft.* An applicant for a restricted category airworthiness certificate for an aircraft type certificated in the restricted category, that was either a surplus aircraft of the Armed Forces or previously type certificated in another category, is entitled to an airworthiness certificate if the aircraft has been inspected by the Administrator and found by him to be in a good state of preservation and repair and in a condition for safe operation.

- (c) *Import aircraft.* An applicant for the original issue of a restricted category airworthiness certificate for an import aircraft type certificated in the restricted category only in accordance with Sec. 21.29 of this Part is entitled to an airworthiness certificate if the country in which the aircraft was manufactured certifies, and the Administrator finds, that the aircraft conforms to the type design and is in a condition for safe operation.

- (d) *[Noise requirements.* For propeller-driven small airplanes (except airplanes designed for "agricultural aircraft operations," as defined in Sec. 137.3 of this chapter, as effective on January 1, 1966, or for dispensing fire fighting materials) that have not had any flight time before the applicable date specified in Part 36 of this chapter, and notwithstanding the other provisions of this section, no original restricted category airworthiness certificate is issued under this section unless the Administrator finds that the type design complies with the applicable noise requirements of Part 36 of this chapter in addition to the applicable airworthiness requirements of this section. For import airplanes, compliance with this paragraph is shown if the country in which the airplane was manufactured certifies, and the Administrator finds, that the applicable requirements of Part 36 of this chapter (or the applicable airplane noise requirements of the country in which the airplane was manufactured and any other requirements the Administrator may prescribe to provide noise levels no greater than those provided by compliance with the applicable requirements of Part 36 of this chapter) and paragraph (c) of this section are complied with.]

Amdt. 21-42, EFF. 2/7/75

FAR 21.187 : Issue of multiple airworthiness certification.

- (a) [An applicant for an airworthiness certificate in the restricted category, and in one or more other categories except primary category, is entitled to the certificate, if—
(1) He shows compliance with the requirements for each category, when the aircraft is in configuration for that category; and

frangible or locally deformable, must be designed such that its separation or relative local deformation will occur without rupture or local tearing of the fuel tank or fuel system components that will cause fuel leakage. The ultimate strength of frangible or deformable attachments must be as follows :

- (1) The load required to separate a frangible attachment from its support structure, or deform a locally deformable attachment relative to its support structure, must be between 25 and 50 percent of the minimum ultimate load (ultimate strength) of the weakest component in the attached system. In no case may the load be less than 300 pounds.
- (2) A frangible or locally deformable attachment must separate or locally deform as intended whenever its ultimate load (as defined in paragraph (d)(1) of this section) is applied in the modes most likely to occur.

- (3) All frangible or locally deformable attachments must comply with the fatigue requirements of Sec. 29.571.

- (c) *Separation of fuel and ignition sources.* To provide maximum crash resistance, fuel must be located as far as practicable from all occupiable areas and from all potential ignition sources.

- (f) *Other basic mechanical design criteria.* Fuel tanks, fuel lines, electrical wires, and electrical devices must be designed, constructed, and installed, as far as practicable, to be crash resistant.

- (g) *Rigid or semirigid fuel tanks.* Rigid or semirigid fuel tank or bladder walls must be impact and tear resistant.]

Amdt. 29-35, EFF. 11/2/94

FAR 29.953 : Fuel system independence.

- (a) For category A rotorcraft—

- (1) The fuel system must meet the requirements of Sec. 29.903(b) ; and

- (2) Unless other provisions are made to meet subparagraph (1) of this paragraph, the fuel system must allow fuel to be supplied to each engine through a system independent of those parts of each system supplying fuel to other engines.

- (b) Each fuel system for a multiengine category B rotorcraft must meet the requirements of paragraph (a)(2) of this section. However, separate fuel tanks need not be provided for each engine.

FAR 29.954 : [Fuel system lightning protection.]

[The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by—

- (a) Direct lightning strikes to areas having a high probability of stroke attachment ;
(b) Swept lightning strokes to areas where swept strokes are highly probable ; and
(c) Corona and streamer at fuel vent outlets.]

Amdt. 29-26, EFF. 10/3/88

(3) For fuel tanks in other areas :

- (i) Upward-1.5g.
- (ii) Forward-4g.
- (iii) Sideward-2g.
- (iv) Downward-4g.

(c) *Fuel line self-sealing breakaway couplings.* Self-sealing breakaway couplings must be installed unless hazardous relative motion of fuel system components to each other or to local rotorcraft structure is demonstrated to be extremely improbable or unless other means are provided. The couplings or equivalent devices must be installed at all fuel tank-to-fuel line connections, tank-to-tank interconnects, and at other points in the fuel system where local structural deformation could lead to the release of fuel.

(1) The design and construction of self-sealing breakaway couplings must incorporate the following design features :

(i) The load necessary to separate a breakaway coupling must be between 25 to 50 percent of the minimum ultimate failure load (ultimate strength) of the weakest component in the fluid-carrying line. The separation load must in no case be less than 300 pounds, regardless of the size of the fluid line.

(ii) A breakaway coupling must separate whenever its ultimate load (as defined in paragraph (c)(1)(i) of this section) is applied in the failure modes most likely to occur.

(iii) All breakaway couplings must incorporate design provisions to visually ascertain that the coupling is locked together (leak-free) and is open during normal installation and service.

(iv) All breakaway couplings must incorporate design provisions to prevent uncoupling or unintended closing due to operational shocks, vibrations, or accelerations.

(v) No breakaway coupling design may allow the release of fuel once the coupling has performed its intended function.

(2) All individual breakaway couplings, coupling fuel feed systems, or equivalent means must be designed, tested, installed, and maintained so that inadvertent fuel shutoff in flight is improbable in accordance with Sec. 29.955(a) and must comply with the fatigue evaluation requirements of Sec. 29.571 without leaking.

(3) Alternate, equivalent means to the use of breakaway couplings must not create a survivable impact-induced load on the fuel line to which it is installed greater than 25 to 50 percent of the ultimate load (strength) of the weakest component in the line and must comply with the fatigue requirements of Sec. 29.571 without leaking.

(d) *Frangible or deformable structural attachments.* Unless hazardous relative motion of fuel tanks and fuel system components to local rotorcraft structure is demonstrated to be extremely improbable in an otherwise survivable impact, frangible or locally deformable attachments of fuel tanks and fuel system components to local rotorcraft structure must be used. The attachment of fuel tanks and fuel system components to local rotorcraft structure, whether

(2) He shows that the aircraft can be converted from one category to another by removing or adding equipment by simple mechanical means.

(b) The operator of an aircraft certificated under this section shall have the aircraft inspected by the Administrator, or by a certificated mechanic with an appropriate airframe rating, to determine airworthiness each time the aircraft is converted from the restricted category to another category for the carriage of passengers for compensation or hire, unless the Administrator finds this unnecessary for safety in a particular case.

(c) The aircraft complies with the applicable requirements of part 34.

Amdt. 21-70, Eff. 12/31/92

FAR 21.189 : Issue of airworthiness certificate for limited category aircraft.

(a) An applicant for an airworthiness certificate for an aircraft in the limited category is entitled to the certificate when—

(1) He shows that the aircraft has been previously issued a limited category type certificate and that the aircraft conforms to that type certificate; and

(2) The Administrator finds, after inspection (including a flight check by the applicant), that the aircraft is in a good state of preservation and repair and is in a condition for safe operation.

(b) The Administrator prescribes limitations and conditions necessary for safe operation.

(c) [[Deleted]]

Amdt. 21-4, Eff. 7/29/65

FAR 21.191 : Experimental certificates.

Experimental certificates are issued for the following purposes :

(a) *Research and development.* Testing new aircraft design concepts, new aircraft equipment, new aircraft installations, new aircraft operating techniques, or new uses for aircraft.

(b) *Showing compliance with regulations.* Conducting flight tests and other operations to show compliance with the airworthiness regulations including flights to show compliance for issuance of type and supplemental type certificates, flights to substantiate major design changes, and flights to show compliance with the function and reliability requirements of the regulations.

(c) *Crew training.* Training of the applicant's flight crews.

(d) *Exhibition.* Exhibiting the aircraft's flight capabilities, performance, or unusual characteristics at air shows, motion picture, television, and similar productions, and the maintenance of exhibition flight proficiency, including (for persons exhibiting aircraft) flying to and from such air shows and productions.

(e) *Air racing.* Participating in air races, including (for such participants) practicing for such air races and flying to and from racing events.

(f) *Market surveys.* Use of aircraft for purposes of conducting market surveys, sales demonstrations, and customer crew training only as provided in Sec. 21.195.

(g) *Operating amateur-built aircraft.* Operating an aircraft the major portion of which has been fabricated and assembled by persons who undertook the construction project solely for their own education or recreation.

- (b) [*Operating kit-built aircraft.* Operating a primary category aircraft that meets the criteria of Sec. 21.24(a)(1) that was assembled by a person from a kit manufactured by the holder of a production certificate for that kit, without the supervision and quality control of the production certificate holder under Sec. 21.184(a).]
- Amdt. 21-70, Eff. 12/31/92

FAR 21.193 : Experimental certificates : general.

An applicant for an experimental certificate must submit the following information :

- (a) A statement, in a form and manner prescribed by the Administrator setting forth the purpose for which the aircraft is to be used.
- (b) Enough data (such as photographs) to identify the aircraft.
- (c) Upon inspection of the aircraft, any pertinent information found necessary by the Administrator to safeguard the general public.
- (d) In the case of an aircraft to be used for experimental purposes—
 - (1) The purpose of the experiment ;
 - (2) The estimated time or number of flights required for the experiment ;
 - (3) The areas over which the experiment will be conducted ; and
 - (4) Except for aircraft converted from a previously certificated type without appreciable change in the external configuration, three-view drawings or three-view dimensioned photographs of the aircraft.

FAR 21.195 : Experimental certificates : aircraft to be used for market surveys, sales demonstrations, and customer crew training.

- (a) A manufacturer of aircraft manufactured within the United States may apply for an experimental certificate for an aircraft that is to be used for market surveys, sales demonstrations or customer crew training.
- (b) A manufacturer of aircraft engines who has altered a type certificated aircraft by installing different engines, manufactured by him within the United States, may apply for an experimental certificate for that aircraft to be used for market surveys, sales demonstrations, or customer crew training, if the basic aircraft, before alteration, was type certificated in the normal, acrobatic, [commuter] or transport category.
- (c) A person who has altered the design of a type certificated aircraft may apply for an experimental certificate for the altered aircraft to be used for market surveys, sales demonstrations, or customer crew training if the basic aircraft, before alteration, was type certificated in the normal, utility, acrobatic, or transport category.
- (d) An applicant for an experimental certificate under this section is entitled to that certificate if, in addition to meeting the requirements of Sec. 21.193—
 - (1) He has established an inspection and maintenance program for the continued airworthiness of the aircraft ; and
 - (2) He shows that the aircraft has been flown for at least 50 hours, or for at least 5 hours if it is a type certificated aircraft which has been modified.

Amdt. 21-59, Eff. 2/17/87

- (1) No engine or fuel pump can draw fuel from more than one tank at a time ; or
- (2) There are means to prevent introducing air into the system.
- (c) Each fuel system for a turbine engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80° F. and having 0.75 cc. of free water per gallon added and cooled to the most critical condition for icing likely to be encountered in operation.

Amdt. 29-12, Eff. 2/1/77

FAR 29.952 : [Fuel system crash resistance.]

[Unless other means acceptable to the Administrator are employed to minimize the hazard of fuel fires to occupants following an otherwise survivable impact (crash landing), the fuel systems must incorporate the design features of this section. These systems must be shown to be capable of sustaining the static and dynamic deceleration loads of this section, considered as ultimate loads acting alone, measured at the system component's center of gravity without structural damage to system components, fuel tanks, or their attachments that would leak fuel to an ignition source.

- (a) *Drop test requirements.* Each tank, or the most critical tank, must be drop-tested as follows :

- (1) The drop height must be at least 50 feet.
- (2) The drop impact surface must be nondeforming.
- (3) The tank must be filled with water to 80 percent of the normal, full capacity.
- (4) The tank must be enclosed in a surrounding structure representative of the installation unless it can be established that the surrounding structure is free of projections or other design features likely to contribute to rupture of the tank.

- (5) The tank must drop freely and impact in a horizontal position $\pm 10^\circ$.

- (6) After the drop test, there must be no leakage.

- (b) *Fuel tank load factors.* Except for fuel tanks located so that tank rupture with fuel release to either significant ignition sources, such as engines, heaters, and auxiliary power units, or occupants is extremely remote, each fuel tank must be designed and installed to retain its contents under the following ultimate inertial load factors, acting alone.

- (1) For fuel tanks in the cabin :

- (i) Upward—4g.
- (ii) Forward—16g.
- (iii) Sideward—8g.
- (iv) Downward—20g.

- (2) For fuel tanks located above or behind the crew or passenger compartment that, if loosened, could injure an occupant in an emergency landing :

- (i) Upward—1.5g.
- (ii) Forward—8g.
- (iii) Sideward—2g.
- (iv) Downward—4g.

- (f) [Each test prescribed by this section must be conducted without intervening disassembly and, except for the lubrication system failure test required by paragraph (c) of this section, each part tested must be in a serviceable condition at the conclusion of the test.]

Amdt. 29-26, Eff. 10/3/88

FAR 29.931 : Shafting critical speed.

- (a) [The critical speeds of any shafting must be determined by demonstration except that analytical methods may be used if reliable methods of analysis are available for the particular design.
- (b) If any critical speed lies within, or close to, the operating ranges for idling, power-on, and autorotative conditions, the stresses occurring at that speed must be within safe limits. This must be shown by tests.

If analytical methods are used and show that no critical speed lies within the permissible operating ranges, the margins between the calculated critical speeds and the limits of the allowable operating ranges must be adequate to allow for possible variations between the computed and actual values.]

Amdt. 29-12, Eff. 2/1/77

FAR 29.935 : Shafting joints.

Each universal joint, slip joint, and other shafting joints whose lubrication is necessary for operation must have provision for lubrication.

FAR 29.939 : Turbine engine operating characteristics.

- (a) Turbine engine operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flameout) are present, to a hazardous degree, during normal and emergency operation within the range of operating limitations of the rotorcraft and of the engine.
- (b) The turbine engine air inlet system may not, as a result of airflow distortion during normal operation, cause vibration harmful to the engine.
- (c) [For governor-controlled engines, it must be shown that there exists no hazardous torsional instability of the drive system associated with critical combinations of power, rotational speed, and control displacement.]

Amdt. 29-12, Eff. 2/1/77

75.3 Fuel System

FAR 29.951 : General.

- (a) [Each fuel system must be constructed and arranged to ensure a flow of fuel at a rate and pressure established for proper engine and auxiliary power unit functioning under any likely operating conditions, including the maneuvers for which certification is requested and during which the engine or auxiliary power unit is permitted to be in operation.]
- (b) Each fuel system must be arranged so that—

FAR 21.197 : Special flight permits.

- (a) A special flight permit may be issued for an aircraft that may not currently meet applicable airworthiness requirements but is capable of safe flight, for the following purposes :

- (1) Flying the aircraft to a base where repairs, alterations, or maintenance are to be performed, or to a point of storage.
- (2) Delivering or exporting the aircraft.
- (3) Production flight testing new production aircraft.
- (4) Evacuating aircraft from areas of impending danger.
- (5) Conducting customer demonstration flights in new production aircraft that have satisfactorily completed production flight tests.

- (b) A special flight permit may also be issued to authorize the operation of an aircraft at a weight in excess of its maximum certificated takeoff weight for flight beyond the normal range over water, or over land areas where adequate landing facilities or appropriate fuel is not available. The excess weight that may be authorized under this paragraph is limited to the additional fuel, fuel-carrying facilities, and navigation equipment necessary for the flight.

- (c) [Upon application, as prescribed in Secs. 121.79 and 135.17] of this chapter, a special flight permit with a continuing authorization may be issued for aircraft that may not meet applicable airworthiness requirements but are capable of safe flight for the purpose of flying aircraft to a base where maintenance or alterations are to be performed. The permit issued under this paragraph is an authorization, including conditions and limitations for flight, which is set forth in the certificate holder's operations specifications. The permit issued under this paragraph may be issued to—

- (1) [Certificate holders authorized to conduct operations under Part 121] of this chapter ; or
- (2) Certificate holders authorized to conduct operations under Part 135 for those aircraft they operate and maintain under a continuous airworthiness maintenance program prescribed by Sec. 135.411 (a)(2) or (b) of that part.

The permit issued under this paragraph is an authorization, including any conditions and limitations for flight, which is set forth in the certificate holder's operations specifications.

Amdt. 21-79, Eff. 4/27/2001

FAR 21.199 : Issue of special flight permits.

- (a) [Except as provided in Sec. 21.197(c), an applicant for a special flight permit must submit a statement in a form and manner prescribed by the Administrator, indicating—

- (1) The purpose of the flight.
- (2) The proposed itinerary.
- (3) The crew required to operate the aircraft and its equipment, e.g., pilot, co-pilot, navigator, etc.
- (4) The ways, if any, in which the aircraft does not comply with the applicable airworthiness requirements.

- (5) Any restriction the applicant considers necessary for safe operation of the aircraft.
- (6) Any other information considered necessary by the Administrator for the purpose of prescribing operating limitations.
- (b) The Administrator may make, or require the applicant to make appropriate inspections or tests necessary for safety.

Amdt. 21-22, Eff. 9/21/68

- (b) If turbine engine torque output to the transmission can exceed the highest engine or transmission torque limit, and that output is not directly controlled by the pilot under normal operating conditions (such as where the primary engine power control is accomplished through the flight control), the following test must be made :
 - (1) Under conditions associated with all engines operating, make 200 applications, for 10 seconds each, of torque that is at least equal to the lesser of—
 - (i) The maximum torque used in meeting Sec. 29.923 plus 10 percent ; or
 - (ii) The maximum torque attainable under probable operating conditions, assuming that torque limiting devices, if any, function properly.
 - (2) For multiengine rotorcraft under conditions associated with each engine, in turn, becoming inoperative, apply to the remaining transmission torque inputs the maximum torque attainable under probable operating conditions, assuming that torque limiting devices, if any, function properly. Each transmission input must be tested at this maximum torque for at least fifteen minutes.
- (c) *Lubrication system failure.* For lubrication systems required for proper operation of rotor drive systems, the following apply :
 - (1) *Category A.* Unless such failures are extremely remote, it must be shown by test that any failure which results in loss of lubricant in any normal use lubrication system will not prevent continued safe operation, although not necessarily without damage, at a torque and rotational speed prescribed by the applicant for continued flight, for at least 30 minutes after perception by the flightcrew of the lubrication system failure or loss of lubricant.
 - (2) *Category B.* The requirements of Category A apply except that the rotor drive system need only be capable of operating under autorotative conditions for at least 15 minutes.
 - (d) *Overspeed test.* The rotor drive system must be subjected to 50 overspeed runs, each 30 ± 3 seconds in duration, at not less than either the higher of the rotational speed to be expected from an engine control device failure or 105 percent of the maximum rotational speed, including transients, to be expected in service. If speed and torque limiting devices are installed, are independent of the normal engine control, and are shown to be reliable, their rotational speed limits need not be exceeded. These runs must be conducted as follows :¹
 - (1) Overspeed runs must be alternated with stabilizing runs of from 1 to 5 minutes duration each at 60 to 80 percent of maximum continuous speed.
 - (2) [Acceleration and deceleration must be accomplished in a period not longer than 10 seconds (except where maximum engine acceleration rate will require more than 10 seconds), and the time for changing speeds may not be deducted from the specified time for the overspeed runs.]
 - (3) Overspeed runs must be made with the rotors in the flattest pitch for smooth operation.
 - (e) The tests prescribed in paragraphs (b) and (d) of this section must be conducted on the rotorcraft, and the torque must be absorbed by the rotors to be installed, except that other ground or flight test facilities with other appropriate methods of torque absorption may be used if the conditions of support and vibration closely simulate the conditions that would exist during a test on the rotorcraft.

speed for use with continuous OEI torque must be conducted as follows : For each engine, in sequence, that engine must be inoperative and the remaining engines must be run for 1 hour.

- (3) The number of periods prescribed in paragraph (k)(1) or (k)(2) of this section may not be less than the number of engines, nor may it be less than two.

(l) [Reserved.]

(m) Any components that are affected by maneuvering and gust loads must be investigated for the same flight conditions as are the main rotors, and their service lives must be determined by fatigue tests or by other acceptable methods. In addition, a level of safety equal to that of the main rotors must be provided for—

- (1) Each component in the rotor drive system whose failure would cause an uncontrolled landing ;
- (2) Each component essential to the phasing of rotors on multirotor rotorcraft, or that furnishes a driving link for the essential control of rotors in autorotation ; and

(3) Each component common to two or more engines on multiengine rotorcraft.

(n) *Special tests.* Each rotor drive system designed to operate at two or more gear ratios must be subjected to special testing for durations necessary to substantiate the safety of the rotor drive system.

(o) Each part tested as prescribed in this section must be in a serviceable condition at the end of the tests. No intervening disassembly which might affect test results may be conducted.

(p) *Endurance tests ; operating lubricants.* To be approved for use in rotor drive and control systems, lubricants must meet the specifications of lubricants used during the tests prescribed by this section. Additional or alternate lubricants may be qualified by equivalent testing or by comparative analysis of lubricant specifications and rotor drive and control system characteristics. In addition—

- (1) At least three 10-hour cycles required by this section must be conducted with transmission and gearbox lubricant temperatures, at the location prescribed for measurement, not lower than the maximum operating temperature for which approval is requested ;
- (2) For pressure lubricated systems, at least three 10-hour cycles required by this section must be conducted with the lubricant pressure, at the location prescribed for measurement, not higher than the minimum operating pressure for which approval is requested ; and
- (3) The test conditions of paragraphs (p)(1) and (p)(2) of this section must be applied simultaneously and must be extended to include operation at any one-engine-inoperative rating for which approval is requested.

Amdt. 29-42, Eff. 9/8/98

FAR 29.927 : Additional tests.

(a) Any additional dynamic, endurance, and operational tests, and vibratory investigations necessary to determine that the rotor drive mechanism is safe, must be performed.

Chapitre 21

Subpart I—Provisional Airworthiness Certificates

Sommaire

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FAR 21.211 : Applicability.

This subpart prescribes procedural requirements for the issue of provisional airworthiness certificates.

FAR 21.213 : Eligibility.

- (a) A manufacturer who is a United States citizen may apply for a Class I or Class II provisional airworthiness certificate for aircraft manufactured by him within the U.S.

- (b) [Any holder of an air carrier operating certificate under Part 121] of this chapter who is a United States citizen may apply for a Class II provisional airworthiness certificate for transport category aircraft that meet either of the following :

- (1) The aircraft has a current Class II provisional type certificate or an amendment thereto.
- (2) The aircraft has a current provisional amendment to a type certificate that was preceded by a corresponding Class II provisional type certificate.

- (c) An aircraft engine manufacturer who is a United States citizen and who has altered a type certificated aircraft by installing different type certificated engines, manufactured by him within the United States, may apply for a Class I provisional airworthiness certificate for that aircraft, if the basic aircraft, before alteration, was type certificated in the normal, utility, acrobatic, commuter, or transport category.

Amdt. 21-79, Eff. 4/27/2001

FAR 21.215 : Application.

[Applications for provisional airworthiness certificates must be submitted to the Manufacturing Inspection District Office in the geographic area in which the manufacturer or air carrier is located. The application must be accompanied by the pertinent information specified in this subpart.]

Amdt. 21-67, Eff. 10/25/89

FAR 21.217 : Duration.

Unless sooner surrendered, superseded, revoked, or otherwise terminated, provisional airworthiness certificates are effective for the duration of the corresponding provisional type certificate, amendment to a provisional type certificate, or provisional amendment to the type certificate.

FAR 21.219 : Transferability.

Class I provisional airworthiness certificates are not transferable. Class II provisional airworthiness certificates may be transferred to an air carrier eligible to apply for a certificate under Sec. 21.213(b).

FAR 21.221 : Class I provisional airworthiness certificates.

- (a) Except as provided in Sec. 21.225, an applicant is entitled to a Class I provisional airworthiness certificate for an aircraft for which a Class I provisional type certificate has been issued if—

- (g) *Endurance tests; engine multifunctioning run.* It must be determined whether malfunctioning of components, such as the engine fuel or ignition systems, or whether unequal engine power can cause dynamic conditions detrimental to the drive system. If so, a suitable number of hours of operation must be accomplished under those conditions, 1 hour of which must be included in each cycle, and the remaining hours of which must be accomplished at the end of the 20 cycles. If no detrimental condition results, an additional hour of operation in compliance with paragraph (b) of this section must be conducted in accordance with the run schedule of paragraph (b)(1) of this section without consideration of paragraph (b)(2) of this section.

- (h) *Endurance tests; overspeed run.* One hour of continuous operation must be conducted at maximum continuous torque and the maximum power-on overspeed expected in service, assuming that speed and torque limiting devices, if any, function properly.

- (i) *Endurance tests; rotor control positions.* When the rotor controls are not being cycled during the tie-down tests, the rotor must be operated, using the procedures prescribed in paragraph (c) of this section, to produce each of the maximum thrust positions for the following percentages of test time (except that the control positions need not produce loads or blade flapping motion exceeding the maximum loads or motions encountered in flight) :

- (1) For full vertical thrust, 20 percent.
- (2) For the forward thrust component, 50 percent.
- (3) For the right thrust component, 10 percent.
- (4) For the left thrust component, 10 percent.
- (5) For the aft thrust component, 10 percent.

- (j) *Endurance tests; clutch and brake engagements.* A total of at least 400 clutch and brake engagements, including the engagements of paragraph (b) of this section, must be made during the takeoff torque runs and, if necessary, at each change of torque and speed throughout the test. In each clutch engagement, the shaft on the driven side of the clutch must be accelerated from rest. The clutch engagements must be accomplished at the speed and by the method prescribed by the applicant. During deceleration after each clutch engagement, the engines must be stopped rapidly enough to allow the engines to be automatically disengaged from the rotors and rotor drives. If a rotor brake is installed for stopping the rotor, the clutch, during brake engagements, must be disengaged above 40 percent of maximum continuous rotor speed and the rotors allowed to decelerate to 40 percent of maximum continuous rotor speed, at which time the rotor brake must be applied. If the clutch design does not allow stopping the rotors with the engine running, or if no clutch is provided, the engine must be stopped before each application of the rotor brake, and then immediately be started after the rotors stop.

- (k) *Endurance tests, OEI power run.*

- (1) *30-minute OEI power run.* For rotorcraft for which the use of 30-minute OEI power is requested, a run at 30-minute OEI torque and the maximum speed for use with 30-minute OEI torque must be conducted as follows : For each engine, in sequence, that engine must be inoperative and the remaining engines must be run for a 30-minute period.

- (2) *Continuous OEI power run.* For rotorcraft for which the use of continuous OEI power is requested, a run at continuous OEI torque and the maximum

turn, and apply the maximum torque and the maximum speed for use with 30-second OEI power to the remaining affected drive system power inputs for not less than 30 seconds. Each application of 30-second OEI power must be followed by two applications of the maximum torque and the maximum speed for use with the 2 minute OEI power for not less than 2 minutes each; the second application must follow a period at stabilized continuous or 30 minute OEI power (whichever is requested by the applicant). At least one run sequence must be conducted from a simulated "flight idle" condition. When conducted on a bench test, the test sequence must be conducted following stabilization at takeoff power.

- (ii) For the purpose of this paragraph, an affected power input includes all parts of the rotor drive system which can be adversely affected by the application of higher or asymmetric torque and speed prescribed by the test.
- (iii) This test may be conducted on a representative bench test facility when engine limitations either preclude repeated use of this power or would result in premature engine removals during the test. The loads, the vibration frequency, and the methods of application to the affected rotor drive system components must be representative of rotorcraft conditions. Test components must be those used to show compliance with the remainder of this section.

- (c) *Endurance tests, maximum continuous run.* Three hours of continuous operation at maximum continuous torque and the maximum speed for use with maximum continuous torque must be conducted as follows :

- (1) The main rotor controls must be operated at a minimum of 15 times each hour through the main rotor pitch positions of maximum vertical thrust, maximum forward thrust component, maximum aft thrust component, maximum left thrust component, and maximum right thrust component, except that the control movements need not produce loads or blade flapping motion exceeding the maximum loads of motions encountered in flight.
- (2) The directional controls must be operated at a minimum of 15 times each hour through the control extremes of maximum right turning torque, neutral torque as required by the power applied to the main rotor, and maximum left turning torque.
- (3) Each maximum control position must be held for at least 10 seconds, and the rate of change of control position must be at least as rapid as that for normal operation.
- (d) *Endurance tests; 90 percent of maximum continuous run.* One hour of continuous operation at 90 percent of maximum continuous torque and the maximum speed for use with 90 percent of maximum continuous torque must be conducted.
- (e) *Endurance tests; 80 percent of maximum continuous run.* One hour of continuous operation at 80 percent of maximum continuous torque and the minimum speed for use with 80 percent of maximum continuous torque must be conducted.
- (f) *Endurance tests; 60 percent of maximum continuous run.* Two hours or, for helicopters for which the use of either 30-minute OEI power or continuous OEI power is requested, 1 hour of continuous operation at 60 percent of maximum continuous torque and the minimum speed for use with 60 percent of maximum continuous torque must be conducted.

- (1) He meets the eligibility requirements of Sec. 21.213 and he complies with this section ; and
- (2) The Administrator finds that there is no feature, characteristic or condition of the aircraft that would make the aircraft unsafe when operated in accordance with the limitations established in Secs. 21.81(e) and [91.317] of this subchapter.
- (b) The manufacturer must hold a provisional type certificate for the aircraft.
- (c) The manufacturer must submit a statement that the aircraft conforms to the type design corresponding to the provisional type certificate and has been found by him to be in safe operating condition under all applicable limitations.
- (d) The aircraft must be flown at least five hours by the manufacturer.
- (e) The aircraft must be supplied with a provisional aircraft flight manual or other document and appropriate placards containing the limitations established by Secs. 21.81(e) and [91.317].

Amdt. 21-66, Eff. 8/18/90

FAR 21.223 : Class II provisional airworthiness certificates.

- (a) Except as provided in Sec. 21.225, an applicant is entitled to a Class II provisional airworthiness certificate for an aircraft for which a Class II provisional type certificate has been issued if—

- (1) He meets the eligibility requirements of Sec. 21.213 and he complies with this section ; and
- (2) The Administrator finds that there is no feature, characteristic, or condition of the aircraft that would make the aircraft unsafe when operated in accordance with the limitations established in Secs. 21.83(h), [91.317], and 121.207 of this chapter.

- (b) The applicant must show that a Class II provisional type certificate for the aircraft has been issued to the manufacturer.

- (c) The applicant must submit a statement by the manufacturer that the aircraft has been manufactured under a quality control system adequate to ensure that the aircraft conforms to the type design corresponding with the provisional type certificate.

- (d) The applicant must submit a statement that the aircraft has been found by him to be in a safe operating condition under the applicable limitations.

- (e) The aircraft must be flown at least five hours by the manufacturer.

- (f) The aircraft must be supplied with a provisional aircraft flight manual containing the limitations established by Secs. 21.83(h), [91.317], and 121.207 of this chapter.

Amdt. 21-66, Eff. 8/18/90

FAR 21.225 : Provisional airworthiness certificates corresponding with provisional amendments to type certificates.

- (a) An applicant is entitled to a Class I or a Class II provisional airworthiness certificate, for an aircraft, for which a provisional amendment to the type certificate has been issued, if—

- (1) He meets the eligibility requirements of Sec. 21.213 and he complies with this section; and
 - (2) The Administrator finds that there is no feature, characteristic, or condition of the aircraft, as modified in accordance with the provisionally amended type certificate, that would make the aircraft unsafe when operated in accordance with the applicable limitations established in Secs. 21.85(g), [91.317], and 121.207 of this chapter.
 - (b) The applicant must show that the modification was made under a quality control system adequate to ensure that the modification conforms to the provisionally amended type certificate.
 - (c) The applicant must submit a statement that the aircraft has been found by him to be in a safe operating condition under the applicable limitations.
 - (d) The aircraft must be flown at least five hours by the manufacturer.
 - (e) The aircraft must be supplied with a provisional aircraft flight manual or other document and appropriate placards containing the limitations required by Secs. 21.85(g), [91.317], and 121.207 of this chapter.
- Amdt. 21-66, Eff. 8/18/90

FAR 29.921 : Rotor brake.

If there is a means to control the rotation of the rotor drive system independently of the engine, any limitations on the use of that means must be specified, and the control for that means must be guarded to prevent inadvertent operation.

FAR 29.923 : Rotor drive system and control mechanism tests.

- (a) *Endurance tests, general.* Each rotor drive system and rotor control mechanism must be tested, as prescribed in paragraphs (b) through (n) [and (p)] of this section, for at least 200 hours plus the time required to meet the requirements of paragraphs (b)(2), (b)(3), and (k) of this section. These tests must be conducted as follows :
 - (1) Ten-hour test cycles must be used, except that the test cycle must be extended to include the OEI test of paragraphs (b)(2) and (k) of this section, if OEI ratings are requested.
 - (2) The tests must be conducted on the rotorcraft.
 - (3) The test torque and rotational speed must be—
 - (i) Determined by the powerplant limitations; and
 - (ii) Absorbed by the rotors to be approved for the rotorcraft.
- (b) *Endurance tests, takeoff run.* The takeoff run must be conducted as follows :
 - (1) Except as prescribed in paragraphs (b)(2) and (b)(3) of this section, the takeoff torque run must consist of 1 hour of alternate runs of 5 minutes at takeoff torque and the maximum speed for use with takeoff torque, and 5 minutes at as low an engine idle speed as practicable. The engine must be decoupled from the rotor drive system, and the rotor brake, if furnished and so intended, must be applied during the first minute of the idle run. During the remaining 4 minutes of the idle run, the clutch must be engaged so that the engine drives the rotors at the minimum practical r.p.m. The engine and the rotor drive system must be accelerated at the maximum rate. When decoupling the engine, it must be decelerated rapidly enough to allow the operation of the overrunning clutch.
 - (2) For helicopters for which the use of a 2½-minute OEI rating is requested, the takeoff run must be conducted as prescribed in paragraph (b)(1) of this section, except for the third and sixth runs for which the takeoff torque and the maximum speed for use with takeoff torque are prescribed in that paragraph. For these runs, the following apply :
 - (i) Each run must consist of at least one period of 2½ minutes with takeoff torque and the maximum speed for use with takeoff torque on all engines.
 - (ii) Each run must consist of at least one period, for each engine in sequence, during which that engine simulates a power failure and the remaining engines are run at the 2½-minutes OEI torque and the maximum speed for use with 2½-minute OEI torque for 2½ minutes.
 - (3) For multiengine, turbine-powered rotorcraft for which the use of 30-second/2-minute OEI power is requested, the takeoff run must be conducted as prescribed in paragraph (b)(1) of this section except for the following :
 - (i) Immediately following any one 5-minute power-on run required by paragraph (b)(1) of this section, simulate a failure for each power source in

- (2) Each fan is located so that a fan blade failure will not jeopardize safety ; or
- (3) Each fan blade can withstand an ultimate load of 1.5 times the centrifugal force expected in service, limited by either—
 - (i) The highest rotational speeds achievable under uncontrolled conditions ; or
 - (ii) An overspeed limiting device.
- (c) [Fatigue evaluation. Unless a fatigue evaluation under Sec. 29.571 is conducted, it must be shown that cooling fan blades are not operating at resonant conditions within the operating limits of the rotorcraft.] Amdt. 29-26, Eff. 10/3/88

75.2 Rotor Drive System

FAR 29.917 : Design.

- (a) *General.* The rotor drive system includes any part necessary to transmit power from the engines to the rotor hubs. This includes gear boxes, shafting, universal joints, couplings, rotor brake assemblies, clutches, supporting bearings for shafting, any attendant accessory pads or drives, and any cooling fans that are a part of, attached to, or mounted on the rotor drive system.
- (b) [Design assessment. A design assessment must be performed to ensure that the rotor drive system functions safely over the full range of conditions for which certification is sought. The design assessment must include a detailed failure analysis to identify all failures that will prevent continued safe flight or safe landing and must identify the means to minimize the likelihood of their occurrence.
- (c) [Arrangement. Rotor drive systems must be arranged as follows :
 - (1) Each rotor drive system of multi-engine rotorcraft must be arranged so that each rotor necessary for operation and control will continue to be driven by the remaining engines if any engine fails.
 - (2) For single-engine rotorcraft, each rotor drive system must be so arranged that each rotor necessary for control in autorotation will continue to be driven by the main rotors after disengagement of the engine from the main and auxiliary rotors.
 - (3) Each rotor drive system must incorporate a unit for each engine to automatically disengage that engine from the main and auxiliary rotors if that engine fails.
 - (4) If a torque limiting device is used in the rotor drive system, it must be located so as to allow continued control of the rotorcraft when the device is operating.
 - (5) If the rotors must be phased for intermeshing, each system must provide constant and positive phase relationship under any operating condition.
 - (6) If a rotor dephasing device is incorporated, there must be means to keep the rotors locked in proper phase before operation.

Amdt. 29-40, Eff. 8/8/96

Chapitre 22

Subpart J—Delegation Option Authorization Procedures

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FAR 21.231 : Applicability.

This subpart prescribes procedures for—

- (a) Obtaining and using a delegation option authorization for type, production, and airworthiness certification (as applicable) of—
 - (1) Small airplanes and small gliders;
 - (2) [Commuter category airplanes];
 - (3) Normal category rotorcraft;
 - (4) Turbojet engines of not more than 1,000 pounds thrust;
 - (5) Turbopropeller and reciprocating engines of not more than 500 brake horsepower; and
 - (6) Propellers manufactured for use on engines covered by paragraph (a)(4) of this section; and
 - (b) Issuing airworthiness approval tags for engines, propellers, and parts of products covered by paragraph (a) of this section.
- Amdt. 21-59, EFF. 2/17/87

FAR 21.235 : Application.

- (a) An application for a delegation option authorization must be submitted, in a form and manner prescribed by the Administrator, to the [Aircraft Certification Office] for the area in which the manufacturer is located.
 - (b) The application must include the names, signatures, and titles of the persons for whom authorization to sign airworthiness certificates, repair and alteration forms, and inspection forms is requested.
- Amdt. 21-67, EFF. 10/25/89

FAR 21.239 : Eligibility.

[To be eligible for a delegation option authorization, the applicant must—

- (a) Hold a current type certificate, issued to him under the standard procedures, for a product type certificated under the same part as each product for which the delegation option authorization is sought;
 - (b) Hold a current production certificate issued under the standard procedures;
 - (c) Employ a staff of engineering, flight test, production, and inspection personnel who can determine compliance with the applicable airworthiness requirements of this chapter; and
 - (d) Meet the requirements of this subpart.]
- Amdt. 21-5, EFF. 10/8/65

FAR 21.241 : [Deleted.]

[Deleted.]

Amdt. 21-5, EFF. 10/8/65

- (1) Prevent the continued safe operation of the remaining engines; or
 - (2) Require immediate action, other than normal pilot action with primary flight controls, by any crewmember to maintain safe operation.
- (c) *Category A : Control of engine rotation.* For each category A rotorcraft, there must be a means for stopping the rotation of any engine individually in flight, except that, for turbine engine installations, the means for stopping the engine need be provided only where necessary for safety. In addition—
- (1) Each component of the engine stopping system that is located on the engine side of the firewall, and that might be exposed to fire, must be at least fire resistant; or
 - (2) Duplicate means must be available for stopping the engine and the controls must be where all are not likely to be damaged at the same time in case of fire.
- (d) *[Turbine engine installation.* For turbine engine installations—
- (1) Design precautions must be taken to minimize the hazards to the rotorcraft in the event of an engine rotor failure; and
 - (2) The powerplant systems associated with engine control devices, systems, and instrumentation must be designed to give reasonable assurance that those engine operating limitations that adversely affect engine rotor structural integrity will not be exceeded in service.]
- (e) *Restart capability :*
- (1) A means to restart any engine in flight must be provided.
 - (2) Except for the in-flight shutdown of all engines, engine restart capability must be demonstrated throughout a flight envelope for the rotorcraft.
 - (3) Following the in-flight shutdown of all engines, in-flight engine restart capability must be provided.
- Amdt. 29-36, EFF. 1/31/96

FAR 29.907 : Engine vibration.

- (a) Each engine must be installed to prevent harmful vibration of any part of the engine or rotorcraft.
- (b) The addition of the rotor and the rotor drive system to the engine may not subject the principal rotating parts of the engine to excessive vibration stresses. This must be shown by a vibration investigation.

FAR 29.908 : Cooling fans.

[For cooling fans that are a part of a powerplant installation the following apply :

- (a) *Category A.* For cooling fans installed in Category A rotorcraft, it must be shown that a fan blade failure will not prevent continued safe flight either because of damage caused by the failed blade or loss of cooling air.]
- (b) *Category B.* For cooling fans installed in category B rotorcraft, there must be means to protect the rotorcraft and allow a safe landing if a fan blade fails. It must be shown that—
 - (1) The fan blade would be contained in the case of a failure;

75.1 General

FAR 29.901 : Installation.

(a) For the purpose of this part, the powerplant installation includes each part of the rotorcraft (other than the main and auxiliary rotor structures) that—

- (1) Is necessary for propulsion ;
- (2) Affects the control of the major propulsive units ; or
- (3) Affects the safety of the major propulsive units between normal inspections or overhauls.

(b) For each powerplant installation—

- (1) The installation must comply with—
 - (i) The installation instructions provided under Sec. 33.5 of this chapter ; and
 - (ii) The applicable provisions of this subpart.

(2) Each component of the installation must be constructed, arranged, and installed to ensure its continued safe operation between normal inspections or overhauls for the range of temperature and altitude for which approval is requested.

(3) Accessibility must be provided to allow any inspection and maintenance necessary for continued airworthiness ;

(4) Electrical interconnections must be provided to prevent differences of potential between major components of the installation and the rest of the rotorcraft ; and

(5) Axial and radial expansion of turbine engines may not affect the safety of the installation.

(6) Design precautions must be taken to minimize the possibility of incorrect assembly of components and equipment essential to safe operation of the rotorcraft, except where operation with the incorrect assembly can be shown to be extremely improbable.

(c) [For each powerplant and auxiliary power unit installation, it must be established that no single failure or malfunction or probable combination of failures will jeopardize the safe operation of the rotorcraft except that the failure of structural elements need not be considered if the probability of any such failure is extremely remote.]

(d) Each auxiliary power unit installation must meet the applicable provisions of this subpart.

Amdt. 29-36, Eff. 1/31/96

FAR 29.903 : Engines.

(a) *Engine type certification.* Each engine must have an approved type certificate. Reciprocating engines for use in helicopters must be qualified in accordance with Sec. 33.49(d) of this chapter or be otherwise approved for the intended usage.

(b) *Category A : Engine isolation.* For each category A rotorcraft, the powerplants must be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any engine, or the failure of any system that can affect any engine, will not—

FAR 21.243 : Duration.

[A delegation option authorization is effective until it is surrendered or the Administrator suspends, revokes, or otherwise terminates it.]

Amdt. 21-5, Eff. 10/8/65

FAR 21.245 : Maintenance of eligibility.

[The holder of a delegation option authorization shall continue to meet the requirements for issue of the authorization or shall notify the Administrator within 48 hours of any change (including a change of personnel) that could affect the ability of the holder to meet those requirements.]

Amdt. 21-5, Eff. 10/8/65

FAR 21.247 : Transferability.

A delegation option authorization is not transferable.

Amdt. 21-5, Eff. 10/8/65

FAR 21.249 : Inspections.

[Upon request, each holder of a delegation option authorization and each applicant shall let the Administrator the inspect his organization, facilities, product, and records.]

Amdt. 21-5, Eff. 10/8/65

FAR 21.251 : Limits of applicability.

(a) Delegation option authorizations apply only to products that are manufactured by the holder of the authorization.

(b) Delegation option authorizations may be used for—

- (1) Type certification ;
- (2) Changes in the type design of products for which the manufacturer holds, or obtains, a type certificate ;
- (3) The amendment of a production certificate held by the manufacturer to include additional models or additional types for which he holds or obtains a type certificate ; and
- (4) The issue of—

- (i) Experimental certificates for aircraft for which the manufacturer has applied for a type certificate or amended type certificate under Sec. 21.253, to permit the operation of those aircraft for the purpose of research and development, crew training, market surveys, or the showing of compliance with the applicable airworthiness requirements ;
- (ii) Airworthiness certificates (other than experimental certificates) for aircraft for which the manufacturer holds a type certificate and holds or is in the process of obtaining a production certificate ;
- (iii) Airworthiness approval tags [(FAA Form 8130-3)] for engines and propellers for which the manufacturer holds a type certificate and holds or is in the process of obtaining a production certificate ; and

- (iv) Airworthiness approval tags [(FAA Form 8130-3)] for parts of products covered by this section.
- (c) Delegation option procedures may be applied to one or more types selected by the manufacturer, who must notify the FAA of each model, and of the first serial number of each model manufactured by him under the delegation option procedures. Other types or models may remain under the standard procedures.
- (d) Delegation option authorizations are subject to any additional limitations prescribed by the Administrator after inspection of the applicant's facilities or review of the staff qualifications.

Amdt. 21-43, Eff. 2/14/75

FAR 21.253 : Type certificates : application.

- (a) [To obtain, under the delegation option authorization, a type certificate for a new product or an amended type certificate the manufacturer must submit to the Administrator—
- (1) An application for a type certificate (FAA Form 312) ;
- (2) A statement listing the airworthiness requirements of this chapter (by part number and effective date) that the manufacturer considers applicable ;
- (3) After determining that the type design meets the applicable requirements, a statement certifying that this determination has been made ;
- (4) After placing the required technical data and type inspection report in the technical data file required by Sec. 21.293(a)(1)(i), a statement certifying that this has been done ;
- (5) A proposed type certificate data sheet ; and
- (6) An Aircraft Flight Manual (if required) or a summary of required operating limitations and other information necessary for safe operation of the product.]

Amdt. 21-5, Eff. 10/8/65

FAR 21.255 : [Deleted.]

[Deleted.]
Amdt. 21-5, Eff. 10/8/65

FAR 21.257 : Type certificates : issue.

[An applicant is entitled to a type certificate for a product manufactured under a delegation option authorization if the Administrator finds that the product meets the applicable airworthiness, noise, fuel venting, and exhaust emission requirements (including applicable acoustical change or emissions change requirements in the case of changes in type design).]

Amdt. 21-68, Eff. 9/10/90

FAR 21.259 : [Deleted.]

[Deleted.]
Amdt. 21-5, Eff. 10/8/65

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FAR 21.261 : [Equivalent safety provisions.]

[The manufacturer shall obtain the Administrator's concurrence on the application of all equivalent safety provisions applied under Sec. 21.21.]
Amdt. 21-5, Eff. 10/8/65

FAR 21.263 : [Deleted.]

[Deleted.]
Amdt. 21-5, Eff. 10/8/65

FAR 21.265 : [Deleted.]

[Deleted.]
Amdt. 21-5, Eff. 10/8/65

FAR 21.267 : [Production certificates.]

[To have a new model or new type certificate listed on his production certificate (issued under Subpart G of this part), the manufacturer must submit to the Administrator—

- (a) An application for an amendment to the production certificate ;
- (b) After determining that the production certification requirements of Subpart G, with respect to the new model or type, are met, a statement certifying that this determination has been made ;
- (c) A statement identifying the type certificate number under which the product is being manufactured ; and
- (d) After placing the manufacturing and quality control data required by Sec. 21.143 with the data required by Sec. 21.293(a)(1)(ii), a statement certifying that this has been done.]

Amdt. 21-5, Eff. 10/8/65

FAR 21.269 : [Export airworthiness approvals.]

[The manufacturer may issue export airworthiness approvals.]
Amdt. 21-5, Eff. 10/8/65

FAR 21.271 : Airworthiness approval tags.

- (a) A manufacturer may issue an airworthiness approval tag (FAA Form 8130-3) for each engine and propeller covered by Sec. 21.251(b)(4), and may issue an airworthiness approval tag for parts of each product covered by that section, if he finds, on the basis of inspection and operation tests, that those products conform to a type design for which he holds a type certificate and are in condition for safe operation.
- (b) When a new model has been included on the Production Limitation Record, the production certificate number shall be stamped on the engine or propeller identification data plate instead of issuing an airworthiness approval tag.

Amdt. 21-43, Eff. 2/14/75

FAR 21.273 : Airworthiness certificates other than experimental.

- (a) The manufacturer may issue [an] airworthiness certificate for aircraft manufactured under a delegation option authorization if he finds, on the basis of the inspection and production flight check, that each aircraft conforms to a type design for which he holds a type certificate and is in a condition for safe operation.
 - (b) The manufacturer may authorize any employee to sign airworthiness certificates if that employee—
 - (1) Performs, or is in direct charge of, the inspection specified in paragraph (a) of this section ; and
 - (2) Is listed on the manufacturer's application for the delegation option authorization, or on amendments thereof.
- Amdt. 21-18, Eff. 11/1/67

FAR 21.275 : [Experimental certificates.]

- (a) [The manufacturer shall, before issuing an experimental certificate, obtain from the Administrator any limitations and conditions that the Administrator considers necessary for safety.
 - (b) For experimental certificates issued by the manufacturer, under this subpart, for aircraft for which the manufacturer holds the type certificate and which have undergone changes to the type design requiring flight test, the manufacturer may prescribe any operating limitations that he considers necessary.]
- Amdt. 21-5, Eff. 10/8/65

FAR 21.277 : [Data review and service experience.]

- (a) [If the Administrator finds that a product for which a type certificate was issued under this subpart does not meet the applicable airworthiness requirements, or that an unsafe feature or characteristic caused by a defect in design or manufacture exists, the manufacturer, upon notification by the Administrator, shall investigate the matter and report to the Administrator the results of the investigation and the action, if any, taken or proposed.
 - (b) If corrective action by the user of the product is necessary for safety because of any noncompliance or defect specified in paragraph (a) of this section, the manufacturer shall submit the information necessary for the issue of an Airworthiness Directive under Part 39.]
- Amdt. 21-5, Eff. 10/8/65

FAR 21.283 : [Deleted.]

[Deleted]
Amdt. 21-5, Eff. 10/8/65

FAR 21.285 : [Deleted.]

[Deleted]
Amdt. 21-5, Eff. 10/8/65

Chapitre 75

Subpart E : Powerplant

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- (f) The fatigue evaluation of Sec. 29.571 of this part does not apply to rotorcraft-load combinations to be used for nonhuman external cargo except for the failure of critical structural elements that would result in a hazard to the rotorcraft. For rotorcraft-load combinations to be used for human external cargo, the fatigue evaluation of Sec. 29.571 of this part applies to the entire quick release and personnel carrying device structural systems and their attachments.]

Amdt. 29-43, Eff. 10/5/99

74.8 Miscellaneous

FAR 29.871 : Leveling marks.

There must be reference marks for leveling the rotorcraft on the ground.

FAR 29.873 : Ballast provisions.

Ballast provisions must be designed and constructed to prevent inadvertent shifting of ballast in flight.

FAR 29.877 : [Reserved.]

[Reserved.]

Amdt. 29-21, Eff. 3/2/83

FAR 21.289 : [Major repairs, rebuilding, and alteration.]

[For types covered by a delegation option authorization, a manufacturer may—

- (a) After finding that a major repair or major alteration meets the applicable airworthiness requirements of this chapter, approve that repair or alteration ; and
- (b) Authorize any employee to execute and sign FAA Form 337 and make required log book entries if that employee—
 - (1) Inspects, or is in direct charge of inspecting, the repair, rebuilding, or alteration ; and
 - (2) Is listed on the application for the delegation option authorization, or on amendments thereof.]

Amdt. 21-5, Eff. 10/8/65

FAR 21.293 : [Current records.]

- (a) [The manufacturer shall maintain at his factory, for each product type certificated under a delegation option authorization, current records containing the following :

- (1) For the duration of the manufacturing operation under the delegation option authorization—

- (i) A technical data file that includes the type design drawings, specifications, reports on tests prescribed by this part, and the original type inspection report and amendments to that report ;

- (ii) The data (including amendments) required to be submitted with the original application for each production certificate ; and

- (iii) A record of any rebuilding and alteration performed by the manufacturer on products manufactured under the delegation option authorization.

- (2) For 2 years—

- (i) A complete inspection record for each product manufactured, by serial number, and data covering the processes and tests to which materials and parts are subjected ; and

- (ii) A record of reported service difficulties.

- (b) The records and data specified in paragraph (a) of this section shall be—

- (1) Made available, upon the Administrator's request, for examination by the Administrator at any time ; and

- (2) Identified and sent to the Administrator as soon as the manufacturer no longer operates under the delegation option procedures.]

Amdt. 21-5, Eff. 10/8/65

- (3) Both the primary and backup quick release subsystems must—
 - (i) Be reliable, durable, and function properly with all external loads up to and including the maximum external limit load for which authorization is requested.
 - (ii) Be protected against electromagnetic interference (EMI) from external and internal sources and against lightning to prevent inadvertent load release.
- (A) The minimum level of protection required for jettisonable rotorcraft-load combinations used for nonhuman external cargo is a radio frequency field strength of 20 volts per meter.
- (B) The minimum level of protection required for jettisonable rotorcraft-load combinations used for human external cargo is a radio frequency field strength of 200 volts per meter.
- (iii) Be protected against any failure that could be induced by a failure mode of any other electrical or mechanical rotorcraft system.
- (c) For rotorcraft-load combinations to be used for human external cargo applications, the rotorcraft must—
 - (1) For jettisonable external loads, have a quick-release system that meets the requirements of paragraph (b) of this section and that—
 - (i) Provides a dual actuation device for the primary quick release subsystem, and
 - (ii) Provides a separate dual actuation device for the backup quick release subsystem;
 - (2) Have a reliable, approved personnel carrying device system that has the structural capability and personnel safety features essential for external occupant safety;
 - (3) Have placards and markings at all appropriate locations that clearly state the essential system operating instructions and, for the personnel carrying device system, ingress and egress instructions;
 - (4) Have equipment to allow direct intercommunication among required crewmembers and external occupants;
 - (5) Have the appropriate limitations and procedures incorporated in the flight manual for conducting human external cargo operations; and
 - (6) For human external cargo applications requiring use of Category A rotorcraft, have one-engine-inoperative hover performance data and procedures in the flight manual for the weights, altitudes, and temperatures for which external load approval is requested.
- (d) The critically configured jettisonable external loads must be shown by a combination of analysis, ground tests, and flight tests to be both transportable and releasable throughout the approved operational envelope without hazard to the rotorcraft during normal flight conditions. In addition, these external loads must be shown to be releasable without hazard to the rotorcraft during emergency flight conditions.
- (e) A placard or marking must be installed next to the external-load attaching means clearly stating any operational limitations and the maximum authorized external load as demonstrated under Sec. 29.25 and this section.

- (3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices.
 - (4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents.
 - (5) Ability of rotorcraft components that are critical to safety of flight to withstand fire and heat.
- (c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g. equipment shutdown or actuation of a fire extinguisher), quick acting means must be provided to alert the crew.
- (d) Each area where flammable fluids or vapors might escape by leakage of a fluid system must be identified and defined.]
- Amdt. 29-17, Eff. 12/1/78

FAR 29.865 : External loads.

- (a) [It must be shown by analysis, test, or both, that the rotorcraft external load attaching means for rotorcraft-load combinations to be used for nonhuman external cargo applications can withstand a limit static load equal to 2.5, or some lower load factor approved under Secs. 29.337 through 29.341, multiplied by the maximum external load for which authorization is requested. It must be shown by analysis, test, or both that the rotorcraft external load attaching means and corresponding personnel carrying device system for rotorcraft-load combinations to be used for human external cargo applications can withstand a limit static load equal to 3.5 or some lower load factor, not less than 2.5, approved under Secs. 29.337 through 29.341, multiplied by the maximum external load for which authorization is requested. The load for any rotorcraft-load combination class, for any external cargo type, must be applied in the vertical direction. For jettisonable external loads of any applicable external cargo type, the load must also be applied in any direction making the maximum angle with the vertical that can be achieved in service but not less than 30 deg.. However, the 30 deg. angle may be reduced to a lesser angle if—

- (1) An operating limitation is established limiting external load operations to such angles for which compliance with this paragraph has been shown ; or
 - (2) It is shown that the lesser angle can not be exceeded in service.
- (b) [The external load attaching means, for jettisonable rotorcraft- load combinations, must include a quick-release system to enable the pilot to release the external load quickly during flight. The quick- release system must consist of a primary quick release subsystem and a backup quick release subsystem that are isolated from one another. The quick release system, and the means by which it is controlled, must comply with the following :
- (1) A control for the primary quick release subsystem must be installed either on one of the pilot's primary controls or in an equivalently accessible location and must be designed and located so that it may be operated by either the pilot or a crewmember without hazardonously limiting the ability to control the rotorcraft during an emergency situation.
 - (2) A control for the backup quick release subsystem, readily accessible to either the pilot or another crewmember, must be provided.

Chapitre 23

Subpart K–Approval of Materials, Parts, Processes, and Appliances

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FAR 21.301 : Applicability.

This subpart prescribes procedural requirements for the approval of certain materials, parts, processes, and appliances.

FAR 21.303 : Replacement and modification parts.

- (a) Except as provided in paragraph (b) of this section, no person may produce a modification or replacement part for sale for installation on a type certificated product unless it is produced pursuant to a Parts Manufacturer Approval issued under this subpart.
- (b) This section does not apply to the following :
 - (1) Parts produced under a type or production certificate.
 - (2) Parts produced by an owner or operator for maintaining or altering his own product.
 - (3) Parts produced under an FAA Technical Standard Order.
 - (4) Standard parts (such as bolts and nuts) conforming to established industry or United States specifications.
- (c) An application for a Parts Manufacturer Approval is made to the [Manager of the Aircraft Certification Office for the geographic area] in which the manufacturing facility is located and must include the following :
 - (1) The identity of the product on which the part is to be installed.
 - (2) The name and address of the manufacturing facilities at which these parts are to be manufactured.
 - (3) The design of the part, which consists of-
 - (i) Drawings and specifications necessary to show the configuration of the part ; and
 - (ii) Information on dimensions, materials, and processes necessary to define the structural strength of the part.
 - (4) Test reports and computations necessary to show that the design of the part meets the airworthiness requirements of the Federal Aviation Regulations applicable to the product on which the part is to be installed, unless the applicant shows that the design of the part is identical to the design of a part that is covered under a type certificate. If the design of the part was obtained by a licensing agreement, evidence of that agreement must be furnished.
- (d) An applicant is entitled to a Parts Manufacturer Approval for a replacement or modification part if-
 - (1) The Administrator finds, upon examination of the design and after completing all tests and inspections, that the design meets the airworthiness requirements of the Federal Aviation Regulations applicable to the product on which the part is to be installed ; and
 - (2) He submits a statement certifying that he has established the fabrication inspection system required by paragraph (b) of this section.
- (e) Each applicant for a Parts Manufacturer Approval must allow the Administrator to make any inspection or test necessary to determine compliance with the applicable Federal Aviation Regulations. However, unless otherwise authorized by the Administrator-

- (3) There must be means to warn the crew when any heater whose heat output is essential for safe operation has been shut off by the automatic means prescribed in subparagraph (1) of this paragraph.
- (f) *Air intakes.* Each combustion and ventilating air intake must be where no flammable fluids or vapors can enter the heater system under any operating condition-
 - (1) During normal operation ; or
 - (2) As a result of the malfunction of any other component.
- (g) *Heater exhaust.* Each heater exhaust system must meet the requirements of Secs. 29.1121 and 29.1123. In addition-
 - (1) Each exhaust shroud must be sealed so that no flammable fluids or hazardous quantities of vapors can reach the exhaust systems through joints ; and
 - (2) No exhaust system may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.
- (h) *Heater fuel systems.* Each heater fuel system must meet the powerplant fuel system requirements affecting safe heater operation. Each heater fuel system component in the ventilating airstream must be protected by shrouds so that no leakage from those components can enter the ventilating airstream.
- (i) *Drains.* There must be means for safe drainage of any fuel that might accumulate in the combustion chamber or the heat exchanger. In addition-
 - (1) Each part of any drain that operates at high temperatures must be protected in the same manner as heater exhausts ; and
 - (2) Each drain must be protected against hazardous ice accumulation under any operating condition.

Amdt. 29-2, Eff. 6/4/67

FAR 29.861 : Fire protection of structure, controls, and other parts.

Each part of the structure, controls, and the rotor mechanism, and other parts essential to controlled landing and (for category A) flight that would be affected by powerplant fires must be isolated under Sec. 29.1191, or must be-

- (a) For category A rotorcraft, fireproof ; and
 - (b) For Category B rotorcraft, fireproof or protected so that they can perform their essential functions for at least 5 minutes under any foreseeable powerplant fire conditions.]
- Amdt. 29-30, Eff. 4/5/90

FAR 29.863 : Flammable fluid fire protection.

- (a) [In each area where flammable fluids or vapors might escape by leakage of a fluid system, there must be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazards if ignition does occur.
- (b) Compliance with paragraph (a) of this section must be shown by analysis or tests, and the following factors must be considered :
 - (1) Possible sources and paths of fluid leakage, and means of detecting leakage.
 - (2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials.

- (i) Be damaged by heater malfunctioning; or
 - (ii) Allow flammable fluid or vapors to reach the heater in case of leakage.
- (2) Each part of any ventilating air passage that—
- (i) Surrounds the combustion chamber; and
 - (ii) Would not contain (without damage to other rotorcraft components) any fire that may occur within the passage.
- (b) *Ventilating air ducts.* Each ventilating air duct passing through any fire zone must be fireproof. In addition—
- (1) Unless isolation is provided by fireproof valves or by equally effective means, the ventilating air duct downstream of each heater must be fireproof for a distance great enough to ensure that any fire originating in the heater can be contained in the duct; and
 - (2) Each part of any ventilating duct passing through any region having a flammable fluid system must be so constructed or isolated from that system that the malfunctioning of any component of that system cannot introduce flammable fluids or vapors into the ventilating airstream.
- (c) *Combustion air ducts.* Each combustion air duct must be fireproof for a distance great enough to prevent damage from backfiring or reverse flame propagation. In addition—
- (1) No combustion air duct may communicate with the ventilating airstream unless flames from backfires or reverse burning cannot enter the ventilating airstream under any operating condition, including reverse flow or malfunction of the heater or its associated components; and
 - (2) No combustion air duct may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.
- (d) *Heater controls; general.* There must be means to prevent the hazardous accumulation of water or ice on or in any heater control component, control system tubing, or safety control.
- (e) *Heater safety controls.* For each combustion heater, safety control means must be provided as follows :
- (1) [Means independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow must be provided, for each heater, to automatically shut off the ignition and fuel supply of that heater at a point remote from that heater, when any of the following occurs :
 - (i) The heat exchanger temperature exceeds safe limits.
 - (ii) The ventilating air temperature exceeds safe limits.
 - (iii) The combustion airflow becomes inadequate for safe operation.
 - (iv) The ventilating airflow becomes inadequate for safe operation.]
 - (2) The means of complying with subparagraph (1) of this paragraph for any individual heater must—
 - (i) Be independent of components serving any other heater whose heat output is essential for safe operation; and
 - (ii) Keep the heater off until restarted by the crew.

- (1) No part may be presented to the Administrator for an inspection or test unless compliance with paragraphs (f)(2) through (f)(4) of this section has been shown for that part; and
 - (2) No change may be made to a part between the time that compliance with paragraphs (f)(2) through (f)(4) of this section is shown for that part and the time that the part is presented to the Administrator for the inspection or test.
- (f) Each applicant for a Parts Manufacturer Approval must make all inspections and tests necessary to determine—
- (1) Compliance with the applicable airworthiness requirements;
 - (2) That materials conform to the specifications in the design;
 - (3) That the part conforms to the drawings in the design; and
 - (4) That the fabrication processes, construction, and assembly conform to those specified in the design.
- (g) The Administrator does not issue a Parts Manufacturer Approval if the manufacturing facilities for the part are located outside of the United States, unless the Administrator finds that the location of the manufacturing facilities places no burden on the FAA in administering applicable airworthiness requirements.
- (h) Each holder of a Parts Manufacturer Approval shall establish and maintain a fabrication inspection system that ensures that each completed part conforms to its design data and is safe for installation on applicable type certificated products. The system shall include the following :
- (1) Incoming materials used in the finished part must be as specified in the design data.
 - (2) Incoming materials must be properly identified if their physical and chemical properties cannot otherwise be readily and accurately determined.
 - (3) Materials subject to damage and deterioration must be suitably stored and adequately protected.
 - (4) Processes affecting the quality and safety of the finished product must be accomplished in accordance with acceptable specifications.
 - (5) Parts in process must be inspected for conformity with the design data at points in production where accurate determination can be made. Statistical quality control procedures may be employed where it is shown that a satisfactory level of quality will be maintained for the particular part involved.
 - (6) Current design drawings must be readily available to manufacturing and inspection personnel, and used when necessary.
 - (7) Major changes to the basic design must be adequately controlled and approved before being incorporated in the finished part.
 - (8) Rejected materials and components must be segregated and identified in such a manner as to preclude their use in the finished part.
 - (9) Inspection records must be maintained, identified with the completed part, where practicable, and retained in the manufacturer's file for a period of at least 2 years after the part has been completed.
- (i) A Parts Manufacturer Approval issued under this section is not transferable and is effective until surrendered or withdrawn or otherwise terminated by the Administrator.

- (j) The holder of a Parts Manufacturer Approval shall notify the FAA in writing within 10 days from the date the manufacturing facility at which the parts are manufactured is relocated or expanded to include additional facilities at other locations.
- (k) Each holder of a Parts Manufacturer Approval shall determine that each completed part conforms to the design data and is safe for installation on type certificated products.

Amdt. 21-67, Eff. 10/25/89

FAR 21.305 : Approval of materials, parts, processes, and appliances.

Whenever a material, part, process, or appliance is required to be approved under this chapter, it may be approved—

- (a) Under a Parts Manufacturer Approval issued under Sec. 21.303;
- (b) [Under a Technical Standard Order issued by the Administrator. Advisory Circular 20-110 contains a list of Technical Standard Orders that may be used to obtain approval. Copies of the Advisory Circular may be obtained from the U.S. Department of Transportation, Publication Section (M-443.1), Washington, D.C. 20590.]
- (c) In conjunction with type certification procedures for a product; or
- (d) In any other manner approved by the Administrator.

Amdt. 21-50, Eff. 9/9/80

FAR 21.307 : [Deleted.]

[Deleted.]

Amdt. 21-25, Eff. 10/5/69

FAR 29.855 : Cargo and baggage compartments.

- (a) [Each cargo and baggage compartment must be constructed of or lined with materials in accordance with the following :
 - (1) For accessible and inaccessible compartments not occupied by passengers or crew, the material must be at least fire resistant.
 - (2) Materials must meet the requirements in Sec. 29.853(a)(1), (a)(2), and (a)(3) for cargo or baggage compartments in which—
 - (i) The presence of a compartment fire would be easily discovered by a crewmember while at the crewmember's station;
 - (ii) Each part of the compartment is easily accessible in flight;
 - (iii) The compartment has a volume of 200 cubic feet or less; and
 - (iv) Notwithstanding Sec. 29.1439(a), protective breathing equipment is not required.]
- (b) No compartment may contain any controls, wiring, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that—
 - (1) They cannot be damaged by the movement of cargo in the compartment; and
 - (2) Their breakage or failure will not create a fire hazard.
- (c) The design and sealing of inaccessible compartments must be adequate to contain compartment fires until a landing and safe evacuation can be made.
- (d) Each cargo and baggage compartment that is not sealed so as to contain cargo compartment fires completely without endangering the safety of a rotorcraft or its occupants must be designed, or must have a device, to ensure detection of fires or smoke by a crewmember while at his station and to prevent the accumulation of harmful quantities of smoke, flame, extinguishing agents, and other noxious gases in any crew or passenger compartment. This must be shown in flight.
- (e) For rotorcraft used for the carriage of cargo only, the cabin area may be considered a cargo compartment and, in addition to paragraphs (a) through (d) of this section, the following apply :
 - (1) There must be means to shut off the ventilating airflow to or within the compartment. Controls for this purpose must be accessible to the flight crew in the crew compartment.
 - (2) Required crew emergency exits must be accessible under all cargo loading conditions.
 - (3) Sources of heat within each compartment must be shielded and insulated to prevent igniting the cargo.

Amdt. 29-30, Eff. 4/5/90

FAR 29.859 : Combustion heater fire protection.

- (a) *Combustion heater fire zones.* The following combustion heater fire zones must be protected against fire under the applicable provisions of Secs. 29.1181 through 29.1191, and 29.1195 through 29.1203 :
 - (1) The region surrounding any heater, if that region contains any flammable fluid system components (including the heater fuel system), that could—

are constructed of materials not covered in paragraph (a)(3) of this section, must be self extinguishing when tested vertically in accordance with the applicable portion of Appendix F of Part 25 of this chapter, or other approved equivalent methods. The average burn length may not exceed 8 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 5 seconds after falling.

- (3) Acrylic windows and signs, parts constructed in whole or in part of elastomeric materials, edge lighted instrument assemblies consisting of two or more instruments in a common housing, seat belts, shoulder harnesses, and cargo and baggage tiedown equipment, including containers, bins, pallets, etc., used in passenger or crew compartments, may not have an average burn rate greater than 2.5 inches per minute when tested horizontally in accordance with the applicable portions of Appendix F of Part 25 of this chapter, or other approved equivalent methods.
- (4) Except for electrical wire and cable insulation, and for small parts (such as knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys, and small electrical parts) that the Administrator finds would not contribute significantly to the propagation of a fire, materials in items not specified in paragraphs (a)(1), (a)(2), or (a)(3) of this section may not have a burn rate greater than 4 inches per minute when tested horizontally in accordance with the applicable portions of Appendix F of Part 25 of this chapter, or other approved equivalent methods.
- (b) [In addition to meeting the requirements of paragraph (a)(2), seat cushions, except those on flight crewmember seats, must meet the test requirements of Part II of Appendix F of Part 25 of this chapter, or equivalent.]
- (c) If smoking is to be prohibited, there must be a placard so stating, and if smoking is to be allowed—
- (1) There must be an adequate number of self-contained removable ashtrays; and
- (2) Where the crew compartment is separated from the passenger compartment, there must be at least one illuminated sign (using either letters or symbols) notifying all passengers when smoking is prohibited. Signs which notify when smoking is prohibited must—
- (i) When illuminated, be legible to each passenger seated in the passenger cabin under all probable lighting conditions; and
- (ii) Be so constructed that the crew can turn the illumination on and off.
- (d) Each receptacle for towels, paper, or waste must be at least fire-resistant and must have means for containing possible fires.
- (e) There must be a hand fire extinguisher for the flight crewmembers.
- (f) At least the number of hand fire extinguishers must be conveniently located in passenger compartments :

Passenger capacity :	Fire extinguishers
7 through 30	1
31 through 60	2
61 or more	3

Amdt. 29-23, Eff. 11/26/84

Chapitre 24

Subpart L—Export

Airworthiness Approvals

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FAR 21.321 : Applicability.

- (a) This subpart prescribes—
 - (1) Procedural requirements for the issue of export airworthiness approvals; and
 - (2) Rules governing the holders of those approvals.
- (b) For the purposes of this subpart—
 - (1) [A Class I product is a complete aircraft, aircraft engine, or propeller, which—
 - (i) Has been type certificated in accordance with the applicable Federal Aviation Regulations and for which Federal Aviation Specifications or type certificate data sheets have been issued; or
 - (ii) Is identical to a type certificated product specified in paragraph (b)(1)(i) of this section in all respects except as is otherwise acceptable to the civil aviation authority of the importing state.]
 - (2) A Class II product is a major component of a Class I product (e.g., wings, fuselages, engine/propeller assemblies, landing gears, power transmissions, control surfaces, etc.), the failure of which would jeopardize the safety of a Class I product; or any part, material, or appliance, approved and manufactured under the Technical Standard Order (TSO) system in the "C" series.
 - (3) A Class III product is any part or component which is not a Class I or Class II product and includes standard parts, i.e., those designated as AN, NAS, SAE, etc.
 - (4) The words "newly overhauled" when used to describe a product means that the product has not been operated or placed in service, except for functional testing, since having been overhauled, inspected and approved for return to service in accordance with the applicable Federal Aviation Regulations.

Amdt. 21-48, EFF. 4/16/79

FAR 21.323 : [Eligibility.]

- (a) [Any exporter or his authorized representative may obtain an export airworthiness approval for a Class I or Class II product.
- (b) Any manufacturer may obtain an export airworthiness approval for a Class III product if the manufacturer—
 - (1) Has in his employ a designated representative of the Administrator who has been authorized to issue that approval; and
 - (2) Holds for that product—
 - (i) A production certificate;
 - (ii) An approved production inspection system;
 - (iii) An FAA Parts Manufacturer Approval (PMA); or
 - (iv) A Technical Standard Order authorization.]

Amdt. 21-2, EFF. 8/30/65

- (d) There must be means to ensure compliance with paragraphs (b) and (c) of this section under any reasonably probable failure of any ventilating, heating, or other system or equipment.

FAR 29.833 : Heaters.

Each combustion heater must be approved.

74.7 Fire Protection

FAR 29.851 : Fire extinguishers.

(a) *Hand fire extinguishers.* For hand fire extinguishers the following apply :

- (1) Each hand fire extinguisher must be approved.
- (2) The kinds and quantities of each extinguishing agent used must be appropriate to the kinds of fires likely to occur where that agent is used.
- (3) Each extinguisher for use in a personnel compartment must be designed to minimize the hazard of toxic gas concentrations.
- (b) *Built-in fire extinguishers.* If a built-in fire extinguishing system is required—
 - (1) The capacity of each system, in relation to the volume of the compartment where used and the ventilation rate, must be adequate for any fire likely to occur in that compartment.
 - (2) Each system must be installed so that—
 - (i) No extinguishing agent likely to enter personnel compartments will be present in a quantity that is hazardous to the occupants; and
 - (ii) No discharge of the extinguisher can cause structural damage.

FAR 29.853 : Compartment interiors.

For each compartment to be used by the crew or passengers—

- (a) [The materials (including finishes or decorative surfaces applied to the materials) must meet the following test criteria as applicable :
 - (1) Interior ceiling panels, interior wall panels, partitions, galley structure, large cabinet walls, structural flooring, and materials used in the construction of stowage compartments (other than underseat stowage compartments and compartments for stowing small items such as magazines and maps) must be self-extinguishing when tested vertically in accordance with the applicable portions of Appendix F of Part 25 of this chapter, or other approved equivalent methods. The average burn length may not exceed 6 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling.
 - (2) Floor covering, textiles (including draperies and upholstery), seat cushions, padding, decorative and non-decorative coated fabrics, leather, trays and galley furnishings, electrical conduit, thermal and acoustical insulation and insulation covering, air ducting joint and edge covering, cargo compartment liners, insulation blankets, cargo cover, and transparencies, molded and thermofomed parts, air ducting joints, and trim strips (decorative and chafing) that

FAR 29.813 : Emergency exit access.

- (a) Each passageway between passenger compartments, and each passageway leading to Type I and Type II emergency exits, must be—
- (1) Unobstructed ; and
 - (2) At least 20 inches wide.
- (b) For each emergency exit covered by Sec. 29.809(f), there must be enough space adjacent to that exit to allow a crewmember to assist in the evacuation of passengers without reducing the unobstructed width of the passageway below that required for that exit.
- (c) There must be access from each aisle to each Type III and Type IV exit, and
- (1) For rotorcraft that have a passenger seating configuration, excluding pilot seats, of 20 or more, the projected opening of the exit provided must not be obstructed by seats, berths, or other protrusions (including seatbacks in any position) for a distance from that exit of not less than the width of the narrowest passenger seat installed on the rotorcraft ;
 - (2) For rotorcraft that have a passenger seating configuration, excluding pilot seats, of 19 or less, there may be minor obstructions in the region described in subparagraph (1) of this paragraph, if there are compensating factors to maintain the effectiveness of the exit.]

Amdt. 29-12, Eff. 2/1/77

FAR 29.815 : Main aisle width.

The main passenger aisle width between seats must equal or exceed the values in the following table :

Passenger seating capacity	Minimum main passenger aisle width	
	Less than 25 inches from floor (Inches)	25 inches and more from floor (Inches)
10 or less	12[*]	15]
11 through 19	12	20
20 or more	15	20

[*A narrow width not less than 9 inches may be approved when substantiated by tests found necessary by the Administrator.]

Amdt. 29-12, Eff. 2/1/77

FAR 29.831 : Ventilation.

- (a) Each passenger and crew compartment must be ventilated, and each crew compartment must have enough fresh air (but not less than 10 cu. ft. per minute per crewmember) to let crewmembers perform their duties without undue discomfort or fatigue.
- (b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapors.
- (c) The concentration of carbon monoxide may not exceed one part in 20,000 parts of air during forward flight. If the concentration exceeds this value under other conditions, there must be suitable operating restrictions.

FAR 21.325 : Export airworthiness approvals.

(a) *Kinds of approvals.*

- (1) Export airworthiness approval of Class I products is issued in the form of Export Certificates of Airworthiness, FAA Form 8130-4. Such a certificate does not authorize the operation of aircraft.
 - (2) Export airworthiness approval of Class II and III products is issued in the form of Airworthiness Approval Tags, FAA Form 8130-3.
- (b) *Products which may be approved.* Export airworthiness approvals are issued for—
- (1) New aircraft that are assembled and that have been flight-tested, and other Class I products located in the United States, except that export airworthiness approval may be issued for [any] of the following without assembly or flight-test :
 - (i) [A small airplane type certificated under Part 3 or 4a of the Civil Air Regulations, or Part 23 of the Federal Aviation Regulations, and manufactured under a production certificate ;
 - (ii) A glider type certificated under Sec. 21.23 of this part and manufactured under a production certificate ; or
 - (iii) A normal category rotorcraft type certificated under Part 6 of the Civil Air Regulations or Part 27 of the Federal Aviation Regulations and manufactured under a production certificate.]
 - (2) Used aircraft possessing a valid U.S. airworthiness certificate, or other used Class I products that have been maintained in accordance with the applicable CARs or FARs and are located in a foreign country, if the Administrator finds that the location places no undue burden upon the [FAA] in administering the provisions of this regulation.
 - (3) Class II and III products that are manufactured and located in the U.S.

(c) [*Export airworthiness approval exceptions.* If the export airworthiness approval is issued on the basis of a written statement by the importing state as provided for in Sec. 21.327(e)(4), the requirements that are not met and the differences in configuration, if any, between the product to be exported and the related type certificated product, are listed on the export airworthiness approval as exceptions.]

Amdt. 21-48, Eff. 4/16/79

FAR 21.327 : Application.

- (a) Except as provided in paragraph (b) of this section, an application for export airworthiness approval for a Class I or Class II product is made on a form and in a manner prescribed by the Administrator and is submitted to the appropriate Flight Standards District Office or to the nearest international field office.
- (b) A manufacturer holding a production certificate may apply orally to the appropriate Flight Standards District Office or the nearest international field office for export airworthiness approval of a Class II product approved under his production certificate.
- (c) Application for export airworthiness approval of Class III products is made to the designated representative of the Administrator authorized to issue those approvals.
- (d) A separate application must be made for—

- (1) Each aircraft;
- (2) Each engine and propeller, except that one application may be made for more than one engine or propeller, if all are of the same type and model and are exported to the same purchaser and country; and
- (3) Each type of Class II product, except that one application may be used for more than one type of Class II product when—
 - (i) They are separated and identified in the application as to the type and model of the related Class I product; and
 - (ii) They are to be exported to the same purchaser and country.
- (e) Each application must be accompanied by a written statement from the importing country that it will validate the export airworthiness approval if the product being exported is—
 - (1) An aircraft manufactured outside the United States and being exported to a country with which the United States has a reciprocal agreement concerning the validation of export certificates;
 - (2) An unassembled aircraft which has not been flight-tested;
 - (3) A product that does not meet the special requirement of the importing country; or
 - (4) A product that does not meet a requirement specified in Secs. 21.329, 21.331, or 21.333, as applicable, for the issuance of an export airworthiness approval. The written statement must list the requirements not met.
- (f) Each application for export airworthiness approval of a Class I product must include, as applicable :
 - (1) A Statement of Conformity, FAA Form 8130-9, for each new product that has not been manufactured under a production certificate.
 - (2) A weight and balance report, with a loading schedule when applicable, for each aircraft in accordance with Part 43 of this chapter. For transport aircraft (and commuter category airplanes,) this report must be based on an actual weighing of the aircraft within the preceding twelve months, but after any major repairs or alterations to the aircraft. Changes in equipment not classed as major changes that are made after the actual weighing may be accounted for on a "computed" basis and the report revised accordingly. Manufacturers of new nontransport category airplanes, normal category rotorcraft, and gliders may submit reports having computed weight and balance data, in place of an actual weighing of the aircraft, if fleet weight control procedures approved by the FAA have been established for such aircraft. In such a case, the following statement must be entered in each report : "The weight and balance data shown in this report are computed on the basis of Federal Aviation Administration approved procedures for establishing fleet weight averages." The weight and balance report must include an equipment list showing weights and moment arms of all required and optional items of equipment that are included in the certificated empty weight.
 - (3) A maintenance manual for each new product when such a manual is required by the applicable airworthiness rules.
 - (4) Evidence of compliance with the applicable airworthiness directives. A suitable notation must be made when such directives are not complied with.

FAR 29.812 : [Emergency lighting.]

[For transport Category A rotorcraft, the following apply :

- (a) A source of light with its power supply independent of the main lighting system must be installed to—
 - (1) Illuminate each passenger emergency exit marking and locating sign; and
 - (2) Provide enough general lighting in the passenger cabin so that the average illumination, when measured at 40-inch intervals at seat armrest height on the center line of the main passenger aisle, is at least 0.05 foot-candle.
- (b) Exterior emergency lighting must be provided at each emergency exit. The illumination may not be less than 0.05 foot-candle (measured normal to the direction of the incident light) for minimum width on the ground surface, with landing gear extended, equal to the width of the emergency exit where an evacuee is likely to make first contact with the ground outside the cabin. The exterior emergency lighting may be provided by either interior or exterior sources with light intensity measurements made with the emergency exits open.
- (c) Each light required by paragraph (a) or (b) of this section must be operable manually from the cockpit station and from a point in the passenger compartment that is readily accessible. The cockpit control device must have an "on," "off," and "armed" position so that when turned on at the cockpit or passenger compartment station or when armed at the cockpit station, the emergency lights will either illuminate or remain illuminated upon interruption of the rotorcraft's normal electric power.
- (d) Any means required to assist the occupants in descending to the ground must be illuminated so that the erected assist means is visible from the rotorcraft.
 - (1) The assist means must be provided with an illumination of not less than 0.03 foot-candle (measured normal to the direction of the incident light) at the ground end of the erected assist means where an evacuee using the established escape route would normally make first contact with the ground, with the rotorcraft in each of the attitudes corresponding to the collapse of one or more legs of the landing gear.
 - (2) If the emergency lighting subsystem illuminating the assist means is independent of the rotorcraft's main emergency lighting system, it—
 - (i) Must automatically be activated when the assist means is erected;
 - (ii) Must provide the illumination required by paragraph (d)(1); and
 - (iii) May not be adversely affected by stowage.
- (e) The energy supply to each emergency lighting unit must provide the required level of illumination for at least 10 minutes at the critical ambient conditions after an emergency landing.
- (f) If storage batteries are used as the energy supply for the emergency lighting system, they may be recharged from the rotorcraft's main electrical power system provided the charging circuit is designed to preclude inadvertent battery discharge into charging circuit faults.]

Amdt. 29-24, Eft. 12/6/84

- (b) The identity and location of each passenger emergency exit must be recognizable from a distance equal to the width of the cabin.
- (c) The location of each passenger emergency exit must be indicated by a sign visible to occupants approaching along the main passenger aisle. There must be a locating sign—
- (1) Next to or above the aisle near each floor emergency exit, except that one sign may serve two exits if both exits can be seen readily from that sign ; and
 - (2) On each bulkhead or divider that prevents fore and aft vision along the passenger cabin, to indicate emergency exits beyond and obscured by it, except that if this is not possible the sign may be placed at another appropriate location.
- (d) Each passenger emergency exit marking and each locating sign must have white letters 1 inch high on a red background 2 inches high, be self or electrically illuminated, and have a minimum luminescence (brightness) of at least 160 microlamberts. The colors may be reversed if this will increase the emergency illumination of the passenger compartment.
- (e) The location of each passenger emergency exit operating handle and instructions for opening must be shown—
- (1) For each emergency exit, by a marking on or near the exit that is readable from a distance of 30 inches ; and
 - (2) For each Type I or Type II emergency exit with a locking mechanism released by rotary motion of the handle, by—
 - (i) A red arrow, with a shaft at least three-fourths inch wide and a head twice the width of the shaft, extending along at least 70° of arc at a radius approximately equal to three-fourths of the handle length ; and
 - (ii) The word "open" in red letters 1 inch high, placed horizontally near the head of the arrow.
- (f) Each emergency exit, and its means of opening, must be marked on the outside of the rotorcraft. In addition, the following apply :
- (1) There must be a 2-inch colored band outlining each passenger emergency exit, except small rotorcraft with a maximum weight of 12,500 pounds or less may have a 2-inch colored band outlining each exit release lever or device of passenger emergency exits which are normally used doors.
 - (2) Each outside marking, including the band, must have color contrast to be readily distinguishable from the surrounding fuselage surface. The contrast must be such that, if the reflectance of the darker color is 15 percent or less, the reflectance of the lighter color must be at least 45 percent. "Reflectance" is the ratio of the luminous flux reflected by a body to the luminous flux it received. When the reflectance of the darker color is greater than 15 percent, at least a 30 percent difference between its reflectance and the reflectance of the lighter color must be provided.
- (g) Exits marked as such, though in excess of the required number of exits, must meet the requirements for emergency exits of the particular type. Emergency exits need only be marked with the word "Exit."

Amdt. 29-31, Eff. 10/22/90

- (5) When temporary installations are incorporated in an aircraft for the purpose of export delivery, the application form must include a general description of the installations together with a statement that the installation will be removed and the aircraft restored to the approved configuration upon completion of the delivery flight.
- (6) Historical records such as aircraft and engine log books, repair and alteration forms, etc., for used aircraft and newly overhauled products.
- (7) For products intended for overseas shipment, the application form must describe the methods used, if any, for the preservation and packaging of such products to protect them against corrosion and damage while in transit or storage. The description must also indicate the duration of the effectiveness of such methods.
- (8) The Airplane or Rotorcraft Flight Manual when such material is required by the applicable airworthiness regulations for the particular aircraft.
- (9) A statement as to the date when title passed or is expected to pass to a foreign purchaser.
- (10) The data required by the special requirements of the importing country.

Amdt. 21-59, Eff. 2/17/87

FAR 21.329 : Issue of Export Certificates of Airworthiness for Class I Products.

An applicant is entitled to an export certificate of airworthiness for a Class I product if that applicant shows at the time the product is submitted to the Administrator for export airworthiness approval that it meets the requirements of paragraphs (a) through (f) of this section, as applicable, except as provided in paragraph (g) of this section :

- (a) New or used aircraft manufactured in the United States must meet the airworthiness requirement for a standard U.S. airworthiness certificate under Sec. 21.183, or meet the airworthiness certification requirements for a "restricted" airworthiness certificate under Sec. 21.185.
- (b) New or used aircraft manufactured outside the United States must have a valid U.S. standard airworthiness certificate.
- (c) Used aircraft must have undergone an annual type inspection and be approved for return to service in accordance with Part 43 of this Chapter. The inspection must have been performed and properly documented within 30 days before the date the application is made for an export certificate of airworthiness. In complying with this paragraph, consideration may be given to the inspections performed on an aircraft maintained in accordance with a [continuous airworthiness maintenance program under Parts 121] of this Chapter or a progressive inspection program under Part 91 of this Chapter, within the 30 days prior to the date the application is made for an export certificate of airworthiness.
- (d) New engines and propellers must conform to the type design and must be in a condition for safe operation.
- (e) Used engines and propellers which are not being exported as part of a certificated aircraft must have been newly overhauled.
- (f) The special requirements of the importing country must have been met.

- (g) A product need not meet a requirement specified in paragraphs (a) through (f) of this section, as applicable, if acceptable to the importing country and the importing country indicates that acceptability in accordance with Sec. 21.327(e)(4) of this Part.

Amdt. 21-79, Eff. 4/27/2001

FAR 21.331 : Issue of airworthiness approval tags for Class II products.

- (a) [An applicant is entitled to an export airworthiness approval tag for Class II products if that applicant shows, except as provided in paragraph (b) of this section, that—
- (1) The products are new or have been newly overhauled and conform to the approved design data;
 - (2) The products are in a condition for safe operation;
 - (3) The products are identified with at least the manufacturer's name, part number, model designation (when applicable), and serial number or equivalent; and
 - (4) The products meet the special requirements of the importing country.
- (b) A product need not meet a requirement specified in paragraph (a) of this section if acceptable to the importing country and the importing country indicates that acceptability in accordance with Sec. 21.327(e)(4) of this Part.]
- Amdt. 21-48, Eff. 4/16/79

FAR 21.333 : Issue of export airworthiness approval tags for Class III products.

- (a) [An applicant is entitled to an export airworthiness approval tag for Class III products if that applicant shows, except as provided in paragraph (b) of this section, that—
- (1) The products conform to the approved design data applicable to the Class I or Class II products of which they are a part;
 - (2) The products are in a condition for safe operation; and
 - (3) The products comply with the special requirements of the importing country.
- (b) A product need not meet a requirement specified in paragraph (a) of this section if acceptable to the importing country and the importing country indicates that acceptability in accordance with Sec. 21.327(e)(4) of this Part.]
- Amdt. 21-48, Eff. 4/16/79

FAR 21.335 : Responsibilities of exporters.

Each exporter receiving an export airworthiness approval for a product shall—

- (a) Forward to the air authority of the importing country all documents and information necessary for the proper operation of the products being exported, e.g., Flight Manuals, Maintenance Manuals, Service Bulletins, and assembly instructions, and such other material as is stipulated in the special requirements of the importing country. The documents, information, and material may be forwarded by any means consistent with the special requirements of the importing country;

- (1) With the rotorcraft on the ground and with the landing gear extended;
 - (2) With one or more legs or part of the landing gear collapsed, broken, or not extended; and
 - (3) With the rotorcraft resting on its side, if required by Sec. 29.803(d).
- (g) The slide for each passenger emergency exit must be a self-supporting slide or equivalent, and must be designed to meet the following requirements:

- (1) It must be automatically deployed, and deployment must begin during the interval between the time the exit opening means is actuated from inside the rotorcraft and the time the exit is fully opened. However, each passenger emergency exit which is also a passenger entrance door or a service door must be provided with means to prevent deployment of the slide when the exit is opened from either the inside or the outside under nonemergency conditions for normal use.
 - (2) It must be automatically erected within 10 seconds after deployment is begun.
 - (3) It must be of such length after full deployment that the lower end is self-supporting on the ground and provides safe evacuation of occupants to the ground after collapse of one or more legs or part of the landing gear.
 - (4) It must have the capability, in 25-knot winds directed from the most critical angle, to deploy and, with the assistance of only one person, to remain usable after full deployment to evacuate occupants safely to the ground.
 - (5) Each slide installation must be qualified by five consecutive deployment and inflation tests conducted (per exit) without failure, and at least three tests of each such five-test series must be conducted using a single representative sample of the device. The sample devices must be deployed and inflated by the system's primary means after being subjected to the inertia forces specified in Sec. 29.561(b). If any part of the system fails or does not function properly during the required tests, the cause of the failure or malfunction must be corrected by positive means and after that, the full series of five consecutive deployment and inflation tests must be conducted without failure.
 - (h) For rotorcraft having 30 or fewer passenger seats and having an exit threshold more than 6 feet above the ground, a rope or other assist means may be used in place of the slide specified in paragraph (f) of this section, provided an evacuation demonstration is accomplished as prescribed in Sec. 29.803(d) or (e).
 - (i) If a rope, with its attachment, is used for compliance with paragraph (f), (g), or (h) of this section, it must—
 - (1) Withstand a 400-pound static load; and
 - (2) Attach to the fuselage structure at or above the top of the emergency exit opening, or at another approved location if the stowed rope would reduce the pilot's view in flight.]
- Amdt. 29-30, Eff. 4/5/90

FAR 29.811 : Emergency exit marking.

- (a) [Each passenger emergency exit, its means of access, and its means of opening must be conspicuously marked for the guidance of occupants using the exits in daylight or in the dark. Such markings must be designed to remain visible for rotorcraft equipped for overwater flights if the rotorcraft is capsized and the cabin is submerged.]

- (2) The probability of the rotorcraft coming to rest on its side in a crash landing must be extremely remote.

(d) [*Ditching emergency exits for passengers.* If certification with ditching provisions is requested, ditching emergency exits must be provided in accordance with the following requirements and must be proven by test, demonstration, or analysis unless the emergency exits required by paragraph (b) of this section already meet these requirements.]

- (1) For rotorcraft that have a passenger seating configuration, excluding pilots seats, of nine seats or less, one exit above the waterline in each side of the rotorcraft, meeting at least the dimensions of a Type IV exit.
- (2) For rotorcraft that have a passenger seating configuration, excluding pilots seats, of 10 seats or more, one exit above the waterline in a side of the rotorcraft meeting at least the dimensions of a Type III exit, for each unit (or part of a unit) of 35 passenger seats, but no less than two such exits in the passenger cabin, with one on each side of the rotorcraft. However, where it has been shown through analysis, ditching demonstrations, or any other tests found necessary by the Administrator, that the evacuation capability of the rotorcraft during ditching is improved by the use of larger exits, or by other means, the passenger seat to exit ratio may be increased.
- (3) [Flotation devices, whether stowed or deployed, may not interfere with or obstruct the exits.]
- (e) *Ramp exits.* One type I exit only, or one Type II exit only, that is required in the side of the fuselage under paragraph (b) of this section, may be installed instead in the ramp of floor ramp rotorcraft if—
 - (1) Its installation in the side of the fuselage is impractical; and
 - (2) Its installation in the ramp meets Sec. 29.813.
- (f) *Tests.* The proper functioning of each emergency exit must be shown by test.

Amdt. 29-30, Eff. 4/5/90

FAR 29.809 : Emergency exit arrangement.

- (a) Each emergency exit must consist of a movable door or hatch in the external walls of the fuselage and must provide an unobstructed opening to the outside.
- (b) Each emergency exit must be openable from the inside and from the outside.
- (c) The means of opening each emergency exit must be simple and obvious and may not require exceptional effort.
- (d) There must be means for locking each emergency exit and for preventing opening in flight inadvertently or as a result of mechanical failure.
- (e) There must be means to minimize the probability of the jamming of any emergency exit in a minor crash landing as a result of fuselage deformation under the ultimate inertial forces in Sec. 29.783(d).
- (f) [Except as provided in paragraph (h) of this section, each land-based rotorcraft emergency exit must have an approved slide as stated in paragraph (g) of this section, or its equivalent, to assist occupants in descending to the ground from each floor level exit and an approved rope, or its equivalent, for all other exits, if the exit threshold is more than 6 feet above the ground—

- (b) Forward the manufacturer's assembly instructions and an FAA-approved flight test checkoff form to the air authority of the importing country when unassembled aircraft are being exported. These instructions must be in sufficient detail to permit whatever rigging, alignment, and ground testing is necessary to ensure that the aircraft will conform to the approved configuration when assembled;
- (c) Remove or cause to be removed any temporary installation incorporated on an aircraft for the purpose of export delivery and restore the aircraft to the approved configuration upon completion of the delivery flight ;
- (d) Secure all proper foreign entry clearances from all the countries involved when conducting sales demonstrations or delivery flights ; and
- (e) When title to an aircraft passes or has passed to a foreign purchaser—
 - (1) Request cancellation of the U.S. registration and airworthiness certificates, giving the date of transfer of title, and the name and address of the foreign owner ;
 - (2) Return the Registration and Airworthiness Certificates, [AC Form 8050.3 and FAA Form 8100-2], to the FAA ; and
 - (3) Submit a statement certifying that the United States' identification and registration numbers have been removed from the aircraft in compliance with Sec. 45.33.

Amdt. 21-48, Eff. 4/16/79

FAR 21.337 : Performance of inspections and overhauls.

Unless otherwise provided for in this subpart, each inspection and overhaul required for export airworthiness approval of Class I and Class II products must be performed and approved by one of the following :

- (a) The manufacturer of the product.
- (b) An appropriately certificated domestic repair station.
- (c) An appropriately certificated foreign repair station having adequate overhaul facilities, and maintenance organization appropriate to the product involved, when the product is a Class I product located in a foreign country and an international office of Flight Standards Service has approved the use of such foreign repair station.
- (d) The holder of an inspection authorization as provided in Part 65 of this Chapter.
- (e) An air carrier, when the product is one that the carrier has maintained under its own or another air carrier's [continuous airworthiness maintenance program and maintenance manuals as provided in Part 121] of this Chapter.
- (f) A commercial operator, when the product is one that the operator has maintained under its continuous airworthiness maintenance program and maintenance manual as provided in Part 121 of this Chapter.

Amdt. 21-79, Eff. 4/27/2001

FAR 21.339 : Special export airworthiness approval for aircraft.

A special export certificate of airworthiness may be issued for an aircraft located in the United States that is to be flown to several foreign countries for the purpose of sale, without returning the aircraft to the United States for the certificate if—

- (a) [The aircraft possesses either—
- (1) A standard U.S. certificate of airworthiness; or
 - (2) A special U.S. certificate of airworthiness in the restricted category issued under Sec. 21.185.]
- (b) The owner files an application as required by Sec. 21.327 of this subpart, except that items 3 and 4 of the application (FAA Form 8130-1) need not be completed;
- (c) The aircraft is inspected by the Administrator before leaving the United States and is found to comply with all the applicable requirements;
- (d) A list of foreign countries in which it is intended to conduct sales demonstrations, together with the expected dates and duration of such demonstration, is included in the application;
- (e) For each prospective importing country, the applicant shows that—
- (1) He has met that country's special requirements, other than those requiring that documents, information, and materials be furnished; and
 - (2) He has the documents, information, and materials necessary to meet the special requirements of that country; and
- (f) All other requirements for the issuance of a Class I export certificate of airworthiness are met.
- Amdt. 21-55, Eff. 10/8/81

FAR 29.805 : Flight crew emergency exits.

- (a) For rotorcraft with passenger emergency exits that are not convenient to the flight crew, there must be flight crew emergency exits, on both sides of the rotorcraft or as a top hatch, in the flight crew area.
- (b) Each flight crew emergency exit must be of sufficient size and must be located so as to allow rapid evacuation of the flight crew. This must be shown by test.
- (c) [Each exit must not be obstructed by water or flotation devices after a ditching. This must be shown by test, demonstration, or analysis.]
- Amdt. 29-30, Eff. 4/5/90

FAR 29.807 : Passenger emergency exits.

- (a) *Type.* For the purpose of this part, the types of passenger emergency exit are as follows:
- (1) *Type I.* This type must have a rectangular opening of not less than 24 inches wide by 48 inches high, with corner radii not greater than one-third the width of the exit, in the passenger area in the side of the fuselage at floor level and as far away as practicable from areas that might become potential fire hazards in a crash.
 - (2) *Type II.* This type is the same as Type I, except that the opening must be at least 20 inches wide by 44 inches high.
 - (3) *Type III.* This type is the same as Type I, except that—
 - (i) The opening must be at least 20 inches wide by 36 inches high; and
 - (ii) The exits need not be at floor level.
 - (4) *Type IV.* This type must have a rectangular opening of not less than 19 inches wide by 26 inches high, with corner radii not greater than one-third the width of the exit, in the side of the fuselage with a step-up inside the rotorcraft of not more than 29 inches.

Openings with dimensions larger than those specified in this section may be used, regardless of shape, if the base of the opening has a flat surface of not less than the specified width.

- (b) *Passenger emergency exits; side-of-fuselage.* Emergency exits must be accessible to the passengers and, except as provided in paragraph (d) of this section, must be provided in accordance with the following table:

Passenger seating capacity	Type I	Type II	Type III	Type IV
1 through 10	-	-	-	1
11 through 19	-	-	1 or	2
20 through 39	-	1	-	1
40 through 59	1	-	-	1
60 through 79	1	-	1 or	2

- (c) *Passenger emergency exits; other than side-of-fuselage.* In addition to the requirements of paragraph (b) of this section—

- (1) There must be enough openings in the top, bottom, or ends of the fuselage to allow evacuation with the rotorcraft on its side; or

- (b) Each practicable design measure, compatible with the general characteristics of the rotorcraft, must be taken to minimize the probability that in an emergency landing on water, the behavior of the rotorcraft would cause immediate injury to the occupants or would make it impossible for them to escape.
- (c) The probable behavior of the rotorcraft in a water landing must be investigated by model tests or by comparison with rotorcraft of similar configuration for which the ditching characteristics are known. Scoops, flaps, projections, and any other factors likely to affect the hydrodynamic characteristics of the rotorcraft must be considered.
- (d) It must be shown that, under reasonably probable water conditions, the flotation time and trim of the rotorcraft will allow the occupants to leave the rotorcraft and enter the liferafts required by Sec. 29.1415. If compliance with this provision is shown by buoyancy and trim computations, appropriate allowances must be made for probable structural damage and leakage. If the rotorcraft has fuel tanks (with fuel jettisoning provisions) that can reasonably be expected to withstand a ditching without leakage, the jettisonable volume of fuel may be considered as buoyancy volume.
- (e) Unless the effects of the collapse of external doors and windows are accounted for in the investigation of the probable behavior of the rotorcraft in a water landing (as prescribed in paragraphs (c) and (d) of this section), the external doors and windows must be designed to withstand the probable maximum local pressures.]

Amdt. 29-12, Eff. 2/1/77

FAR 29.803 : Emergency evacuation.

- (a) Each crew and passenger area must have means for rapid evacuation in a crash landing, with the landing gear (1) extended and (2) retracted, considering the possibility of fire.
- (b) Passenger entrance, crew, and service doors may be considered as emergency exits if they meet the requirements of this section and of Secs. 29.805 through 29.815.
- (c) [[Reserved.]]
- (d) Except as provided in paragraph (e) of this section, the following categories of rotorcraft must be tested in accordance with the requirements of Appendix D of this part to demonstrate that the maximum seating capacity, including the crewmembers required by the operating rules, can be evacuated from the rotorcraft to the ground within 90 seconds.
 - (1) Rotorcraft with a seating capacity of more than 44 passengers.
 - (2) Rotorcraft with all of the following :
 - (i) Ten or more passengers per passenger exit as determined under Sec. 29.807(b).
 - (ii) No main aisle, as described in Sec. 29.815, for each row of passenger seats.
 - (iii) Access to each passenger exit for each passenger by virtue of design features of seats, such as folding or break-over seat backs or folding seats.
- (e) A combination of analysis and tests may be used to show that the rotorcraft is capable of being evacuated within 90 seconds under the conditions specified in Sec. 29.803(d) if the Administrator finds that the combination of analysis and tests will provide data, with respect to the emergency evacuation capability of the rotorcraft, equivalent to that which would be obtained by actual demonstration.]

Amdt. 29-30, Eff. 4/5/90

Chapitre 25

Subpart M–Designated Alteration Station Authorization Procedures

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FAR 21.431 : Applicability.

- (a) This subpart prescribes Designated Alteration Station (DAS) authorization procedures for—
 - (1) Issuing supplemental type certificates;
 - (2) Issuing experimental certificates; and
 - (3) Amending standard airworthiness certificates.
 - (b) [This subpart applies to domestic repair stations, air carriers, commercial operators of large aircraft, and manufacturers of products.]
- Amdt. 21-74, Eff. 3/12/97

FAR 21.435 : Application.

- The applicant for a DAS authorization must submit an application, in writing and signed by an official of the applicant, to the [Aircraft Certification Office responsible for the geographic area] in which the applicant is located. The application must contain—
- (a) The repair station certificate number held by the repair station applicant, and the current ratings covered by the certificate;
 - (b) The air carrier or commercial operator operating certificate number held by the air carrier or commercial operator applicant, and the products that it may operate and maintain under the certificate;
 - (c) A statement by the manufacturer applicant of the products for which he holds the type certificate;
 - (d) The names, signatures, and titles of the persons for whom authorization to issue supplemental type certificates or experimental certificates, or amend airworthiness certificates, is requested; and
 - (e) A description of the applicant's facilities, and of the staff with which compliance with Sec. 21.439(a)(4) is to be shown.
- Amdt. 21-67, Eff. 10/25/89

FAR 21.439 : [Eligibility.]

- (a) [To be eligible for a DAS authorization, the applicant must—
 - (1) Hold a current domestic repair station certificate under Part 145, or air carrier or commercial operator operating certificate under Part 121;
 - (2) Be a manufacturer of a product for which it has alteration authority under Sec. 43.3(i) of this subchapter;
 - (3) Have adequate maintenance facilities and personnel, in the United States, appropriate to the products that it may operate and maintain under its certificate; and
 - (4) Employ, or have available, a staff of engineering, flight test, and inspection personnel who can determine compliance with the applicable airworthiness requirements of this chapter.
- (b) At least one member of the staff required by paragraph (a)(4) of this section must have all of the following qualifications :
 - (1) A thorough working knowledge of the applicable requirements of this chapter.

- (j) Each seating device system may use design features such as crushing or separation of certain parts of the seat in the design to reduce occupant loads for the emergency landing dynamic conditions of Sec. 29.562; otherwise, the system must remain intact and must not interfere with rapid evacuation of the rotorcraft.
 - (k) For purposes of this section, a litter is defined as a device designed to carry a nonambulatory person, primarily in a recumbent position, into and on the rotorcraft. Each berth or litter must be designed to withstand the load reaction of an occupant weight of at least 170 pounds when the occupant is subjected to the forward inertial factors specified in Sec. 29.561(b). A berth or litter installed within 15° or less of the longitudinal axis of the rotorcraft must be provided with a padded end-board, cloth daphragm, or equivalent means that can withstand the forward load reaction. A berth or litter oriented greater than 15° with the longitudinal axis of the rotorcraft must be equipped with appropriate restraints, such as straps or safety belts, to withstand the forward reaction. In addition—
 - (1) The berth or litter must have a restraint system and must not have corners or other protuberances likely to cause serious injury to a person occupying it during emergency landing conditions; and
 - (2) The berth or litter attachment and the occupant restraint system attachments to the structure must be designed to withstand the critical loads resulting from flight and ground load conditions and from the conditions prescribed in Sec. 29.561(b). [The fitting factor required by Sec. 29.625(d) shall be applied.]
- Amdt. 29-42, Eff. 9/8/98

FAR 29.787 : Cargo and baggage compartments.

- (a) Each cargo and baggage compartment must be designed for its placarded maximum weight of contents and for the critical load distributions at the appropriate maximum load factors corresponding to the specified flight and ground load conditions, except the emergency landing conditions of Sec. 29.561.
 - (b) There must be means to prevent the contents of any compartment from becoming a hazard by shifting under the loads specified in paragraph (a) of this section.
 - (c) Under the emergency landing conditions of Sec. 29.561, cargo and baggage compartments must—
 - (1) Be positioned so that if the contents break loose they are unlikely to cause injury to the occupants or restrict any of the escape facilities provided for use after an emergency landing; or
 - (2) Have sufficient strength to withstand the conditions specified in Sec. 29.561, including the means of restraint and their attachments required by paragraph (b) of this section. Sufficient strength must be provided for the maximum authorized weight of cargo and baggage at the critical loading distribution.]
 - (d) If cargo compartment lamps are installed, each lamp must be installed so as to prevent contact between lamp bulb and cargo.
- Amdt. 29-31, Eff. 10/22/90

FAR 29.801 : [Ditching.]

- (a) [If certification with ditching provisions is requested, the rotorcraft must meet the requirements of this section and Secs. 29.807(d), 29.1411 and 29.1415.

FAR 29.785 : Seats, berths, [litters,] safety belts, and harnesses.

- (a) Each seat, safety belt, harness, and adjacent part of the rotorcraft at each station designated for occupancy during takeoff and landing must be free of potentially injurious objects, sharp edges, protuberances, and hard surfaces and must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertial factors specified in Sec. 29.561(b) and dynamic conditions specified in Sec. 29.562.
- (b) Each occupant must be protected from serious head injury by a safety belt plus a shoulder harness that will prevent the head from contacting any injurious object, except as provided for in Sec. 29.562(c)(5). A shoulder harness (upper torso restraint), in combination with the safety belt, constitutes a torso restraint system as described in TSO-C114.
- (c) Each occupant's seat must have a combined safety belt and shoulder harness with a single-point release. Each pilot's combined safety belt and shoulder harness must allow each pilot when seated with safety belt and shoulder harness fastened to perform all functions necessary for flight operations. There must be a means to secure belt and harness when not in use to prevent interference with the operation of the rotorcraft and with rapid egress in an emergency.
- (d) If seat backs do not have a firm handhold, there must be hand grips or rails along each aisle to let the occupants steady themselves while using the aisle in moderately rough air.
- (e) Each projecting object that would injure persons seated or moving about in the rotorcraft in normal flight must be padded.
- (f) Each seat and its supporting structure must be designed for an occupant weight of at least 170 pounds, considering the maximum load factors, inertial forces, and reactions between the occupant, seat, and safety belt or harness corresponding with the applicable flight and ground-load conditions, including the emergency landing conditions of Sec. 29.561(b). In addition—
 - (1) Each pilot seat must be designed for the reactions resulting from the application of the pilot forces prescribed in Sec. 29.397; and
 - (2) The inertial forces prescribed in Sec. 29.561(b) must be multiplied by a factor of 1.33 in determining the strength of the attachment of—
 - (i) Each seat to the structure; and
 - (ii) Each safety belt or harness to the seat or structure.
- (g) When the safety belt and shoulder harness are combined, the rated strength of the safety belt and shoulder harness may not be less than that corresponding to the inertial forces specified in Sec. 29.561(b), considering the occupant weight of at least 170 pounds, considering the dimensional characteristics of the restraint system installation, and using a distribution of at least a 60-percent load to the safety belt and at least a 40-percent load to the shoulder harness. If the safety belt is capable of being used without the shoulder harness, the inertial forces specified must be met by the safety belt alone.
- (h) When a headrest is used, the headrest and its supporting structure must be designed to resist the inertia forces specified in Sec. 29.561, with a 1.33 fitting factor and a head weight of at least 13 pounds.
- (i) Each seating device system includes the device such as the seat, the cushions, the occupant restraint system and attachment devices.

- (2) A position, on the applicant's staff, with authority to establish alteration programs that ensure that altered products meet the applicable requirements of this chapter.
- (3) At least one year of satisfactory experience in direct contact with the FAA (or its predecessor agency (CAA)) while processing engineering work for type certification or alteration projects.
- (4) At least eight years of aeronautical engineering experience (which may include the one year required by subparagraph (3) of this paragraph).
- (5) The general technical knowledge and experience necessary to determine that altered products, of the types for which a DAS authorization is requested, are in condition for safe operation.]

Amdt. 21-6, Eff. 10/8/65

FAR 21.441 : [Procedure manual.]

- (a) [No DAS may exercise any authority under this subpart unless it submits, and obtains approval of, a procedural manual containing—
 - (1) The procedures for issuing STCs; and
 - (2) The names, signatures, and responsibilities of officials and of each staff member required by Sec. 21.439(a)(4), identifying those persons who—
 - (i) Have authority to make changes in procedures that require a revision to the procedure manual; and
 - (ii) Are to conduct inspections (including conformity and compliance inspections) or approve inspection reports, prepare or approve data, plan or conduct tests, approve the results of tests, amend airworthiness certificates, issue experimental certificates, approve changes to operating limitations or Aircraft Flight Manuals, and sign supplemental type certificates.
- (b) No DAS may continue to perform any DAS function affected by any change in facilities or staff necessary to continue to meet the requirements of Sec. 21.439, or affected by any change in procedures from those approved under paragraph (a) of this section, unless that change is approved and entered in the manual. For this purpose, the manual shall contain a log-of-revisions page with space for the identification of each revised item, page, or date, and the signature of the person approving the change for the Administrator.]

Amdt. 21-6, Eff. 10/8/65

FAR 21.443 : [Duration.]

- (a) [A DAS authorization is effective until it is surrendered or the Administrator suspends, revokes, or otherwise terminates it.
- (b) The DAS shall return the authorization certificate to the Administrator when it is no longer effective.]

Amdt. 21-6, Eff. 10/8/65

FAR 21.445 : [Maintenance of eligibility.]

[The DAS shall continue to meet the requirements for issue of the authorization or shall notify the Administrator within 48 hours of any change (including a change of personnel) that could affect the ability of the DAS to meet those requirements.]
Amdt. 21-6, EFF. 10/8/65

FAR 21.447 : [Transferability.]

[A DAS authorization is not transferable.]
Amdt. 21-6, EFF. 10/8/65

FAR 21.449 : [Inspections.]

[Upon request, each DAS and each applicant shall let the Administrator inspect his facilities, products, and records.]
Amdt. 21-6, EFF. 10/8/65

FAR 21.451 : Limits of applicability.

- (a) DAS authorizations apply only to products—
 - (1) Covered by the ratings of the repair station applicant;
 - (2) Covered by the operating certificate and maintenance manual of the air carrier or commercial operator applicant; and
 - (3) For which the manufacturer applicant has alteration authority under Sec. 43.3(f) of this subchapter.
- (b) DAS authorizations may be used for—
 - (1) The issue of supplemental type certificates;
 - (2) The issue of experimental certificates for aircraft that—
 - (i) Are altered by the DAS under a supplemental type certificate issued by the DAS; and
 - (ii) Require flight tests in order to show compliance with the applicable airworthiness requirements of this chapter; and
 - (3) The amendment of standard airworthiness certificates for aircraft altered under this subpart.
- (c) DAS authorizations are subject to any additional limitations prescribed by the Administrator after inspection of the applicant's facilities or review of the staff qualifications.
- (d) [Notwithstanding any other provision of this subpart, a DAS may not issue a supplemental type certificate involving the exhaust emissions change requirements of part 34 or the acoustical change requirements of part 36 of this chapter until the Administrator finds that those requirements are met.]
Amdt. 21-68, EFF. 9/10/90

FAR 21.461 : [Equivalent safety provisions.]

[The DAS shall obtain the Administrator's concurrence on the application of all equivalent safety provisions applied under Sec. 21.21.]
Amdt. 21-6, EFF. 10/8/65

FAR 29.783 : Doors.

- (a) Each closed cabin must have at least one adequate and easily accessible external door.
- (b) Each external door must be located, and appropriate operating procedures must be established, to ensure that persons using the door will not be endangered by the rotors, propellers, engine intakes, and exhausts when the operating procedures are used.
- (c) There must be means for locking crew and external passenger doors and for preventing their opening in flight inadvertently or as a result of mechanical failure. It must be possible to open external doors from inside and outside the cabin with the rotorcraft on the ground even though persons may be crowded against the door on the inside of the rotorcraft. The means of opening must be simple and obvious and so arranged and marked that it can be readily located and operated.
- (d) There must be reasonable provisions to prevent the jamming of any external door in a minor crash as a result of fuselage deformation under the following ultimate inertial forces except for cargo or service doors not suitable for use as an exit in an emergency:
 - (1) Upward—1.5g.
 - (2) Forward—4.0g.
 - (3) Sideward—2.0g.
 - (4) Downward—4.0g.
- (e) There must be means for direct visual inspection of the locking mechanism by crewmembers to determine whether the external doors (including passenger, crew, service, and cargo doors) are fully locked. There must be visual means to signal to appropriate crewmembers when normally used external doors are closed and fully locked.
- (f) For outward opening external doors usable for entrance or egress, there must be an auxiliary safety latching device to prevent the door from opening when the primary latching mechanism fails. If the door does not meet the requirements of paragraph (c) of this section with this device in place, suitable operating procedures must be established to prevent the use of the device during takeoff and landing.
- (g) If an integral stair is installed in a passenger entry door that is qualified as a passenger emergency exit, the stair must be designed so that under the following conditions the effectiveness of passenger emergency egress will not be impaired:
 - (1) The door, integral stair, and operating mechanism have been subjected to the inertia forces specified in paragraph (d) of this section, acting separately relative to the surrounding structure.
 - (2) The rotorcraft is in the normal ground attitude and in each of the attitudes corresponding to collapse of one or more legs, or primary members, as applicable, of the landing gear.
- (h) [Nonjettisonable doors used as ditching emergency exits must have means to enable them to be secured in the open position and remain secure for emergency egress in sea state conditions prescribed for ditching.]
Amdt. 29-31, EFF. 10/22/90

FAR 29.773 : Pilot compartment view.

- (a) *Nonprecipitation conditions.* For nonprecipitation conditions, the following apply :
- (1) Each pilot compartment must be arranged to give the pilots a sufficiently extensive, clear, and undistorted view for safe operation.
 - (2) Each pilot compartment must be free of glare and reflection that could interfere with the pilot's view. If certification for night operation is requested, this must be shown by night flight tests.
- (b) *Precipitation conditions.* For precipitation conditions, the following apply :
- (1) Each pilot must have a sufficiently extensive view for safe operation—
 - (i) In heavy rain at forward speeds up to V_H ; and
 - (ii) In the most severe icing condition for which certification is requested.
 - (2) [The first pilot must have a window that—
 - (i) Is openable under the conditions prescribed in subparagraph (1) of this paragraph; and
 - (ii) Provides the view prescribed in that subparagraph.

Amdt. 29-3, Eff. 2/25/68

FAR 29.775 : Windshield and windows.

[Windshields and windows must be made of material that will not break into dangerous fragments.]
Amdt. 29-31, Eff. 10/22/90

FAR 29.777 : Cockpit controls.

Cockpit controls must be—

- (a) Located to provide convenient operation and to prevent confusion and inadvertent operation ; and
- (b) Located and arranged with respect to the pilot's seats so that there is full and unrestricted movement of each control without interference from the cockpit structure or the pilot's clothing when pilots from 5'2" to 6'0" in height are seated.

FAR 29.779 : [Motion and effect of cockpit controls.]

[Cockpit controls must be designed so that they operate in accordance with the following movements and actuation :

- (a) Flight controls, including the collective pitch control, must operate with a sense of motion which corresponds to the effect on the rotorcraft.
- (b) Twist-grip engine power controls must be designed so that, for lefthand operation, the motion of the pilot's hand is clockwise to increase power when the hand is viewed from the edge containing the index finger. Other engine power controls, excluding the collective control, must operate with a forward motion to increase power.
- (c) Normal landing gear controls must operate downward to extend the landing gear.]

Amdt. 29-24, Eff. 12/6/84

FAR 21.463 : [Supplemental type certificates.]

- (a) [For each supplemental type certificate issued under this subpart, the DAS shall follow the procedure manual prescribed in Sec. 21.441 and shall, before issuing the certificate—

- (1) Submit to the Administrator a statement describing—
 - (i) The type design change ;
 - (ii) The airworthiness requirements of this chapter (by part and effective date) that the DAS considers applicable; and
 - (iii) The proposed program for meeting the applicable airworthiness requirements ;
 - (2) Find that each applicable airworthiness requirement is met ; and
 - (3) Find that the type of product for which the STC is to be issued, as modified by the supplemental type design data upon which the STC is based, is of proper design for safe operation.
- (b) Within 30 days after the date of issue of the STC, the DAS shall submit to the Administrator—
- (1) Two copies of the STC ;
 - (2) One copy of the design data approved by the DAS and referred to in the STC ;
 - (3) One copy of each inspection and test report ; and
 - (4) Two copies of each revision to the Aircraft Flight Manual or to the operating limitations, and any other information necessary for safe operation of the product.]

Amdt. 21-6, Eff. 10/8/65

FAR 21.473 : [Airworthiness certificates other than experimental.]

[For each amendment made to a standard airworthiness certificate under this subpart, the DAS shall follow the procedure manual prescribed in Sec. 21.441 and shall, before making that amendment—

- (a) Complete each flight test necessary to meet the applicable airworthiness requirements of this chapter ;
- (b) Find that each applicable airworthiness requirement of this chapter is met ; and
- (c) Find that the aircraft is in condition for safe operation.]

Amdt. 21-6, Eff. 10/8/65

FAR 21.475 : [Experimental certificates.]

[The DAS shall, before issuing an experimental certificate, obtain from the Administrator any limitations and conditions that the Administrator considers necessary for safety.]

Amdt. 21-6, Eff. 10/8/65

FAR 21.477 : [Data review and service experience.]

- (a) [If the Administrator finds that a product for which an STC was issued under this subpart does not meet the applicable airworthiness requirements, or that an unsafe feature or characteristic caused by a defect in design or manufacture exists, the DAS, upon notification by the Administrator, shall investigate the matter and report to the Administrator the results of the investigation and the action, if any, taken or proposed.
 - (b) If corrective action by the user of the product is necessary for safety because of any noncompliance or defect specified in paragraph (a) of this section, the DAS shall submit the information necessary for the issue of an Airworthiness Directive under Part 39.]
- Amdt. 21-6, Eff. 10/8/65

FAR 21.493 : [Current records.]

- (a) [The DAS shall maintain, at its facility, current records containing–
 - (1) For each product for which it has issued an STC under this subpart, a technical data file that includes any data and amendments thereto (including drawings, photographs, specifications, instructions, and reports) necessary for the STC;
 - (2) A list of products by make, model, manufacturer's serial number and, if applicable, any FAA identification, that have been altered under the DAS authorization; and
 - (3) A file of information from all available sources on alteration difficulties of products altered under the DAS authorization.
- (b) The records prescribed in paragraph (a) of this section shall be–
 - (1) Made available by the DAS, upon the Administrator's request, for examination by the Administrator at any time; and
 - (2) In the case of the data file prescribed in paragraph (a)(1) of this section, identified by the DAS and sent to the Administrator as soon as the DAS no longer operates under this subpart.]

Amdt. 21-6, Eff. 10/8/65

74.5 Floats and Hulls**FAR 29.753 : Main float design.**

- (a) *Bag floats.* Each bag float must be designed to withstand–
 - (1) The maximum pressure differential that might be developed at the maximum altitude for which certification with that float is requested; and
 - (2) The vertical loads prescribed in Sec. 29.521(a), distributed along the length of the bag over three-quarters of its projected area.
- (b) *Rigid floats.* Each rigid float must be able to withstand the vertical, horizontal, and side loads prescribed in Sec. 29.521. An appropriate load distribution under critical conditions must be used.

FAR 29.755 : Hull buoyancy.

[*Water-based and amphibian rotorcraft.* The hull and auxiliary floats, if used, must have enough watertight compartments so that, with any single compartment of the hull or auxiliary floats flooded, the buoyancy of the hull and auxiliary floats, and wheel tires if used, provides a margin of positive water stability great enough to minimize the probability of capsizing the rotorcraft for the worst combination of wave heights and surface winds for which approval is desired.]

Amdt. 29-30, Eff. 4/5/90

FAR 29.757 : [Hull and auxiliary float strength.]

[The hull, and auxiliary floats if used, must withstand the water loads prescribed by Sec. 29.519 with a rational and conservative distribution of local and distributed water pressures over the hull and float bottom.]

Amdt. 29-3, Eff. 2/25/68

74.6 Personnel and Cargo Accommodations**FAR 29.771 : Pilot compartment.**

For each pilot compartment–

- (a) The compartment and its equipment must allow each pilot to perform his duties without unreasonable concentration or fatigue;
- (b) [If there is provision for a second pilot, the rotorcraft must be controllable with equal safety from either pilot position. Flight and powerplant controls must be designed to prevent confusion or inadvertent operation when the rotorcraft is piloted from either position;]
- (c) The vibration and noise characteristics of cockpit apertures may not interfere with safe operation;
- (d) Inflight leakage of rain or snow that could distract the crew or harm the structure must be prevented.

Amdt. 29-24, Eff. 12/6/84

- (1) The design maximum weight ;
 - (2) A load on each main wheel tire equal to the static ground reaction corresponding to the critical center of gravity ; and
 - (3) A load on nose wheel tires (to be compared with the dynamic rating established for those tires) equal to the reaction obtained at the nose wheel, assuming that the mass of the rotorcraft acts at the most critical center of gravity and exerts a force of 1.0g. downward and 0.25g. forward, the reactions being distributed to the nose and main wheels according to the principles of statics with the drag reaction at the ground applied only at wheels with brakes.
- (c) [Each tire installed on a retractable landing gear system must, at the maximum size of the tire type expected in service, have a clearance to surrounding structure and systems that is adequate to prevent contact between the tire and any part of the structure or systems.]

Amdt. 29-12, Eff. 2/1/77

FAR 29.735 : Brakes.

[For rotorcraft with wheel-type landing gear, a braking device must be installed that is—]

- (a) Controllable by the pilot ;
- (b) Usable during power-off landings ; and
- (c) Adequate to—

- (1) Counteract any normal unbalanced torque when starting or stopping the rotor ; and
 - (2) Hold the rotorcraft parked on a 10 degree slope on a dry, smooth pavement.
- Amdt. 29-24, Eff. 12/6/84

FAR 29.737 : Skis.

- (a) The maximum limit load rating of each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements of this part.
- (b) There must be a stabilizing means to maintain the ski in an appropriate position during flight. This means must have enough strength to withstand the maximum aerodynamic and inertia loads on the ski.

FAR 29.751 : Main float buoyancy.

- (a) For main floats, the buoyancy necessary to support the maximum weight of the rotorcraft in fresh water must be exceeded by—
 - (1) 50 percent, for single floats ; and
 - (2) 60 percent, for multiple floats.
- (b) Each main float must have [enough water-tight compartments so that, with any single main float compartment flooded, the mainfloats will provide a margin of positive stability great enough to minimize the probability of capsizing.]

Amdt. 29-3, Eff. 2/25/68

Chapitre 26

Subpart N—Approval of Engines, Propellers, Materials, Parts, and Appliances : Import

Sommaire

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FAR 21.500 : [Approval of engines and propellers]

[Each holder or licensee of a U.S. type certificate for an aircraft engine or propeller manufactured in a foreign country with which the United States has an agreement for the acceptance of those products for export and import, shall furnish with each such aircraft engine or propeller imported into this country, a certificate of airworthiness for export issued by the country of manufacture certifying that the individual aircraft engine or propeller—

- (a) Conforms to its U.S. type certificate and is in condition for safe operation; and
- (b) Has been subjected by the manufacturer to a final operational check.]

Amdt. 21-25, Eff. 10/5/69

FAR 21.502 : [Approval of materials, parts, and appliances.]

- (a) [A material, part, or appliance, manufactured in a foreign country with which the United States has an agreement for the acceptance of those materials, parts, or appliances for export and import, is considered to meet the requirements for approval in the Federal Aviation Regulations when the country of manufacture issues a certificate of airworthiness for export certifying that the individual material, part, or appliance meets those requirements, unless the Administrator finds, based on the technical data submitted under paragraph (b) of this section, that the material, part, or appliance is otherwise not consistent with the intent of the Federal Aviation Regulations.

- (b) An applicant for approval of a material, part, or appliance must, upon request, submit to the Administrator any technical data respecting that material, part, or appliance.]

Amdt. 21-25, Eff. 10/5/69

FAR 29.729 : Retracting mechanism.

[For rotorcraft with retractable landing gear, the following apply:]

- (a) *Loads.* The landing gear, retracting mechanism, wheel well doors, and supporting structure must be designed for—
 - (1) The loads occurring in any maneuvering condition with the gear retracted;
 - (2) The combined friction, inertia, and air loads occurring during retraction and extension at any airspeed up to the design maximum landing gear operating speed; and
 - (3) The flight loads, including those in yawed flight, occurring with the gear extended at any airspeed up to the design maximum landing gear extended speed.
- (b) *Landing gear lock.* A positive means must be provided to keep the gear extended.
- (c) *Emergency operation.* When other than manual power is used to operate the gear, emergency means must be provided for extending the gear in the event of—
 - (1) Any reasonably probable failure in the normal retraction system; or
 - (2) The failure of any single source of hydraulic, electric, or equivalent energy.
- (d) *Operation tests.* The proper functioning of the retracting mechanism must be shown by operation tests.
- (e) *Position indicator.* There must be means to indicate to the pilot when the gear is secured in the extreme positions.
- (f) [Control. The location and operation of the retraction control must meet the requirements of Secs. 29.777 and 29.779.
- (g) *Landing gear warning.* An aural or equally effective landing gear warning device must be provided that functions continuously when the rotorcraft is in a normal landing mode and the landing gear is not fully extended and locked. A manual shutoff capability must be provided for the warning device and the warning system must automatically reset when the rotorcraft is no longer in the landing mode.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.731 : Wheels.

- (a) Each landing gear wheel must be approved.
- (b) The maximum static load rating of each wheel may not be less than the corresponding static ground reaction with—
 - (1) Maximum weight; and
 - (2) Critical center of gravity.
- (c) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the applicable ground load requirements of this part.

FAR 29.733 : Tires.

- Each landing gear wheel must have a tire—
 - (a) That is a proper fit on the rim of the wheel; and
 - (b) Of a rating that is not exceeded under—

(d) When an effective mass is used in showing compliance with paragraph (b) of this section, the following formulae may be used instead of more rational computations.

$$W_e = W \left(\frac{h + (1-L)d}{h+d} \right)$$
$$n = n_j \frac{W}{W_e} + L$$

where :

W_e : the effective weight to be used in the drop test (lbs.) ;
 $W = W_M$: for main gear units, equal to the static reaction on the par- (lbs.)
ticular unit with the rotorcraft in the most critical attitude.
A rational method may be used in computing a main gear
static reaction, taking into consideration the moment arm
between the main wheel reaction and the rotorcraft center
of gravity.

$W = W_N$: for nose gear units, equal to the vertical component of the (lbs.)
static reaction that would exist at the nose wheel, assuming
that the mass of the rotorcraft acts at the center of gravity
and exerts a force of 1.0g downward and 0.25g forward.

$W = W_T$: for tailwheel units, equal to whichever of the following is (lbs.)
critical :

- (1) The static weight on the tailwheel with the rotorcraft resting on all wheels ; or
- (2) The vertical component of the ground reaction that would occur at the tail-
wheel assuming that the mass of the rotorcraft acts at the center of gravity and
exerts a force of 1g downward with the rotorcraft in the maximum nose-up
attitude considered in the nose-up landing conditions.

h : specified free drop height (inches).
 L : ratio of assumed rotor lift to the rotorcraft weight.
 d : deflection under impact of the tire (at the proper inflation
pressure) plus the vertical component of the axle travels
(inches) relative to the drop mass.

n : limit inertia load factor.
 n_j : the load factor developed, during impact, on the mass used
in the drop test (i.e., the acceleration dv/dt in g's recorded
in the drop test plus 1.0).

Amdt. 29-3, Eff. 2/25/68

FAR 29.727 : Reserve energy absorption drop test.

The reserve energy absorption drop test must be conducted as follows :

- (a) The drop height must be 1.5 times that specified in Sec. 29.725(a).
- (b) Rotor lift, where considered in a manner similar to that prescribed in Sec. 29.725(b),
may not exceed 1.5 times the lift allowed under that paragraph.
- (c) [The landing gear must withstand this test without collapsing. Collapse of the landing
gear occurs when a member of the nose, tail, or main gear will not support the
rotorcraft in the proper attitude or allows the rotorcraft structure, other than
landing gear and external accessories, to impact the landing surface.]

Amdt. 29-30, Eff. 4/5/90

Chapitre 27

Subpart O—Technical Standard Order Authorizations

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FAR 21.601 : [Applicability.]

(a) [This subpart prescribes—

(1) Procedural requirements for the issue of Technical Standard Order authorizations;

(2) Rules governing the holders of Technical Standard Order authorizations; and

(3) Procedural requirements for the issuance of a letter of Technical Standard Order design approval.

(b) For the purpose of this subpart—

(1) A Technical Standard Order (referred to in this Subpart as "TSO") is issued by the Administrator and is a minimum performance standard for specified articles (for the purpose of this subpart, articles means materials, parts, processes, or appliances) used on civil aircraft.

(2) A TSO authorization is an FAA design and production approval issued to the manufacturer of an article which has been found to meet a specific TSO.

(3) A letter of TSO design approval is an FAA design approval for a foreign-manufactured article which has been found to meet a specific TSO in accordance with the procedures of Sec. 21.617.

(4) An article manufactured under a TSO authorization, an FAA letter of acceptance as described in Sec. 21.603(b), or an appliance manufactured under a letter of TSO design approval described in Sec. 21.617 is an approved article or appliance for the purpose of meeting the regulations of this chapter that require the article to be approved.

(5) An article manufacturer is the person who controls the design and quality of the article produced (or to be produced, in the case of an application), including the parts of them and any processes or services related to them that are procured from an outside source.

(c) The Administrator does not issue a TSO authorization if the manufacturing facilities for the product are located outside of the United States, unless the Administrator finds that the location of the manufacturer's facilities places no undue burden on the FAA in administering applicable airworthiness requirements]

Amdt. 21-50, Eff. 9/9/80

FAR 21.603 : [TSO marking and privileges.]

(a) [Except as provided in paragraph (b) of this section and Sec. 21.617(c), no person may identify an article with a TSO marking unless that person holds a TSO authorization and the article meets applicable TSO performance standards.

(b) The holder of an FAA letter of acceptance of a statement of conformance issued for an article before July 1, 1962, or any TSO authorization issued after July 1, 1962, may continue to manufacture that article without obtaining a new TSO authorization but shall comply with the requirements of Secs. 21.3, 21.607 through 21.615, 21.619, and 21.621.

(c) Notwithstanding paragraphs (a) and (b) of this section, after August 6, 1976, no person may identify or mark an article with any of the following TSO numbers :

(1) TSO-C18, -C18a, -C18b, -C18c.

FAR 29.687 : Spring devices.

(a) Each control system spring device whose failure could cause flutter or other unsafe characteristics must be reliable.

(b) Compliance with paragraph (a) of this section must be shown by tests simulating service conditions.

FAR 29.691 : Autorotation control mechanism.

Each main rotor blade pitch control mechanism must allow rapid entry into autorotation after power failure.

FAR 29.695 : Power boost and power-operated control system.

(a) If a power boost or power-operated control system is used, an alternate system must be immediately available that allows continued safe flight and landing in the event of—

(1) Any single failure in the power portion of the system ; or

(2) The failure of all engines.

(b) Each alternate system may be a duplicate power portion or a manually operated mechanical system. The power portion includes the power source (such as hydraulic pumps), and such items as valves, lines, and actuators.

(c) The failure of mechanical parts (such as piston rods and links), and the jamming of power cylinders, must be considered unless they are extremely improbable.

7.4.4 Landing Gear**FAR 29.723 : Shock absorption tests.**

The landing inertia load factor and the reserve energy absorption capacity of the landing gear must be substantiated by the tests prescribed in Secs. 29.725 and 29.727, respectively. These tests must be conducted on the complete rotorcraft or on units consisting of wheel, tire, and shock absorber in their proper relation.

FAR 29.725 : Limit drop test.

The limit drop test must be conducted as follows :

(a) The drop height must be [at least 8 inches.]

(1) 13 inches from the lowest point of the landing gear to the ground ; or

(2) Any lesser height, not less than eight inches, resulting in a drop contact velocity equal to the greatest probable sinking speed likely to occur at ground contact in normal power-off landings.

(b) If considered, the rotor lift specified in Sec. 29.473(a) must be introduced into the drop test by appropriate energy absorbing devices or by the use of an effective mass.

(c) Each landing gear unit must be tested in the attitude simulating the landing condition that is most critical from the standpoint of the energy to be absorbed by it.

FAR 29.683 : Operation tests.

It must be shown by operation tests that, when the controls are operated from the pilot compartment with the control system loaded to correspond with loads specified for the system, the system is free from—

- (a) Jamming;
- (b) Excessive friction; and
- (c) Excessive deflection.

FAR 29.685 : Control system details.

- (a) [Each detail of each control system must be designed to prevent jamming, chafing, and interference from cargo, passengers, loose objects, or the freezing of moisture.]
- (b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system.
- (c) There must be means to prevent the slapping of cables or tubes against other parts.

- (d) Cable systems must be designed as follows :

- (1) Cables, cable fittings, turnbuckles, splices, and pulleys must be of an acceptable kind.
- (2) The design of cable systems must prevent any hazardous change in cable tension throughout the range of travel under any operating conditions and temperature variations.
- (3) No cable smaller than one-eighth inch diameter may be used in any primary control system.
- (4) Pulley kinds and sizes must correspond to the cables with which they are used. The pulley-cable combinations and strength values specified in MIL-HDBK-5 must be used unless they are inapplicable.
- (5) Pulleys must have close fitting guards to prevent the cables from being displaced or fouled.
- (6) Pulleys must lie close enough to the plane passing through the cable to prevent the cable from rubbing against the pulley flange.
- (7) No fairlead may cause a change in cable direction of more than 3°.
- (8) No clevis pin subject to load or motion and retained only by cotter pins may be used in the control system.
- (9) Turnbuckles attached to parts having angular motion must be installed to prevent binding throughout the range of travel.
- (10) There must be means for visual inspection at each fairlead, pulley, terminal, and turnbuckle.

- (e) Control system joints subject to angular motion must incorporate the following special factors with respect to the ultimate bearing strength of the softest material used as a bearing :

- (1) 3.33 for push-pull systems other than ball and roller bearing systems.
- (2) 2.0 for cable systems.

- (f) For control system joints, the manufacturer's static, non-Brinell rating of ball and roller bearings may not be exceeded.

Amdt. 29-12, Eff. 2/1/77

- (2) TSO-C24.

- (3) TSO-C33.

- (4) TSO-C61 or C61a.]

Amdt. 21-50, Eff. 9/9/80

FAR 21.605 : Application and issue.

- (a) [The manufacturer (or an authorized agent) shall submit an application for a TSO authorization, together with the following documents, to the Manager of the Aircraft Certification Office for the geographic area in which the applicant is located :]

- (1) A statement of conformance certifying that the applicant has met the requirements of this subpart and that the article concerned meets the applicable TSO that is effective on the date of application for that article.

- (2) One copy of the technical data required in the applicable TSO.

- (3) A description of its quality control system in the detail specified in Sec. 21.143. In complying with this section, the applicant may refer to current quality control data filed with the FAA as part of a previous TSO authorization application.

- (b) When a series of minor changes in accordance with Sec. 21.611 is anticipated, the applicant may set forth in its application the basic model number of the article and the part number of the components with open brackets after it to denote that suffix change letters or numbers (or combinations of them) will be added from time to time.

- (c) After receiving the application and other documents required by paragraph (a) of this section to substantiate compliance with this part, and after a determination has been made of its ability to produce duplicate articles under this part, the Administrator issues a TSO authorization (including all TSO deviations granted to the applicant) to the applicant to identify the article with the applicable TSO marking.

- (d) If the application is deficient, the applicant must, when requested by the Administrator, submit any additional information necessary to show compliance with this part. If the applicant fails to submit the additional information within 30 days after the Administrator's request, the application is denied and the applicant is so notified.

- (e) The Administrator issues or denies the application within 30 days after its receipt or, if additional information has been requested, within 30 days after receiving that information.

Amdt. 21-67, Eff. 10/25/89

FAR 21.607 : [General rules governing holders of TSO authorizations.]

[Each manufacturer of an article for which a TSO authorization has been issued under this Part shall—

- (a) Manufacture the article in accordance with this part and the applicable TSO ;

- (b) Conduct all required tests and inspections and establish and maintain a quality control system adequate to ensure that the article meets the requirements of paragraph (a) of this section and is in condition for safe operation ;

- (c) Prepare and maintain, for each model of each article for which a TSO authorization has been issued, a current file of complete technical data and records in accordance with Sec. 21.613; and
 - (d) Permanently and legibly mark each article to which this section applies with the following information :
 - (1) The name and address of the manufacturer.
 - (2) The name, type, part number, or model designation of the article.
 - (3) The serial number or the date of manufacture of the article or both.
 - (4) The applicable TSO number.]
- Amdt. 21-50, Eff. 9/9/80

FAR 21.609 : Approval for deviation.

- (a) Each manufacturer who requests approval to deviate from any performance standard of a TSO shall show that the standards from which a deviation is requested are compensated for by factors or design features providing an equivalent level of safety.
- (b) [The request for approval to deviate, together with all pertinent data, must be submitted to the Manager of the Aircraft Certification Office for the geographic area in which the manufacturer is located. If the article is manufactured in another country, the request for approval to deviate, together with all pertinent data, must be submitted through the civil aviation authority in that country to the FAA.]

Amdt. 21-67, Eff. 10/25/89

FAR 21.611 : Design changes.

- (a) *Minor changes by the manufacturer holding a TSO authorization.* The manufacturer of an article under an authorization issued under this part may make minor design changes (any change other than a major change) without further approval by the Administrator. In this case, the changed article keeps the original model number (part numbers may be used to identify minor changes) and the manufacturer shall forward to the appropriate [Aircraft Certification Office for the geographic area] any revised data that are necessary for compliance with Sec. 21.605(b).
- (b) *Major changes by manufacturer holding a TSO authorization.* Any design change by the manufacturer that is extensive enough to require a substantially complete investigation to determine compliance with a TSO is a major change. Before making such a change, the manufacturer shall assign a new type or model designation to the article and apply for an authorization under Sec. 21.605.
- (c) *Changes by person other than manufacturer.* No design change by any person (other than the manufacturer who submitted the statement of conformance for the article) is eligible for approval under this part unless the person seeking the approval is a manufacturer and applies under Sec. 21.605(a) for a separate TSO authorization. Persons other than a manufacturer may obtain approval for design changes under Part 43 or under the applicable airworthiness regulations.

Amdt. 21-67, Eff. 10/25/89

FAR 29.674 : [Interconnected controls.]

[Each primary flight control system must provide for safe flight and landing and operate independently after a malfunction, failure, or jam or any auxiliary interconnected control.]

Amdt. 29-30, Eff. 4/5/90

FAR 29.675 : Stops.

- (a) Each control system must have stops that positively limit the range of motion of the pilot's controls.
- (b) Each stop must be located in the system so that the range of travel of its control is not appreciably affected by—
 - (1) Wear ;
 - (2) Slackness; or
 - (3) Takeup adjustments.
- (c) Each stop must be able to withstand the loads corresponding to the design conditions for the system.
- (d) For each main rotor blade—
 - (1) [Stops that are appropriate to the blade design must be provided to limit travel of the blade about its hinge points; and]
 - (2) There must be means to keep the blade from hitting the droop stops during any operation other than starting and stopping the rotor.

Amdt. 29-17, Eff. 12/1/78

FAR 29.679 : Control system locks.

If there is a device to lock the control system with the rotorcraft on the ground or water, there must be means to—

- (a) Automatically disengage the lock when the pilot operates the controls in a normal manner, or limit the operation of the rotorcraft so as to give unmistakable warning to the pilot before takeoff; and
- (b) Prevent the lock from engaging in flight.

FAR 29.681 : Limit load static tests.

- (a) Compliance with the limit load requirements of this part must be shown by tests in which—
 - (1) The direction of the test loads produces the most severe loading in the control system; and
 - (2) Each fitting, pulley, and bracket used in attaching the system to the main structure is included;
- (b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

74.3 Control Systems

FAR 29.671 : General.

- (a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function.
- (b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimize the probability of any incorrect assembly that could result in the malfunction of the system.
- (c) [A means must be provided to allow full control movement of all primary flight controls prior to flight, or a means must be provided that will allow the pilot to determine that full control authority is available prior to flight.

Amdt. 29-24, Eff. 12/6/84

FAR 29.672 : [Stability augmentation, automatic, and power-operated systems.]

[If the functioning of stability augmentation or other automatic or power-operated system is necessary to show compliance with the flight characteristics requirements of this Part, the system must comply with Sec. 29.671 of this Part and the following :

- (a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring the pilot's attention must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system which could result in an unsafe condition if the pilot is unaware of the failure. Warning systems must not activate the control systems.
- (b) The design of the stability augmentation system or of any other automatic or power-operated system must allow initial counteraction of failures without requiring exceptional pilot skill or strength, by overriding the failure by moving the flight controls in the normal sense, and by deactivating the failed system.
- (c) It must be shown that after any single failure of the stability augmentation system or any other automatic or power-operated system,–
 - (1) The rotorcraft is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations;
 - (2) The controllability and maneuverability requirements of this Part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and rotorcraft configurations) which is described in the Rotorcraft Flight Manual; and
 - (3) The trim and stability characteristics are not impaired below a level needed to allow continued safe flight and landing.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.673 : [Primary flight controls.]

[Primary flight controls are those used by the pilot for immediate control of pitch, roll, yaw, and vertical motion of the rotorcraft.]

Amdt. 29-24, Eff. 12/6/84

FAR 21.613 : [Recordkeeping requirements.]

- (a) [Keeping the records. Each manufacturer holding a TSO authorization under this Part shall, for each article manufactured under that authorization, keep the following records at its factory :

- (1) A complete and current technical data file for each type or model article, including design drawings and specifications.
- (2) Complete and current inspection records showing that all inspections and tests required to ensure compliance with this part have been properly completed and documented.
- (b) Retention of records. The manufacturer shall retain the records described in paragraph (a)(1) of this section until it no longer manufactures the article. At that time, copies of these records shall be sent to the Administrator. The manufacturer shall retain the records described in paragraph (a)(2) of this section for a period of at least 2 years.]

Amdt. 21-50, Eff. 9/9/80

FAR 21.615 : [FAA inspection.]

[Upon the request of the Administrator, each manufacturer of an article under a TSO authorization shall allow the Administrator to–

- (a) Inspect any article manufactured under that authorization;
- (b) Inspect the manufacturer's quality control system;
- (c) Witness any tests;
- (d) Inspect the manufacturing facilities; and
- (e) Inspect the technical data files on that article.]

Amdt. 21-50, Eff. 9/9/80

FAR 21.617 : [Issue of letters of TSO design approval : import appliances.]

- (a) [A letter of TSO design approval may be issued for an appliance that is manufactured in a foreign country with which the United States has an agreement for the acceptance of these appliances for export and import and that is to be imported into the United States if–

- (1) The country in which the appliance was manufactured certifies that the appliance has been examined, tested, and found to meet the applicable TSO designated in Sec. 21.305(b) or the applicable performance standards of the country in which the appliance was manufactured and any other performance standards the Administrator may prescribe to provide a level of safety equivalent to that provided by the TSO designated in Sec. 21.305(b); and
- (2) The manufacturer has submitted one copy of the technical data required in the applicable performance standard through its civil aviation authority.
- (b) The letter of TSO design approval will be issued by the Administrator and must list any deviation granted to the manufacturer under Sec. 21.609.
- (c) After the Administrator has issued a letter of TSO design approval and the country of manufacture issues a Certificate of Airworthiness for Export as specified in Sec. 21.502(a), the manufacturer shall be authorized to identify the appliance with the

TSO marking requirements described in Sec. 21.607(d) and in the applicable TSO. Each appliance must be accompanied by a Certificate of Airworthiness for Export as specified in Sec. 21.502(a) issued by the country of manufacture.]

Amdt. 21-50, Eff. 9/9/80

FAR 21.619 : [Noncompliance.]

[The Administrator may, upon notice, withdraw the TSO authorization or letter of TSO design approval of any manufacturer who identifies with a TSO marking an article not meeting the performance standards of the applicable TSO.]

Amdt. 21-50, Eff. 9/9/80

FAR 21.621 : [Transferability and duration.]

[A TSO authorization or letter of TSO design approval issued under this Part is not transferable and is effective until surrendered, withdrawn, or otherwise terminated by the Administrator.]

Amdt. 21-50, Eff. 9/9/80

FAR 29.631 : [Bird strike.]

[The rotorcraft must be designated to ensure capability of continued safe flight and landing (for Category A) or safe landing (for Category B) after impact with a 2.2-lb (1.0 kg) bird when the velocity of the rotorcraft (relative to the bird along the flight path of the rotorcraft) is equal to V_{NE} or V_H (whichever is the lesser) at altitudes up to 8,000 feet. Compliance must be shown by tests or by analysis based on tests carried out on sufficiently representative structures of similar design.]

Amdt. 29-40, Eff. 8/8/96

74.2 Rotors

FAR 29.653 : Pressure venting and drainage of rotor blades.

- (a) [For each rotor blade—
 - (1) There must be means for venting the internal pressure of the blade;
 - (2) Drainage holes must be provided for the blade; and
 - (3) The blade must be designed to prevent water from becoming trapped in it.
 - (b) Paragraph (a)(1) and (2) of this section does not apply to sealed rotor blades capable of withstanding the maximum pressure differentials expected in service.]
- Amdt. 29-3, Eff. 2/25/68

FAR 29.659 : Mass balance.

- (a) [The rotor and blades must be mass balanced as necessary to—
 - (1) Prevent excessive vibration; and
 - (2) Prevent flutter at any speed up to the maximum forward speed.
 - (b) The structural integrity of the mass balance installation must be substantiated.]
- Amdt. 29-3, Eff. 2/25/68

FAR 29.661 : Rotor blade clearance.

There must be enough clearance between the [rotor blades] and other parts of the structure to prevent the blades from striking any part of the structure during any operating condition.

Amdt. 29-3, Eff. 2/25/68

FAR 29.663 : Ground resonance prevention means.

- (a) [The reliability of the means for preventing ground resonance must be shown either by analysis and tests, or reliable service experience, or by showing through analysis or tests that malfunction or failure of a single means will not cause ground resonance.
 - (b) The probable range of variations, during service, of the damping action of the ground resonance prevention means must be established and must be investigated during the test required by Sec. 29.241.]
- Amdt. 29-30, Eff. 4/5/90

- (3) For castings procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis—
- (i) A casting factor of 1.0 may be used ; and
 - (ii) The castings must be inspected as provided in paragraph (d)(1) of this section for casting factors of "1.25 through 1.50" and tested under paragraph (c)(2) of this section.

Amdt. 29-41, Eff. 11/28/97

FAR 29.623 : Bearing factors.

- (a) Except as provided in paragraph (b) of this section, each part that has clearance (free fit), and that is subject to pounding or vibration, must have a bearing factor large enough to provide for the effects of normal relative motion.
- (b) No bearing factor need be used on a part for which any larger special factor is prescribed.

FAR 29.625 : Fitting factors.

For each fitting (part or terminal used to join one structural member to another) the following apply :

- (a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1.15 must be applied to each part of—
 - (1) The fitting ;
 - (2) The means of attachment ; and
 - (3) The bearing on the joined members.
- (b) No fitting factor need be used—
 - (1) For joints made under approved practices and based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood) ; and
 - (2) With respect to any bearing surface for which a larger special factor is used.
- (c) For each integral fitting, the part must be treated as a fitting up to the point at which the section properties become typical of the member.
- (d) [Each seat, berth, litter, safety belt, and harness attachment to the structure must be shown by analysis, tests, or both, to be able to withstand the inertia forces prescribed in Sec. 29.561(b)(3) multiplied by a factor of 1.33.]

Amdt. 29-42, Eff. 9/8/98

FAR 29.629 : [Flutter and divergence.]

[Each aerodynamic surface of the rotorcraft must be free from flutter and divergence under each appropriate speed and power condition.]

Amdt. 29-40, Eff. 8/8/96

FAR 29.621 : Casting factors.

- (a) *General.* The factors, tests, and inspections specified in paragraphs (b) and (c) of this section must be applied in addition to those necessary to establish foundry quality control. The inspections must meet approved specifications. Paragraphs (c) and (d) of this section apply to structural castings except castings that are pressure tested as parts of hydraulic or other fluid systems and do not support structural loads.
- (b) *Bearing stresses and surfaces.* The casting factors specified in paragraphs (c) and (d) of this section—
- (1) Need not exceed 1.25 with respect to bearing stresses regardless of the method of inspection used ; and
- (2) Need not be used with respect to the bearing surfaces of a part whose bearing factor is larger than the applicable casting factor.
- (c) *Critical castings.* For each casting whose failure would preclude continued safe flight and landing of the rotorcraft or result in serious injury to any occupant, the following apply :
- (1) Each critical casting must—
- (i) Have a casting factor of not less than 1.25 ; and
- (ii) Receive 100 percent inspection by visual, radiographic, and magnetic particle (for ferromagnetic materials) or [penetrant] (for nonferromagnetic materials) inspection methods or approved equivalent inspection methods.
- (2) For each critical casting with a casting factor less than 1.50, three sample castings must be static tested and shown to meet—
- (i) The strength requirements of Sec. 29.305 at an ultimate load corresponding to a casting factor of 1.25 ; and
- (ii) The deformation requirements of Sec. 29.305 at a load of 1.15 times the limit load.
- (d) *Noncritical castings.* For each casting other than those specified in paragraph (c) of this section, the following apply :
- (1) Except as provided in paragraphs (d)(2) and (3) of this section, the casting factors and corresponding inspections must meet the following table :
- | <i>Casting factor</i> | | <i>Inspection</i> |
|----------------------------------|--|--|
| 2.0 or greater | | 100 percent visual. |
| Less than 2.0, greater than 1.5. | | 100 percent visual, and magnetic particle (ferromagnetic materials), penetrant (nonferromagnetic materials), or approved equivalent inspection methods. |
| 1.25 through 1.50 | | 100 percent visual, and magnetic particle (ferromagnetic materials), penetrant (nonferromagnetic materials), and radiographic or approved equivalent inspection methods. |
- (2) The percentage of castings inspected by nonvisual methods may be reduced below that specified in paragraph (d)(1) of this section when an approved quality control procedure is established.

FAR 29.613 : Material strength properties and design values.

- (a) Material strength properties must be based on enough tests of material meeting specifications to establish design values on a statistical basis.
- (b) [Design values must be chosen to minimize the probability of structural failure due to material variability. Except as provided in paragraphs (d) and (e) of this section, compliance with this paragraph must be shown by selecting design values that assure material strength with the following probability—
- (1) Where applied loads are eventually distributed through a single member within an assembly, the failure of which would result in loss of structural integrity of the component, 99 percent probability with 95 percent confidence; and
 - (2) For redundant structures, those in which the failure of individual elements would result in applied loads being safely distributed to other load-carrying members, 90 percent probability with 95 percent confidence.]
- (c) The strength, detail design, and fabrication of the structure must minimize the probability of disastrous fatigue failure, particularly at points of stress concentration.
- (d) [Design values may be those contained in the following publications (available from the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120) or other values approved by the Administrator :]
- (1) MIL-HDBK-5, "Metallic Materials and Elements for Flight Vehicle Structure".
 - (2) MIL-HDBK-17, "Plastics for Flight Vehicles".
 - (3) ANC-18, "Design of Wood Aircraft Structures".
 - (4) MIL-HDBK-23, "Composite Construction for Flight Vehicles".
- (e) [Other design values may be used if a selection of the material is made in which a specimen of each individual item is tested before use and it is determined that the actual strength properties of that particular item will equal or exceed those used in design.]

Amdt. 29-30, Eff. 4/5/90

FAR 29.619 : Special factors.

- (a) The special factors prescribed in Secs. 29.621 through 29.625 apply to each part of the structure whose strength is—
- (1) Uncertain;
 - (2) Likely to deteriorate in service before normal replacement; or
 - (3) Subject to appreciable variability due to—
 - (i) Uncertainties in manufacturing processes; or
 - (ii) Uncertainties in inspection methods.
- (b) For each part of the rotorcraft to which Secs. 29.621 through 29.625 apply, the factor of safety prescribed in Sec. 29.303 must be multiplied by a special factor equal to—
- (1) The applicable special factors prescribed in Secs. 29.621 through 29.625; or
 - (2) Any other factor great enough to ensure that the probability of the part being understrength because of the uncertainties specified in paragraph (a) of this section is extremely remote.

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FAR 29.609 : Protection of structure.

Each part of the structure must—

- (a) Be suitably protected against deterioration or loss of strength in service due to any cause, including—

- (1) Weathering ;
- (2) Corrosion ; and
- (3) Abrasion ; and

- (b) Have provisions for ventilation and drainage where necessary to prevent the accumulation of corrosive, flammable, or noxious fluids.

FAR 29.610 : [Lightning and static electricity protection.]

- (a) [The rotorcraft structure must be protected against catastrophic effects from lightning.]

- (b) For metallic components, compliance with paragraph (a) of this section may be shown by—

- (1) Electrically bonding the components properly to the airframe ; or
- (2) Designing the components so that a strike will not endanger the rotorcraft.

- (c) For nonmetallic components, compliance with paragraph (a) of this section may be shown by—

- (1) Designing the components to minimize the effect of a strike ; or
- (2) Incorporating acceptable means of diverting the resulting electrical current to not endanger the rotorcraft.

- (d) [The electric bonding and protection against lightning and static electricity must—

- (1) Minimize the accumulation of electrostatic charge ;
- (2) Minimize the risk of electric shock to crew, passengers, and service and maintenance personnel using normal precautions ;

- (3) Provide an electrical return path, under both normal and fault conditions, on rotorcraft having grounded electrical systems ; and

- (4) Reduce to an acceptable level the effects of lightning and static electricity on the functioning of essential electrical and electronic equipment.]

Amtd. 29-40, Eff. 8/8/96

FAR 29.611 : Inspection provisions.

There must be means to allow close examination of each part that requires—

- (a) Recurring inspection ;
- (b) Adjustment for proper alignment and functioning ; or
- (c) Lubrication.

Subpart D : Design and Construction	
74.1 General FAR 29.601 : Design. (a) The rotorcraft may have no design features or details that experience has shown to be hazardous or unreliable. (b) The suitability of each questionable design detail and part must be established by tests. FAR 29.602 : [Critical parts.] (a) [Critical part. A critical part is a part, the failure of which could have a catastrophic effect upon the rotorcraft, and for which critical characteristics have been identified which must be controlled to ensure the required level of integrity. (b) If the type design includes critical parts, a critical parts list shall be established. Procedures shall be established to define the critical design characteristics, identify processes that affect those characteristics, and identify the design change and process change controls necessary for showing compliance with the quality assurance requirements of part 21 of this chapter.] Amdt. 29-45, Eff. 10/25/99 FAR 29.603 : Materials. The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must— (a) Be established on the basis of experience or tests ; (b) [Meet approved specifications that ensure their having the strength and other properties assumed in the design data ; and (c) Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.] Amdt. 29-17, Eff. 12/1/78 FAR 29.605 : Fabrication methods. [(a)] The methods of fabrication used must produce consistently sound structures. If a fabrication process (such as gluing, spot welding, or heat-treating) requires close control to reach this objective, the process must be performed according to an approved process specification. (b) [Each new aircraft fabrication method must be substantiated by a test program.] Amdt. 29-17, Eff. 12/1/78 FAR 29.607 : Fasteners. (a) [Each removable bolt, screw, nut, pin, or other fastener whose loss could jeopardize the safe operation of the rotorcraft, must incorporate two separate locking devices. The fastener and its locking devices may not be adversely affected by the environmental conditions associated with the particular installation. (b) No self-locking nut may be used on any bolt subject to rotation in operation unless a non-friction locking device is used in addition to the self-locking device.] Amdt. 29-5, Eff. 10/27/68	
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Chapitre 28

Subpart A : General

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FAR 23.1 : Applicability.

- (a) [This Part prescribes airworthiness standards for the issue of type certificates, and changes to those certificates, for airplanes in the normal, utility, acrobatic and commuter categories.]
- (b) Each person who applies under Part 21 for such a certificate or change must show compliance with the applicable requirements of this Part.
- Amdt. 23-34, Eff. 02/17/87

FAR 23.2 : Special retroactive requirements.

- (a) [Notwithstanding Secs. 21.17 and 21.101 of this chapter and irrespective of the type certification basis, each normal, utility, and acrobatic category airplane having a passenger seating configuration, excluding pilot seats, of nine or less, manufactured after December 12, 1986, or any such foreign airplane for entry into the United States must provide a safety belt and shoulder harness for each forward- or aft-facing seat which will protect the occupant from serious head injury when subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561(b)(2) of this part, or which will provide the occupant protection specified in Sec. 23.562 of this part when that section is applicable to the airplane. For other seat orientations, the seat/restraint system must be designed to provide a level of occupant protection equivalent to that provided for forward- or aft-facing seats with a safety belt and shoulder harness installed.]
- (b) Each shoulder harness installed at a flight crewmember station, as required by this section, must allow the crewmember, when seated with the safety belt and shoulder harness fastened, to perform all functions necessary for flight operations.
- (c) For the purpose of this section, the date of manufacture is :
- (1) The date the inspection acceptance records, or equivalent, reflect that the airplane is complete and meets the FAA approved type design data ; or
- (2) In the case of a foreign manufactured airplane, the date the foreign civil airworthiness authority certifies the airplane is complete and issues an original standard airworthiness certificate, or the equivalent in that country.]
- Amdt. 23-36, Eff. 09/14/88

FAR 23.3 : Airplane categories.

- (a) The normal category is limited to airplanes that have a seating configuration, excluding pilot seats, of nine or less, a maximum certificated takeoff of 12,500 pounds or less, and intended for nonacrobatic operation. Nonacrobatic operation includes :
- (1) Any maneuver incident to normal flying ;
- (2) Stalls (except whip stalls) ; and
- (3) Lazy eights, chandelles, and steep turns, in which the angle of bank is not more than 60 degrees.
- (b) The utility category is limited to airplanes that have a seating configuration, excluding pilot seats, of nine or less, a maximum certificated takeoff weight of 12,500 pounds or less, and intended for limited acrobatic operation. Airplanes certificated in the utility category may be used in any of the operations covered under paragraph (a) of this section and in limited acrobatic operations. Limited acrobatic operation includes :

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- (1) Spins (if approved for the particular type of airplane) ; and
- (2) [Lazy eights, chandelles, and steep turns, or similar maneuvers, in which the angle of bank is more than 60 degrees but not more than 90 degrees.]
- (c) The acrobatic category is limited to airplanes that have a seating configuration, excluding pilot seats, of nine or less, a maximum certificated takeoff weight of 12,500 pounds or less, and intended for use without restrictions, other than those shown to be necessary as a result of required flight tests.
- (d) [The commuter category is limited to propeller-driven, multiengine airplanes that have a seating configuration, excluding pilot seats, of 19 or less, and a maximum certificated takeoff weight of 19,000 pounds or less. The commuter category operation is limited to any maneuver incident to normal flying, stalls (except whip stalls), and steep turns, in which the angle of bank is not more than 60 degrees.
- (e) Except for commuter category, airplanes may be type certificated in more than one category if the requirements of each requested category are met.]

Amtdt. 23-50, Eff. 03/11/96

(b) *Fatigue tolerance evaluation (including tolerance to flaws).* The structure must be shown by analysis supported by test evidence and, if available, service experience to be of fatigue tolerant design. The fatigue tolerance evaluation must include the requirements of either paragraph (b)(1), (2), or (3) of this section, or a combination thereof, and also must include a determination of the probable locations and modes of damage caused by fatigue, considering environmental effects, intrinsic/discrete flaws, or accidental damage. Compliance with the flaw tolerance requirements of paragraph (b)(1) or (2) of this section is required unless the applicant establishes that these fatigue flaw tolerant methods for a particular structure cannot be achieved within the limitations of geometry, inspectability, or good design practice. Under these circumstances, the safe-life evaluation of paragraph (b)(3) of this section is required.

(1) *Flaw tolerant safe-life evaluation.* It must be shown that the structure, with flaws present, is able to withstand repeated loads of variable magnitude without detectable flaw growth for the following time intervals—

(i) Life of the rotorcraft; or

(ii) Within a replacement time furnished under Section A29.4 of Appendix A to this part.

(2) *Fail-safe (residual strength after flaw growth) evaluation.* It must be shown that the structure remaining after a partial failure is able to withstand design limit loads without failure within an inspection period furnished under Section A29.4 of Appendix A to this part. Limit loads are defined in Sec. 29.301(a).

(i) The residual strength evaluation must show that the remaining structure after flaw growth is able to withstand design limit loads without failure within its operational life.

(ii) Inspection intervals and methods must be established as necessary to ensure that failures are detected prior to residual strength conditions being reached.

(iii) If significant changes in structural stiffness or geometry, or both, follow from a structural failure or partial failure, the effect on flaw tolerance must be further investigated.

(3) *Safe-life evaluation.* It must be shown that the structure is able to withstand repeated loads of variable magnitude without detectable cracks for the following time intervals—

(i) Life of the rotorcraft; or

(ii) Within a replacement time furnished under Section A29.4 of Appendix A to this part.]

Amtd. 29-28, Eff. 11/27/89

buoyancy load must be applied. The highest likely buoyancy load must include consideration of a partially immersed float creating restoring moments to compensate the upsetting moments caused by side wind, unsymmetrical rotorcraft loading, water wave action, rotorcraft inertia, and probable structural damage and leakage considered under Sec. 29.801(d). Maximum roll and pitch angles determined from compliance with Sec. 29.801(d) may be used, if significant, to determine the extent of immersion of each float. If the floats are deployed in flight, appropriate air loads derived from the flight limitations with the floats deployed shall be used in substantiation of the floats and their attachment to the rotorcraft. For this purpose, the design airspeed for limit load is the float deployed airspeed operating limit multiplied by 1.11.

- (2) *Floats deployed after initial water contact.* Each float must be designed for full or partial immersion prescribed in paragraph (b)(1) of this section. In addition, each float must be designed for combined vertical and drag loads using a relative limit speed of 20 knots between the rotorcraft and the water. The vertical load may not be less than the highest likely buoyancy load determined under paragraph (b)(1) of this section.]

Amdt. 29-30, Eff. 4/5/90

73.8 Fatigue Evaluation

FAR 29.571 : Fatigue evaluation of [structure.]

- (a) [General. An evaluation of the strength of principal elements, detail design points, and fabrication techniques must show that catastrophic failure due to fatigue, considering the effects of environment, intrinsic/discrete flaws, or accidental damage will be avoided. Parts to be evaluated include, but are not limited to, rotors, rotor drive systems between the engines and rotor hubs, controls, fuselage, fixed and movable control surfaces, engine and transmission mountings, landing gear, and their related primary attachments. In addition, the following apply :

- (1) Each evaluation required by this section must include—
 - (i) The identification of principal structural elements, the failure of which could result in catastrophic failure of the rotorcraft;
 - (ii) In-flight measurement in determining the loads or stresses for items in paragraph (a)(1)(i) of this section in all critical conditions throughout the range of limitations in Sec. 29.309 (including altitude effects), except that maneuvering load factors need not exceed the maximum values expected in operations; and
 - (iii) Loading spectra as severe as those expected in operation based on loads or stresses determined under paragraph (a)(1)(ii) of this section, including external load operations, if applicable, and other high frequency power cycle operations.
- (2) Based on the evaluations required by this section, inspections, replacement times, combinations thereof, or other procedures must be established as necessary to avoid catastrophic failure. These inspections, replacement times, combinations thereof, or other procedures must be included in the airworthiness limitations section of the Instructions for Continued Airworthiness required by Sec. 29.1529 and Section A29.4 of Appendix A of this part.

Chapitre 29

Subpart B : Flight

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(c) Compliance with the following must be shown :

- (1) The seating device system must remain intact although it may experience separation intended as part of its design.
- (2) The attachment between the seating device and the airframe structure must remain intact although the structure may have exceeded its limit load.
- (3) The ATD's shoulder harness strap or straps must remain on or in the immediate vicinity of the ATD's shoulder during the impact.
- (4) The safety belt must remain on the ATD's pelvis during the impact.
- (5) The ATD's head either does not contact any portion of the crew or passenger compartment or, if contact is made, the head impact does not exceed a head injury criteria (HIC) of 1,000 as determined by this equation.

$$HIC = (t_2 - t_1) \left(\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t) dt \right)^{2.5}$$

Where : $a(t)$ is the resultant acceleration at the center of gravity of the head form expressed as a multiple of g (the acceleration of gravity) and $t_2 - t_1$ is the time duration, in seconds, of major head impact, not to exceed 0.05 seconds.

- (6) Loads in individual shoulder harness straps must not exceed 1,750 pounds. If dual straps are used for retaining the upper torso, the total harness strap loads must not exceed 2,000 pounds.
 - (7) The maximum compressive load measured between the pelvis and the lumbar column of the ATD must not exceed 1,500 pounds.
 - (d) An alternate approach that achieves an equivalent or greater level of occupant protection, as required by this section, must be substantiated on a rational basis.
- Amdt. 29-41, EFF. 11/28/97

FAR 29.563 : Structural ditching provisions.

If [certification with ditching provisions is requested, structural strength for ditching must meet the requirements of this section and Sec. 29.801(e).

- (a) *Forward speed landing conditions.* The rotorcraft must initially contact the most critical wave for reasonably probable water conditions at forward velocities from zero up to 30 knots in likely pitch, roll, and yaw attitudes. The rotorcraft limit vertical descent velocity may not be less than 5 feet per second relative to the mean water surface. Rotor lift may be used to act through the center of gravity throughout the landing impact. This lift may not exceed two-thirds of the design maximum weight. A maximum forward velocity of less than 30 knots may be used in design if it can be demonstrated that the forward velocity selected would not be exceeded in a normal one-engine-out touchdown.

- (b) *Auxiliary or emergency float conditions.*

- (1) *Floats fixed or deployed before initial water contact.* In addition to the landing loads in paragraph (a) of this section, each auxiliary or emergency float, or its support and attaching structure in the airframe or fuselage, must be designed for the load developed by a fully immersed float unless it can be shown that full immersion is unlikely. If full immersion is unlikely, the highest likely float

- (5) [Rearward-1.5g.]

(d) Any fuselage structure in the area of internal fuel tanks below the passenger floor level must be designed to resist the following ultimate inertial factors and loads, and to protect the fuel tanks from rupture, if rupture is likely when those loads are applied to that area :

- (1) Upward-1.5g.
- (2) Forward-4.0g.
- (3) Sideward-2.0g.
- (4) Downward-4.0g.

Amdt. 29-38, Eff. 6/11/96

FAR 29.562 : Emergency landing dynamic conditions.

(a) The rotorcraft, although it may be damaged in a crash landing, must be designed to reasonably protect each occupant when—

- (1) The occupant properly uses the seats, safety belts, and shoulder harnesses provided in the design; and

(2) The occupant is exposed to loads equivalent to those resulting from the conditions prescribed in this section.

(b) Each seat type design or other seating device approved for crew or passenger occupancy during takeoff and landing must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests of a similar type seat in accordance with the following criteria. The test must be conducted with an occupant simulated by a 170-pound anthropomorphic test dummy (ATD), as defined by 49 CFR 572, Subpart B, or its equivalent, sitting in the normal upright position.

- (1) A change in downward velocity of not less than 30 feet per second when the seat or other seating device is oriented in its nominal position with respect to the rotorcraft's reference system, the rotorcraft's longitudinal axis is canted upward 60° with respect to the impact velocity vector, and the rotorcraft's lateral axis is perpendicular to a vertical plane containing the impact velocity vector and the rotorcraft's longitudinal axis. Peak floor deceleration must occur in not more than 0.031 seconds after impact and must reach a minimum of 30g's.

(2) A change in forward velocity of not less than 42 feet per second when the seat or other seating device is oriented in its nominal position with respect to the rotorcraft's reference system, the rotorcraft's longitudinal axis is yawed 10° either right or left of the impact velocity vector (whichever would cause the greatest load on the shoulder harness), the rotorcraft's lateral axis is contained in a horizontal plane containing the impact velocity vector, and the rotorcraft's vertical axis is perpendicular to a horizontal plane containing the impact velocity vector. Peak floor deceleration must occur in not more than 0.071 seconds after impact and must reach a minimum of 18.4g's.

(3) When floor rails or floor or [sidewall attachment] devices are used to attach the seating devices to the airframe structure for the conditions of this section, the rails or devices must be misaligned with respect to each other by at least 10° vertically (i.e., pitch out of parallel) and by at least a 10° lateral roll, with the directions optional, to account for possible floor warp.

29.1 General

FAR 23.21 : Proof of compliance.

(a) Each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested. This must be shown—

- (1) By tests upon an airplane of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and
- (2) By systematic investigation of each probable combination of weight and center of gravity, if compliance cannot be reasonably inferred from combinations investigated.

(b) The following general tolerances are allowed during flight testing. However, greater tolerances may be allowed in particular tests :

Item	Tolerance
Weight	+5% - 10%
Critical items affected by weight	+5% - 1%
C.G.	±7% total travel.

FAR 23.23 : Load distribution limits.

(a) [Ranges of weights and centers of gravity within which the airplane may be safely operated must be established. If a weight and center of gravity combination is allowable only within certain lateral load distribution limits that could be inadvertently exceeded, these limits must be established for the corresponding weight and center of gravity combinations.]

(b) The load distribution limits may not exceed any of the following :

- (1) The selected limits;
- (2) The limits at which the structure is proven ; or
- (3) The limits at which compliance with each applicable flight requirement of this subpart is shown.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.25 : Weight limits.

(a) [*Maximum weight.* The maximum weight is the highest weight at which compliance with each applicable requirement of this part (other than those complied with at the design landing weight) is shown. The maximum weight must be established so that it is—

- (1) Not more than the least of—
 - (i) The highest weight selected by the applicant ; or
 - (ii) The design maximum weight, which is the highest weight at which compliance with each applicable structural loading condition of this part (other than those complied with at the design landing weight) is shown ; or
 - (iii) [The highest weight at which compliance with each applicable flight requirement is shown, and]

- (2) Not less than the weight with—
 - (i) Each seat occupied, assuming a weight of 170 pounds for each occupant for normal and commuter category airplanes, and 190 pounds for utility and aerobatic category airplanes, except that seats other than pilot seats may be placarded for a lesser weight; and
 - (A) Oil at full tank capacity; and
 - (B) At least enough fuel for maximum continuous power operation of at least 30 minutes for day-VFR approved airplanes and at least 45 minutes for night-VFR and IFR approved airplanes; or
 - (ii) The required minimum crew and fuel and oil to full tank capacity.
- (b) *Minimum weight.* The minimum weight (the lowest weight at which compliance with each applicable requirement of this part is shown) must be established so that it is not more than the sum of—
 - (1) The empty weight determined under Sec. 23.29;
 - (2) The weight of the required minimum crew (assuming a weight of 170 pounds for each crewmember); and
 - (3) The weight of—
 - (i) For turbojet powered airplanes, 5 percent of the total fuel capacity of that particular fuel tank arrangement under investigation; and
 - (ii) For other airplanes, the fuel necessary for one-half hour of operation at maximum continuous power.

Amdt. 23-50, EFF. 03/11/96

FAR 23.29 : Empty weight and corresponding center of gravity.

- (a) The empty weight and corresponding center of gravity must be determined by weighing the airplane with—
 - (1) Fixed ballast;
 - (2) Unusable fuel determined under Sec. 23.959; and
 - (3) Full operating fluids, including—
 - (i) Oil;
 - (ii) Hydraulic fluid; and
 - (iii) Other fluids required for normal operation of airplane systems, except potable water, lavatory precharge water, and water intended for injection in the engines.]
- (b) The condition of the airplane at the time of determining empty weight must be one that is well defined and can be easily repeated.

Amdt. 23-21, EFF. 03/01/78

FAR 23.31 : Removable ballast.

- Removable ballast may be used in showing compliance with the flight requirements of this subpart, if—
 - (a) The place for carrying ballast is properly designed and installed, and is marked under Sec. 23.1557; and

- (d) [Deleted]
 - (e) [If approval for the use of $2\frac{1}{2}$ -minute OEI power is requested, each engine mount and adjacent structure must be designed to withstand the loads resulting from a limit torque equal to 1.25 times the mean torque for $2\frac{1}{2}$ -minute power OEI combined with 1g flight loads.]
- Amdt. 29-26, EFF. 10/3/88
- FAR 29.551 : Auxiliary lifting surfaces.**
- Each auxiliary lifting surface must be designed to withstand—
- (a) The critical flight loads in Secs. 29.337 through 29.341, and 29.351;
 - (b) The applicable ground loads in Secs. 29.235, 29.471 through 29.485, 29.493, 29.505, and 29.521; and
 - (c) Any other critical condition expected in normal operation.

73.7 Emergency Landing Conditions

FAR 29.561 : General.

- (a) The rotorcraft, although it may be damaged in emergency landing conditions on land or water, must be designed as prescribed in this section to protect the occupants under those conditions.
- (b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a crash landing when—
 - (1) Proper use is made of seats, belts, and other safety design provisions;
 - (2) The wheels are retracted (where applicable); and
 - (3) Each occupant and each item of mass inside the cabin that could injure an occupant is restrained when subjected to the following ultimate inertial load factors relative to the surrounding structure :
 - (i) Upward—4g.
 - (ii) Forward—16g.
 - (iii) Sideward—8g.
 - (iv) Downward—20g, after the intended displacement of the seat device.
 - (v) [Rearward—1.5g.]
- (c) The supporting structure must be designed to restrain under any ultimate inertial load factor up to those specified in this paragraph, any item of mass above and/or behind the crew and passenger compartment that could injure an occupant if it came loose in an emergency landing. Items of mass to be considered include, but are not limited to, rotors, transmission, and engines. The items of mass must be restrained for the following ultimate inertial load factors :
 - (1) Upward—1.5g.
 - (2) Forward—[12g.]
 - (3) Sideward—[6g.]
 - (4) Downward—[12g.]

73.6 Main Component Requirements

FAR 29.547 : [Main and tail rotor structure.]

- (a) [A rotor is an assembly of rotating components, which includes the rotor hub, blades, blade dampers, the pitch control mechanisms, and all other parts that rotate with the assembly.
- (b) Each rotor assembly must be designed as prescribed in this section and must function safely for the critical flight load and operating conditions. A design assessment must be performed, including a detailed failure analysis to identify all failures that will prevent continued safe flight or safe landing, and must identify the means to minimize the likelihood of their occurrence.
- (c) The rotor structure must be designed to withstand the following loads prescribed in Secs. 29.337 through 29.341 and 29.351 :]
 - (1) Critical flight loads.
 - (2) Limit loads occurring under normal conditions of autorotation.
- (d) [The rotor structure must be designed to withstand loads simulating-]
 - (1) For the rotor blades, hubs, and flapping hinges, the impact force of each blade against its stop during ground operation; and
 - (2) Any other critical condition expected in normal operation.
- (e) [The rotor structure must be designed to withstand the limit torque at any rotational speed, including zero.
In addition :]
 - (1) The limit torque need not be greater than the torque defined by a torque limiting device (where provided), and may not be less than the greater of-
 - (i) The maximum torque likely to be transmitted to the rotor structure, in either direction, by the rotor drive or by sudden application of the rotor brake; and
 - (ii) [For the main rotor, the limit engine torque specified in Sec. 29.361.]
 - (2) The limit torque must be equally and rationally distributed to the rotor blades.

Amdt. 29-40, Eff. 8/8/96

FAR 29.549 : Fuselage and rotor pylon structures.

- (a) Each fuselage and rotor pylon structure must be designed to withstand-
 - (1) The critical loads prescribed in Secs. 29.337 through 29.341, and 29.351 ;
 - (2) The applicable ground loads prescribed in Secs. 29.235, 29.471 through 29.485, 29.493, 29.497, 29.505, and 29.521 ; and
 - (3) The loads prescribed in Sec. 29.547(d)(1) and (e)(1)(i).
- (b) Auxiliary rotor thrust, the torque reaction of each rotor drive system, and the balancing air and inertia loads occurring under accelerated flight conditions, must be considered.
- (c) Each engine mount and adjacent fuselage structure must be designed to withstand the loads occurring under accelerated flight and landing conditions, including engine torque.

- (b) [Instructions are included in the Airplane Flight Manual, approved manual material, or markings and placards, for the proper placement of the removable ballast under each loading condition for which removable ballast is necessary.]

Amdt. 23-13, Eff. 10/23/72

FAR 23.33 : Propeller speed and pitch limits.

- (a) *General.* The propeller speed and pitch must be limited to values that will assure safe operation under normal operating conditions.
- (b) *Propellers not controllable in flight.* For each propeller whose pitch cannot be controlled in flight-
 - (1) [During takeoff and initial climb at the all engine(s) operating climb speed specified in Sec. 23.65, the propeller must limit the engine r.p.m., at full throttle or at maximum allowable takeoff manifold pressure, to a speed not greater than the maximum allowable takeoff r.p.m. ; and
 - (2) During a closed throttle glide, at $V_{X/E}$, the propeller may not cause an engine speed above 110 percent of maximum continuous speed.]
- (c) *Controllable pitch propellers without constant speed controls.* Each propeller that can be controlled in flight, but that does not have constant speed controls, must have a means to limit the pitch range so that-
 - (1) The lowest possible pitch allows compliance with paragraph (b)(1) of this section ; and
 - (2) The highest possible pitch allows compliance with paragraph (b)(2) of this section.
- (d) *Controllable pitch propellers with constant speed controls.* Each controllable pitch propeller with constant speed controls must have-
 - (1) With the governor in operation, a means at the governor to limit the maximum engine speed to the maximum allowable takeoff r.p.m. ; and
 - (2) With the governor inoperative, the propeller blades at the lowest possible pitch, with takeoff power, the airplane stationary, and no wind, either-
 - (i) A means to limit the maximum engine speed to 103 percent of the maximum allowable takeoff r.p.m., or
 - (ii) For an engine with an approved overspeed, a means to limit the maximum engine and propeller speed to not more than the maximum approved overspeed.

Amdt. 23-50, Eff. 03/11/96

29.2 Performance

FAR 23.45 : General.

- (a) [Unless otherwise prescribed, the performance requirements of this part must be met for-
 - (1) Still air and standard atmosphere ; and
 - (2) Ambient atmospheric conditions, for commuter category airplanes, for reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight, and for turbine engine-powered airplanes.

- (b) Performance data must be determined over not less than the following ranges of conditions—
- (1) Airport altitudes from sea level to 10,000 feet ; and
 - (2) For reciprocating engine-powered airplanes of 6,000 pounds, or less, maximum weight, temperature from standard to 30° C above standard ; or
 - (3) For reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight and turbine engine-powered airplanes, temperature from standard to 30° C above standard, or the maximum ambient atmospheric temperature at which compliance with the cooling provisions of Sec. 23.1041 to Sec. 23.1047 is shown, if lower.
- (c) Performance data must be determined with the cowl flaps or other means for controlling the engine cooling air supply in the position used in the cooling tests required by Sec. 23.1041 to Sec. 23.1047.
- (d) The available propulsive thrust must correspond to engine power, not exceeding the approved power, less—
- (1) Installation losses ; and
 - (2) The power absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.
- (e) The performance, as affected by engine power or thrust, must be based on a relative humidity :
- (1) Of 80 percent at and below standard temperature ; and
 - (2) From 80 percent, at the standard temperature, varying linearly down to 34 percent at the standard temperature plus 50° F.
- (f) Unless otherwise prescribed, in determining the takeoff and landing distances, changes in the airplane's configuration, speed, and power must be made in accordance with procedures established by the applicant for operation in service. These procedures must be able to be executed consistently by pilots of average skill in atmospheric conditions reasonably expected to be encountered in service.
- (g) The following, as applicable, must be determined on a smooth, dry, hard-surfaced runway—
- (1) Takeoff distance of Sec. 23.53(b) ;
 - (2) Accelerate-stop distance of Sec. 23.55 ;
 - (3) Takeoff distance and takeoff run of Sec. 23.59 ; and
 - (4) Landing distance of Sec. 23.75.
- NOTE : The effect on these distances of operation on other types of surfaces (for example, grass, gravel) when dry, may be determined or derived and these surfaces listed in the Airplane Flight Manual in accordance with Sec. 23.1583(p).
- (h) For commuter category airplanes, the following also apply :
- (1) Unless otherwise prescribed, the applicant must select the takeoff, enroute, approach, and landing configurations for the airplane.
 - (2) The airplane configuration may vary with weight, altitude, and temperature, to the extent they are compatible with the operating procedures required by paragraph (h)(3) of this section.

most severe wave heights and profiles for which approval is desired. The loads for the landing conditions of paragraphs (b) and (c) of this section must be developed and distributed along and among the hull and auxiliary floats, if used, in a rational and conservative manner, assuming a rotor lift not exceeding two-thirds of the rotorcraft weight to act throughout the landing impact.

- (b) *Vertical landing conditions.* The rotorcraft must initially contact the most critical wave surface at zero forward speed in likely pitch and roll attitudes which result in critical design loadings. The vertical descent velocity may not be less than 6.5 feet per second relative to the mean water surface.

- (c) *Forward speed landing conditions.* The rotorcraft must contact the most critical wave at forward velocities from zero up to 30 knots in likely pitch, roll, and yaw attitudes and with a vertical descent velocity of not less than 6.5 feet per second relative to the mean water surface. A maximum forward velocity of less than 30 knots may be used in design if it can be demonstrated that the forward velocity selected would not be exceeded in a normal one-engine-out landing.]

- (d) *Auxiliary float immersion condition.* In addition to the loads from the landing conditions, the auxiliary float, and its support and attaching structure in the hull, must be designed for the load developed by a fully immersed float unless it can be shown that full immersion of the float is unlikely, in which case the highest likely float buoyancy load must be applied that considers loading of the float immersed to create restoring moments compensating for upsetting moments caused by side wind, asymmetrical rotorcraft loading, water wave action, and rotorcraft inertia.

Amdt. 29-30, EFF. 4/5/90

FAR 29.521 : Float landing conditions.

If certification for float operation [(including float amphibian operation)] is requested, the rotorcraft, with floats, must be designed to withstand the following loading conditions (where the limit load factor is determined under Sec. 29.473 (b) or assumed to be equal to that determined for wheel landing gear) :

- (a) Up-load conditions in which—
- (1) A load is applied so that, with the rotorcraft in the static level attitude, the resultant water reaction passes vertically through the center of gravity ; and
 - (2) The vertical load prescribed in subparagraph (1) of this paragraph is applied simultaneously with an aft component of 0.25 times the vertical component.
- (b) A side load condition in which—

- (1) A vertical load of 0.75 times the total vertical load specified in paragraph (a) (1) of this section is divided equally among the floats ; and
- (2) For each float, the load share determined under subparagraph (1) of this paragraph, combined with a total side load of 0.25 times the total vertical load specified in subparagraph (1) of this paragraph, is applied to that float only.

Amdt. 29-3, EFF. 2/25/68

- (ii) Distributed symmetrically among the skids;
- (iii) Concentrated at the forward end of the straight part of the skid tube; and
- (iv) Applied only to the forward end of the skid tube and its attachment to the rotorcraft.
- (2) With the rotorcraft in the level landing attitude, a vertical ground reaction load equal to one-half of the vertical load determined under paragraph (b) of this section. This load must be—
 - (i) Applied only to the skid tube and its attachment to the rotorcraft; and
 - (ii) [Distributed equally over 33.3 percent of the length between the skid tube attachments and centrally located midway between the skid tube attachments.]

Amdt. 29-30, Eff. 4/5/90

FAR 29.505 : Ski landing conditions.

If certification for ski operation is requested, the rotorcraft, with skis, must be designed to withstand the following loading conditions (where P is the maximum static weight on each ski with the rotorcraft at design maximum weight, and n_{zcl} is the limit load factor determined under Sec. 29.473(b)) :

- (a) Up-load conditions in which—
 - (1) A vertical load of $P n_{zcl}$ and a horizontal load of $\frac{P n_{zcl}}{4}$ are simultaneously applied at the pedestal bearings; and
 - (2) A vertical load of $1.33 P$ is applied at the pedestal bearings.
- (b) A side load condition in which a side load of $0.35 P_{ulimit}$ is applied at the pedestal bearings in a horizontal plane perpendicular to the centerline of the rotorcraft.
- (c) A torque-load condition in which a torque load of $1.33 P$ (in foot-pounds) is applied to the ski about the vertical axis through the centerline of the pedestal bearings.

FAR 29.511 : [Ground load : unsymmetrical loads on multiple-wheel units.]

- (a) [In dual-wheel gear units, 60 percent of the total ground reaction for the gear unit must be applied to one wheel and 40 percent to the other.
- (b) To provide for the case of one deflated tire, 60 percent of the specified load for the gear unit must be applied to either wheel except that the vertical ground reaction may not be less than the full static value.
- (c) In determining the total load on a gear unit, the transverse shift in the load centroid, due to unsymmetrical load distribution on the wheels, may be neglected.]

Amdt. 29-3, Eff. 2/25/08

73.5 Water Loads**FAR 29.519 : Hull type rotorcraft : [Water-based and amphibian.]**

- (a) [*General.* For hull type rotorcraft, the structure must be designed to withstand the water loading set forth in paragraphs (b), (c), and (d) of this section considering the

- (3) Unless otherwise prescribed, in determining the critical engine-inoperative takeoff performance, takeoff flight path, the accelerate-stop distance, changes in the airplane's configuration, speed, and power must be made in accordance with procedures established by the applicant for operation in service.
- (4) Procedures for the execution of discontinued approaches and balked landings associated with the conditions prescribed in Secs. 23.67(c)(4) and 23.77(c) must be established.

- (5) The procedures established under paragraphs (h)(3) and (h)(4) of this section must—

- (i) Be able to be consistently executed by a crew of average skill in atmospheric conditions reasonably expected to be encountered in service;
- (ii) Use methods or devices that are safe and reliable; and
- (iii) Include allowance for any reasonably expected time delays in the execution of the procedures.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.49 : Stalling speed.

- (a) [V_{S0} and V_{S1} are the stalling speeds or the minimum steady flight speeds, in knots (CAS), at which the airplane is controllable with—

- (1) For reciprocating engine-powered airplanes, the engine(s) idling, the throttle(s) closed or at not more than the power necessary for zero thrust at a speed not more than 110 percent of the stalling speed;

- (2) For turbine engine-powered airplanes, the propulsive thrust not greater than zero at the stalling speed, or, if the resultant thrust has no appreciable effect on the stalling speed, with engine(s) idling and throttle(s) closed;

- (3) The propeller(s) in the takeoff position;

- (4) The airplane in the condition existing in the test, in which V_{S0} and V_{S1} are being used;

- (5) The center of gravity in the position that results in the highest value of V_{S0} and V_{S1} ; and

- (6) The weight used when V_{S0} or V_{S1} are being used as a factor to determine compliance with a required performance standard.

- (b) V_{S0} and V_{S1} must be determined by flight tests, using the procedure and meeting the flight characteristics specified in Sec. 23.201.

- (c) Except as provided in paragraph (d) of this section, V_{S0} at maximum weight must not exceed 61 knots for—

- (1) Single-engine airplanes; and

- (2) Multi-engine airplanes of 6,000 pounds or less maximum weight that cannot meet the minimum rate of climb specified in Sec. 23.67(a)(1) with the critical engine inoperative.

- (d) All single-engine airplanes, and those multi-engine airplanes of 6,000 pounds or less maximum weight with a V_{S0} of more than 61 knots that do not meet the requirements of Sec. 23.67(a)(1), must comply with Sec. 23.562(d).]

Amdt. 23-50, Eff. 03/11/96

FAR 23.51 : Takeoff [speeds.]

- (a) [For normal, utility, and acrobatic category airplanes, rotation speed, V_R , is the speed at which the pilot makes a control input, with the intention of lifting the airplane out of contact with the runway or water surface.
- (1) For multiengine landplanes, V_R , must not be less than the greater of $1.05 V_{MC}$; or $1.10 V_{S1}$;
- (2) For single-engine landplanes, V_R , must not be less than V_{S1} ; and
- (3) For seaplanes and amphibians taking off from water, V_R , may be any speed that is shown to be safe under all reasonably expected conditions, including turbulence and complete failure of the critical engine.
- (b) For normal, utility, and acrobatic category airplanes, the speed at 50 feet above the takeoff surface level must not be less than :
 - (1) For multiengine airplanes, the highest of—
 - (i) A speed that is shown to be safe for continued flight (or emergency landing, if applicable) under all reasonable expected conditions, including turbulence and complete failure of the critical engine;
 - (ii) $1.10 V_{MC}$; or
 - (iii) $1.20 V_{S1}$.
 - (2) For single-engine airplanes, the higher of—
 - (i) A speed that is shown to be safe under all reasonably expected conditions, including turbulence and complete engine failure ; or
 - (ii) $1.20 V_{S1}$.
- (c) For commuter category airplanes, the following apply :
 - (1) V_1 must be established in relation to V_{EF} as follows :
 - (i) V_{EF} is the calibrated airspeed at which the critical engine is assumed to fail. V_{EF} must be selected by the applicant but must not be less than $1.05 V_{MC}$ determined under Sec. 23.149(b) or, at the option of the applicant, not less than V_{MCG} determined under Sec. 23.149(f)
 - (ii) The takeoff decision speed, V_1 , is the calibrated airspeed on the ground at which, as a result of engine failure or other reasons, the pilot is assumed to have made a decision to continue or discontinue the takeoff. The takeoff decision speed, V_1 , must be selected by the applicant but must not be less than V_{EF} plus the speed gained with the critical engine inoperative during the time interval between the instant at which the critical engine is failed and the instant at which the pilot recognizes and reacts to the engine failure, as indicated by the pilot's application of the first retarding means during the accelerate-stop determination of Sec. 23.55.
 - (2) The rotation speed, V_R , in terms of calibrated airspeed, must be selected by the applicant and must not be less than the greatest of the following :
 - (i) V_1 ;
 - (ii) $1.05 V_{MC}$ determined under Sec. 23.149(b) ;
 - (iii) $1.10 V_{S1}$; or
 - (iv) The speed that allows attaining the initial climb-out speed, V_2 , before reaching a height of 35 feet above the takeoff surface in accordance with Sec. 23.57(c)(2).

- (ii) An assumed rotor lift of not more than 1.5 times that used in the limit drop tests prescribed in Sec. 29.725.
- (4) Compliance with paragraphs (b) through (e) of this section must be shown with—
 - (i) The gear in its most critically deflected position for the landing condition being considered ; and
 - (ii) The ground reactions rationally distributed along the bottom of the skid tube.
- (b) *Vertical reactions in the level landing attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of both skids, the vertical reactions must be applied as prescribed in paragraph (a) of this section.
- (c) Drag reactions in the level landing attitude. In the level attitude, and with the rotorcraft contacting the ground along the bottom of both skids, the following apply :
 - (1) The vertical reactions must be combined with horizontal drag reactions of 50 percent of the vertical reaction applied at the ground.
 - (2) The resultant ground loads must equal the vertical load specified in paragraph (b) of this section.
- (d) *Sideloads in the level landing attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of both skids, the following apply :
 - (1) The vertical ground reaction must be—
 - (i) Equal to the vertical loads obtained in the condition specified in paragraph (b) of this section ; and
 - (ii) Divided equally among the skids.
 - (2) The vertical ground reactions must be combined with a horizontal sideload of 25 percent of their value.
 - (3) [The total sideload must be applied equally between skids and along the length of the skids.]
 - (4) The unbalanced moments are assumed to be resisted by angular inertia.
 - (5) The skid gear must be investigated for—
 - (i) Inward acting sideloads ; and
 - (ii) Outward acting sideloads.
- (e) *One-skid landing loads in the level attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of one skid only, the following apply :
 - (1) The vertical load on the ground contact side must be the same as that obtained on that side in the condition specified in paragraph (b) of this section.
 - (2) The unbalanced moments are assumed to be resisted by angular inertia.
- (f) *Special conditions.* In addition to the conditions specified in paragraphs (b) and (c) of this section, the rotorcraft must be designed for the following ground reactions :
 - (1) A ground reaction load acting up and aft at an angle of 45° to the longitudinal axis of the rotorcraft. This load must be—
 - (i) Equal to 1.33 times the maximum weight ;

- (ii) For the rear wheel, 0.8 times the vertical reaction.
- (2) The loads specified in subparagraph (1) of this paragraph must be applied—
 - (i) At the ground contact point with the wheel in the trailing position (for non-full swiveling landing gear or for full swiveling landing gear with a lock, steering device, or shimmy damper to keep the wheel in the trailing position) ; or
 - (ii) At the center of the axle (for full swiveling landing gear without a lock, steering device, or shimmy damper).
- (g) *Braked roll conditions in the level landing attitude.* In the attitudes specified in paragraphs (b) and (c) of this section, and with the shock absorbers in their static positions, the rotorcraft must be designed for braked roll loads as follows :
 - (1) The limit vertical load must be based on a limit vertical load factor of not less than—
 - (i) 1.0, for the attitude specified in paragraph (b) of this section ; and
 - (ii) 1.33, for the attitude specified in paragraph (c) of this section.
 - (2) For each wheel with brakes, a drag load must be applied, at the ground contact point, of not less than the lesser of—
 - (i) 0.8 times the vertical load ; and
 - (ii) The maximum based on limiting brake torque.
- (h) *Rear wheel turning loads in the static ground attitude.* In the static ground attitude, and with the shock absorbers and tires in their static positions, the rotorcraft must be designed for rear wheel turning loads as follows :
 - (1) A vertical ground reaction equal to the static load on the rear wheel must be combined with an equal side load.
 - (2) The load specified in subparagraph (1) of this paragraph must be applied to the rear landing gear—
 - (i) Through the axle, if there is a swivel (the rear wheel being assumed to be swiveled 90 degrees to the longitudinal axis of the rotorcraft) ; or
 - (ii) At the ground contact point if there is a lock, steering device or shimmy damper (the rear wheel being assumed to be in the trailing position).
- (i) *Taxiing condition.* The rotorcraft and its landing gear must be designed for the loads that would occur when the rotorcraft is taxied over the roughest ground that may reasonably be expected in normal operation.

FAR 29.501 : Ground loading conditions : landing gear with skids.

- (a) *General.* Rotorcraft with landing gear with skids must be designed for the loading conditions specified in this section. In showing compliance with this section, the following apply :
 - (1) The design maximum weight, center of gravity, and load factor must be determined under Secs. 29.471 through 29.475.
 - (2) Structural yielding of elastic spring members under limit loads is acceptable.
 - (3) Design ultimate loads for elastic spring members need not exceed those obtained in a drop test of the gear with—
 - (i) A drop height of 1.5 times that specified in Sec. 29.725 ; and

- (3) For any given set of conditions, such as weight, altitude, temperature, and configuration, a single value of V_R must be used to show compliance with both the one-engine-inoperative takeoff and all-engines-operating takeoff requirements.
- (4) The takeoff safety speed, V_2 , in terms of calibrated airspeed, must be selected by the applicant so as to allow the gradient of climb required in Sec. 23.67(c)(1) and (c)(2) but must not be less than $1.10 V_{MC}$ or less than $1.20 V_{S1}$.
- (5) The one-engine-inoperative takeoff distance, using a normal rotation rate at a speed 5 knots less than V_R , established in accordance with paragraph (c)(2) of this section, must be shown not to exceed the corresponding one-engine-inoperative takeoff distance, determined in accordance with Sec. 23.57 and Sec. 23.59(a)(1), using the established V_R . The takeoff, otherwise performed in accordance with Sec. 23.57, must be continued safely from the point at which the airplane is 35 feet above the takeoff surface and at a speed not less than the established V_2 minus 5 knots.
- (6) The applicant must show, with all engines operating, that marked increases in the scheduled takeoff distances, determined in accordance with Sec. 23.59(a)(2), do not result from over-rotation of the airplane or out-of-trim conditions.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.53 : Takeoff [performance.]

- (a) [For normal, utility, and acrobatic category airplanes, the takeoff distance must be determined in accordance with paragraph (b) of this section, using speeds determined in accordance with Sec. 23.51(a) and (b).
- (b) For normal, utility, and acrobatic category airplanes, the distance required to takeoff and climb to a height of 50 feet above the takeoff surface must be determined for each weight, altitude, and temperature within the operational limits established for takeoff with—
 - (1) Takeoff power on each engine ;
 - (2) Wing flaps in the takeoff position(s) ; and
 - (3) Landing gear extended.
- (c) For commuter category airplanes, takeoff performance, as required by Secs. 23.55 through 23.59, must be determined with the operating engine(s) within approved operating limitations.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.55 : Accelerate-stop distance.

For each commuter category airplane, the accelerate-stop distance must be determined as follows :

- (a) [The accelerate-stop distance is the sum of the distances necessary to—
 - (1) Accelerate the airplane from a standing start to V_{EF} with all engines operating ;
 - (2) Accelerate the airplane from V_{EF} to V_1 , assuming the critical engine fails at V_{EF} ; and
 - (3) Come to a full stop from the point at which V_1 is reached.

(b) Means other than wheel brakes may be used to determine the accelerate-stop distances if that means—]

- (1) Is safe and reliable;
- (2) Is used so that consistent results can be expected under normal operating conditions; and
- (3) Is such that exceptional skill is not required to control the airplane.

Amtd. 23-50, Eff. 03/11/96

FAR 23.57 : Takeoff path.

For each commuter category airplane, the takeoff path is as follows :

- (a) [The takeoff path extends from a standing start to a point in the takeoff at which the airplane is 1,500 feet above the takeoff surface at or below which height the transition from the takeoff to the enroute configuration must be completed; and]
 - (1) The takeoff path must be based on the procedures prescribed in Sec. 23.45;
 - (2) The airplane must be accelerated on the ground to V_{EF} at which point the critical engine must be made inoperative and remain inoperative for the rest of the takeoff; and
 - (3) After reaching V_{EF} , the airplane must be accelerated to V_2 .
- (b) [During the acceleration to speed V_2 , the nose gear may be raised off the ground at a speed not less than VR. However, landing gear retraction must not be initiated until the airplane is airborne.]
- (c) During the takeoff path determination, in accordance with paragraphs (a) and (b) of this section—
 - (1) [The slope of the airborne part of the takeoff path must not be negative at any point;]
 - (2) The airplane must reach V_2 before it is 35 feet above the takeoff surface, and must continue at a speed as close as practical to, but not less than V_2 , until it is 400 feet above the takeoff surface;
 - (3) [At each point along the takeoff path, starting at the point at which the airplane reaches 400 feet above the takeoff surface, the available gradient of climb must not be less than—]
 - (i) 1.2 percent for two-engine airplanes;
 - (ii) 1.5 percent for three-engine airplanes;
 - (iii) 1.7 percent for four-engine airplanes; and
 - (4) [Except for gear retraction and automatic propeller feathering, the airplane configuration must not be changed, and no change in power that requires action by the pilot may be made, until the airplane is 400 feet above the takeoff surface.
- (d) The takeoff path to 35 feet above the takeoff surface must be determined by a continuous demonstrated takeoff.
- (e) The takeoff path from 35 feet above the takeoff surface must be determined by synthesis from segments; and
 - (1) The segments must be clearly defined and must be related to distinct changes in configuration, power, and speed ;

FAR 29.493 : Braked roll conditions.

Under braked roll conditions with the shock absorbers in their static positions—

- (a) The limit vertical load must be based on a load factor of at least—
 - (1) 1.33, for the attitude specified in Sec. 29.479(a)(1) ; and
 - (2) 1.0, for the attitude specified in Sec. 29.479(a)(2) ; and
- (b) The structure must be designed to withstand, at the ground contact point of each wheel with brakes, a drag load of at least the lesser of—
 - (1) The vertical load multiplied by a coefficient of friction of 0.8 ; and
 - (2) The maximum value based on limiting brake torque.

FAR 29.497 : Ground loading conditions : landing gear with tail wheels.

(a) *General.* Rotorcraft with landing gear with two wheels forward and one wheel aft of the center of gravity must be designed for loading conditions as prescribed in this section.

- (b) *Level landing attitude with only the forward wheels contacting the ground.* In this attitude—
 - (1) The vertical loads must be applied under Secs. 29.471 through 29.475;
 - (2) The vertical load at each axle must be combined with a drag load at that axle of not less than 25 percent of that vertical load ; and
 - (3) Unbalanced pitching moments are assumed to be resisted by angular inertia forces.
- (c) *Level landing attitude with all wheels contacting the ground simultaneously.* In this attitude, the rotorcraft must be designed for landing loading conditions as prescribed in paragraph (b) of this section.
- (d) *Maximum nose-up attitude with only the rear wheel contacting the ground.* The attitude for this condition must be the maximum nose-up attitude expected in normal operation, including autorotative landings. In this attitude—
 - (1) The appropriate ground loads specified in paragraph (b)(1) and (2) of this section must be determined and applied, using a rational method to account for the moment arm between the rear wheel ground reaction and the rotorcraft center of gravity ; or
 - (2) The probability of landing with initial contact on the rear wheel must be shown to be extremely remote.
- (e) *Level landing attitude with only one forward wheel contacting the ground.* In this attitude, the rotorcraft must be designed for ground loads as specified in paragraph (b)(1) and (3) of this section.
- (f) *Side loads in the level landing attitude.* In the attitudes specified in paragraphs (b) and (c) of this section, the following apply :
 - (1) The side loads must be combined at each wheel with one-half of the maximum vertical ground reactions obtained for that wheel under paragraphs (b) and (c) of this section. In this condition, the side loads must be—
 - (i) For the forward wheels, 0.8 times the vertical reaction (on one side) acting inward, and 0.6 times the vertical reaction (on the other side) acting outward ; and

- (3) The vertical load at the instant of peak drag load combined with a drag component simulating the forces required to accelerate the wheel rolling assembly up to the specified ground speed, with—
- (i) The ground speed for determination of the spin-up loads being at least 75 percent of the optimum forward flight speed for minimum rate of descent in autorotation; and
- (ii) The loading conditions of this subparagraph applied to the landing gear and its attaching structure only.
- (4) If there are two wheels forward, a distribution of the loads applied to those wheels under subparagraphs (1) and (2) of this paragraph in a ratio of 40 : 60.
- (c) *Pitching moments.* Pitching moments are assumed to be resisted by—
- (1) In the case of the attitude in paragraph (a)(1) of this section, the forward landing gear; and
- (2) In the case of the attitude in paragraph (a)(2) of this section, the angular inertia forces.

FAR 29.481 : Tail-down landing conditions.

- (a) The rotorcraft is assumed to be in the maximum nose-up attitude allowing ground clearance by each part of the rotorcraft.
- (b) In this attitude, ground loads are assumed to act perpendicular to the ground.

FAR 29.483 : One-wheel landing conditions.

- For the one-wheel landing condition, the rotorcraft is assumed to be in the level attitude and to contact the ground on one aft wheel. In this attitude—
- (a) The vertical load must be the same as that obtained on that side under Sec. 29.479(b)(1); and
- (b) The unbalanced external loads must be reacted by rotorcraft inertia.

FAR 29.485 : Lateral drift landing conditions.

- (a) The rotorcraft is assumed to be in the level landing attitude, with—
- (1) Side loads combined with one-half of the maximum ground reactions obtained in the level landing conditions of Sec. 29.479(b)(1); and
- (2) The loads obtained under subparagraph (1) of this paragraph applied—
- (i) At the ground contact point; or
- (ii) For full-swiveling gear, at the center of the axle.
- (b) The rotorcraft must be designed to withstand, at ground contact—
- (1) When only the aft wheels contact the ground, side loads of 0.8 times the vertical reaction acting inward on one side and 0.6 times the vertical reaction acting outward on the other side, all combined with the vertical loads specified in paragraph (a) of this section; and
- (2) When the wheels contact the ground simultaneously—
- (i) For the aft wheels, the side loads specified in subparagraph (1) of this paragraph; and
- (ii) For the forward wheels, a side load of 0.8 times the vertical reaction combined with the vertical load specified in paragraph (a) of this section.

- (2) The weight of the airplane, the configuration, and the power must be assumed constant throughout each segment and must correspond to the most critical condition prevailing in the segment; and
- (3) The takeoff flight path must be based on the airplane's performance without utilizing ground effect.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.59 : Takeoff distance and takeoff run.

[For each commuter category airplane, the takeoff distance and, at the option of the applicant, the takeoff run, must be determined.]

- (a) Takeoff distance is the greater of—
- (1) The horizontal distance along the takeoff path from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface as determined under Sec. 23.57; or
- (2) [With all engines operating, 115 percent of the horizontal distance from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface, determined by a procedure consistent with Sec. 23.57.
- (b) If the takeoff distance includes a clearway, the takeoff run is the greater of—
- (1) The horizontal distance along the takeoff path from the start of the takeoff to a point equidistant between the liftoff point and the point at which the airplane is 35 feet above the takeoff surface as determined under Sec. 23.57; or
- (2) With all engines operating, 115 percent of the horizontal distance from the start of the takeoff to a point equidistant between the liftoff point and the point at which the airplane is 35 feet above the takeoff surface, determined by a procedure consistent with Sec. 23.57.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.61 : [Takeoff flight path.]

[For each commuter category airplane, the takeoff flight path must be determined as follows :

- (a) The takeoff flight path begins 35 feet above the takeoff surface at the end of the takeoff distance determined in accordance with Sec. 23.59.
- (b) The net takeoff flight path data must be determined so that they represent the actual takeoff flight paths, as determined in accordance with Sec. 23.57 and with paragraph (a) of this section, reduced at each point by a gradient of climb equal to—
- (1) 0.8 percent for two-engine airplanes;
- (2) 0.9 percent for three-engine airplanes; and
- (3) 1.0 percent for four-engine airplanes.
- (c) The prescribed reduction in climb gradient may be applied as an equivalent reduction in acceleration along that part of the takeoff flight path at which the airplane is accelerated in level flight.]

Amdt. 23-34, Eff. 02/17/87

FAR 23.63 : Climb : general.

- (a) [Compliance with the requirements of Secs. 23.65, 23.66, 23.67, 23.69, and 23.77 must be shown—
- (1) Out of ground effect ; and
 - (2) At speeds that are not less than those at which compliance with the powerplant cooling requirements of Secs. 23.1041 to 23.1047 has been demonstrated ; and
 - (3) Unless otherwise specified, with one engine inoperative, at a bank angle not exceeding 5 degrees.
- (b) For normal, utility, and acrobatic category reciprocating engine-powered airplanes of 6,000 pounds or less maximum weight, compliance must be shown with Sec. 23.65(a), Sec. 23.67(a), where appropriate, and Sec. 23.77(a) at maximum takeoff or landing weight, as appropriate, in a standard atmosphere.
- (c) For normal, utility, and acrobatic category reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight, and turbine engine-powered airplanes in the normal, utility, and acrobatic category, compliance must be shown at weights as a function of airport altitude and ambient temperature, within the operational limits established for takeoff and landing, respectively, with—
- (1) Sections 23.65(b) and 23.67(b)(1) and (2), where appropriate, for takeoff, and
 - (2) Section 23.67(b)(2), where appropriate, and Sec. 23.77(b), for landing.
- (d) For commuter category airplanes, compliance must be shown at weights as a function of airport altitude and ambient temperature within the operational limits established for takeoff and landing, respectively, with—
- (1) Sections 23.67(c)(1), 23.67(c)(2), and 23.67(c)(3) for takeoff ; and
 - (2) Sections 23.67(c)(3), 23.67(c)(4), and 23.77(c) for landing.]
- Amdt. 23-50, EFF. 03/11/96

FAR 23.65 : Climb : all engines operating.

- (a) [Each normal, utility, and acrobatic category reciprocating engine-powered airplane of 6,000 pounds or less maximum weight must have a steady climb gradient at sea level of at least 8.3 percent for landplanes or 6.7 percent for seaplanes and amphibians with—
- (1) Not more than maximum continuous power on each engine ;
 - (2) The landing gear retracted ;
 - (3) The wing flaps in the takeoff position(s) ; and
 - (4) A climb speed not less than the greater of $1.1 V_{MC}$ and $1.2 V_{S1}$ for multiengine airplanes and not less than $1.2 V_{S1}$ for single-engine airplanes.
- (b) Each normal, utility, and acrobatic category reciprocating engine-powered airplane of more than 6,000 pounds maximum weight and turbine engine-powered airplanes in the normal, utility, and acrobatic category must have a steady gradient of climb after takeoff of at least 4 percent with
- (1) Takeoff power on each engine ;
 - (2) The landing gear extended, except that if the landing gear can be retracted in not more than seven seconds, the test may be conducted with the gear retracted ;

- (1) The limit ground loads obtained in the landing conditions in this part must be considered to be external loads that would occur in the rotorcraft structure if it were acting as a rigid body ; and
 - (2) In each specified landing condition, the external loads must be placed in equilibrium with linear and angular inertia loads in a rational or conservative manner.
- (b) *Critical centers of gravity.* The critical centers of gravity within the range for which certification is requested must be selected so that the maximum design loads are obtained in each landing gear element.

FAR 29.473 : Ground loading conditions and assumptions.

- (a) [For specified landing conditions, a design maximum weight must be used that is not less than the maximum weight. A rotor lift may be assumed to act through the center of gravity throughout the landing impact. This lift may not exceed two-thirds of the design maximum weight.
- (b) Unless otherwise prescribed, for each specified landing condition, the rotorcraft must be designed for a limit load factor of not less than the limit inertia load factor substantiated under Sec. 29.725.
- (c) Triggering or actuating devices for additional or supplementary energy absorption may not fail under loads established in the tests prescribed in Secs. 29.725 and 29.727, but the factor of safety prescribed in Sec. 29.303 need not be used.]
- Amdt. 29-3, EFF. 2/25/68

FAR 29.475 : Tires and shock absorbers.

Unless otherwise prescribed, for each specified landing condition, the tires must be assumed to be in their static position and the shock absorbers to be in their most critical position.

FAR 29.477 : Landing gear arrangement.

Sections 29.235, 29.479 through 29.485, and 29.493 apply to landing gear with two wheels aft, and one or more wheels forward, of the center of gravity.

FAR 29.479 : Level landing conditions.

- (a) *Attitudes.* Under each of the loading conditions prescribed in paragraph (b) of this section, the rotorcraft is assumed to be in each of the following level landing attitudes :
- (1) An attitude in which each wheel contacts the ground simultaneously.
 - (2) An attitude in which the aft wheels contact the ground with the forward wheels just clear of the ground.
- (b) *Loading conditions.* The rotorcraft must be designed for the following landing loading conditions :
- (1) Vertical loads applied under Sec. 29.471.
 - (2) The loads resulting from a combination of the loads applied under subparagraph (1) of this paragraph with drag loads at each wheel of not less than 25 percent of the vertical load at that wheel.

FAR 29.403 : [Removed.]

[Removed.]

Amdt. 29-31, Eff. 10/22/90

FAR 29.411 : Ground clearance : tail rotor guard.

(a) It must be impossible for the tail rotor to contact the landing surface during a normal landing.

(b) If a tail rotor guard is required to show compliance with paragraph (a) of this section—

- (1) Suitable design loads must be established for the guard ; and
- (2) The guard and its supporting structure must be designed to withstand those loads.

FAR 29.413 : [Removed.]

[Removed.]

Amdt. 29-31, Eff. 10/22/90

FAR 29.427 : Unsymmetrical loads.

(a) Horizontal tail surfaces and their supporting structure must be designed for unsymmetrical loads arising from yawing and rotor wake effects in combination with the prescribed flight conditions.

(b) To meet the design criteria of paragraph (a) of this section, in the absence of more rational data, both of the following must be met :

- (1) [One hundred percent of the maximum loading from the symmetrical flight conditions acts on the surface on one side of the plane of symmetry, and no loading acts on the other side.
- (2) Fifty percent of the maximum loading from the symmetrical flight conditions acts on the surface on each side of the plane of symmetry, in opposite directions.]
- (c) For empennage arrangements where the horizontal tail surfaces are supported by the vertical tails surfaces, the vertical tail surfaces and supporting structure must be designed for the combined vertical and horizontal surface loads resulting from each prescribed flight condition, considered separately. The flight conditions must be selected so that the maximum design loads are obtained on each surface. In the absence of more rational data, the unsymmetrical horizontal tail surface loading distributions described in this section must be assumed.

Amdt. 29-31, Eff. 10/22/90

73.4 Ground Loads**FAR 29.471 : General.**

(a) *Loads and equilibrium.* For limit ground loads—

(3) The wing flaps in the takeoff position(s) ; and

(4) A climb speed as specified in Sec. 23.65(a)(4).]

Amdt. 23-50, Eff. 03/11/96

FAR 23.66 : [Takeoff climb : one engine inoperative.]

[For normal, utility, and acrobatic category reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight, and turbine engine-powered airplanes in the normal, utility, and acrobatic category, the steady gradient of climb or descent must be determined at each weight, altitude, and ambient temperature within the operational limits established by the applicant with—

- (a) The critical engine inoperative and its propeller in the position it rapidly and automatically assumes ;
- (b) The remaining engine(s) at takeoff power ;
- (c) The landing gear extended, except that if the landing gear can be retracted in not more than seven seconds, the test may be conducted with the gear retracted ;
- (d) The wing flaps in the takeoff position(s) ;
- (e) The wings level ; and
- (f) A climb speed equal to that achieved at 50 feet in the demonstration of Sec. 23.53.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.67 : Climb : one engine inoperative.

(a) [For normal, utility, and acrobatic category reciprocating engine-powered airplanes of 6,000 pounds or less maximum weight, the following apply :

- (1) Except for those airplanes that meet the requirements prescribed in Sec. 23.562(d), each airplane with a V_{50} of more than 61 knots must be able to maintain a steady climb gradient of at least 1.5 percent at a pressure altitude of 5,000 feet with the—
 - (i) Critical engine inoperative and its propeller in the minimum drag position ;
 - (ii) Remaining engine(s) at not more than maximum continuous power ;
 - (iii) Landing gear retracted ;
 - (iv) Wing flaps retracted ; and
 - (v) Climb speed not less than $1.2 V_{S1}$.
- (2) For each airplane that meets the requirements prescribed in Sec. 23.562(d), or that has a V_{50} of 61 knots or less, the steady gradient of climb or descent at a pressure altitude of 5,000 feet must be determined with the—
 - (i) Critical engine inoperative and its propeller in the minimum drag position ;
 - (ii) Remaining engine(s) at not more than maximum continuous power ;
 - (iii) Landing gear retracted ;
 - (iv) Wing flaps retracted ; and
 - (v) Climb speed not less than $1.2 V_{S1}$.
- (b) For normal, utility, and acrobatic category reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight, and turbine engine-powered airplanes in the normal, utility, and acrobatic category—

- (1) The steady gradient of climb at an altitude of 400 feet above the takeoff must be measurably positive with the—
 - (i) Critical engine inoperative and its propeller in the minimum drag position;
 - (ii) Remaining engine(s) at takeoff power;
 - (iii) Landing gear retracted;
 - (iv) Wing flaps in the takeoff position(s); and
 - (v) Climb speed equal to that achieved at 50 feet in the demonstration of Sec. 23.53.
 - (2) The steady gradient of climb must not be less than 0.75 percent at an altitude of 1,500 feet above the takeoff surface, or landing surface, as appropriate, with the—
 - (i) Critical engine inoperative and its propeller in the minimum drag position;
 - (ii) Remaining engine(s) at not more than maximum continuous power;
 - (iii) Landing gear retracted;
 - (iv) Wing flaps retracted; and
 - (v) Climb speed not less than $1.2 V_{S1}$.
- (c) For commuter category airplanes, the following apply:
- (1) *Takeoff: landing gear extended.* The steady gradient of climb at the altitude of the takeoff surface must be measurably positive for two-engine airplanes, not less than 0.3 percent for three-engine airplanes, or 0.5 percent for four-engine airplanes with—
 - (i) The critical engine inoperative and its propeller in the position it rapidly and automatically assumes;
 - (ii) The remaining engine(s) at takeoff power;
 - (iii) The landing gear extended, and all landing gear doors open;
 - (iv) The wing flaps in the takeoff position(s);
 - (v) The wings level; and
 - (vi) A climb speed equal to V_2 .
 - (2) *Takeoff, landing gear retracted.* The steady gradient of climb at an altitude of 400 feet above the takeoff surface must not be less than 2.0 percent for two-engine airplanes, 2.3 percent for three-engine airplanes, and 2.6 percent for four-engine airplanes with—
 - (i) The critical engine inoperative and its propeller in the position it rapidly and automatically assumes;
 - (ii) The remaining engine(s) at takeoff power;
 - (iii) The landing gear retracted;
 - (iv) The wing flaps in the takeoff position(s);
 - (v) A climb speed equal to V_2 .
 - (3) *Enroute.* The steady gradient of climb at an altitude of 1,500 feet above the takeoff or landing surface, as appropriate, must be not less than 1.2 percent for two-engine airplanes, 1.5 percent for three-engine airplanes, and 1.7 percent for four-engine airplanes with—

- (2) Notwithstanding paragraph (b)(3) of this section, when power-operated actuator controls or power boost controls are used, the system must also withstand the loads resulting from the limit pilot forces prescribed in Sec. 29.397 in conjunction with the forces output of each normally energized power device, including any single power boost or actuator system failure;
- (3) If the system design or the normal operating loads are such that a part of the system cannot react to the limit pilot forces prescribed in Sec. 29.397, that part of the system must be designed to withstand the maximum loads that can be obtained in normal operation. The minimum design loads must, in any case, provide a rigged system for service use, including consideration of fatigue, jamming, ground gusts, control inertia, and friction loads. In the absence of a rational analysis, the design loads resulting from 0.60 of the specified limit pilot forces are acceptable minimum design loads; and
- (4) If operational loads may be exceeded through jamming, ground gusts, control inertia, or friction, the system must withstand the limit pilot forces specified in Sec. 29.397, without yielding.]

Amdt. 29-30, EFF. 4/5/90

FAR 29.397 : Limit pilot forces and torques.

- (a) Except as provided in paragraph (b) of this section, the limit pilot forces are as follows:
 - (1) For foot control, 130 pounds.
 - (2) For stick controls, 100 pounds fore and aft, and 67 pounds laterally.
- (b) For flap, tab, stabilizer, rotor brake, and landing gear operating controls, the following apply (R=radius in inches):
 - (1) Crank, wheel, and lever controls, $\frac{1 \pm R}{3}$ 50 pounds, but not less than 50 pounds nor more than 100 pounds for hand operated controls or 130 pounds for foot operated controls, applied at any angle within 20 degrees of the plane of motion of the control.
 - (2) [Twist controls, 80R inch-pounds.]

Amdt. 29-47, EFF. 5/9/2001

FAR 29.399 : Dual control system.

Each dual primary flight control system must be able to withstand the loads that result when pilot forces not less than 0.75 times those obtained under Sec. 29.395 are applied—

- (a) In opposition; and
- (b) In the same direction.

FAR 29.401 : [Removed.]

[Removed.]

Amdt. 29-31, EFF. 10/22/90

FAR 29.361 : Engine torque.

[The limit engine torque may not be less than the following :

- (a) For turbine engines, the highest of—
 - (1) The mean torque for maximum continuous power multiplied by 1.25;
 - (2) The torque required by Sec. 29.923;
 - (3) The torque required by Sec. 29.927; or
 - (4) The torque imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming).
- (b) For reciprocating engines, the mean torque maximum continuous power multiplied by—
 - (1) 1.33, for engines with five or more cylinders; and
 - (2) Two, three, and four, for engines with four, three, and two cylinders, respectively.]

Amdt. 29-26, Eff. 10/3/88

73.3 Control Surface and System Loads**FAR 29.391 : General.**

[Each auxiliary rotor, each fixed or movable stabilizing or control surface, and each system operating any flight control must meet the requirements of Secs. 29.395 through 29.399, 29.411, and 29.427.]

Amdt. 29-41, Eff. 11/28/97

FAR 29.395 : Control system.

- (a) The reaction to the loads prescribed in Sec. 29.397 must be provided by—
 - (1) The control stops only;
 - (2) The control locks only;
 - (3) The irreversible mechanism only (with the mechanism locked and with the control surface in the critical positions for the effective parts of the system within its limit of motion);
 - (4) The attachment of the control system to the rotor blade pitch control horn only (with the control in the critical positions for the affected parts of the system within the limits of its motion); and
 - (5) The attachment of the control system to the control surface horn (with the control in the critical positions for the affected parts of the system within the limits of its motion).
- (b) [Each primary control system, including its supporting structure, must be designed as follows :
 - (1) The system must withstand loads resulting from the limit pilot forces prescribed in Sec. 29.397;

- (i) The critical engine inoperative and its propeller in the minimum drag position;
- (ii) The remaining engine(s) at not more than maximum continuous power;
- (iii) The landing gear retracted;
- (iv) The wing flaps retracted; and
- (v) A climb speed not less than $1.2 V_{S1}$.
- (4) *Discontinued approach.* The steady gradient of climb at an altitude of 400 feet above the landing surface must be not less than 2.1 percent for two-engine airplanes, 2.4 percent for three-engine airplanes, and 2.7 percent for four-engine airplanes, with—
 - (i) The critical engine inoperative and its propeller in the minimum drag position;
 - (ii) The remaining engine(s) at takeoff power;
 - (iii) Landing gear retracted;
 - (iv) Wing flaps in the approach position(s) in which V_{S1} for these position(s) does not exceed 110 percent of the V_{S1} for the related all-engines-operating landing position(s); and
 - (v) A climb speed established in connection with normal landing procedures but not exceeding $1.3 V_{S1}$.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.69 : [Enroute climb/descent.]

- (a) [All engines operating. The steady gradient and rate of climb must be determined at each weight, altitude, and ambient temperature within the operational limits established by the applicant with—
 - (1) Not more than maximum continuous power on each engine;
 - (2) The landing gear retracted;
 - (3) The wing flaps retracted; and
 - (4) A climb speed not less than $1.3 V_{S1}$.
- (b) *One engine inoperative.* The steady gradient and rate of climb/descent must be determined at each weight, altitude, and ambient temperature within the operational limits established by the applicant with—
 - (1) The critical engine inoperative and its propeller in the minimum drag position;
 - (2) The remaining engine(s) at not more than maximum continuous power;
 - (3) The landing gear retracted;
 - (4) The wing flaps retracted; and
 - (5) A climb speed not less than $1.2 V_{S1}$.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.71 : [Glide : single-engine airplanes.]

[The maximum horizontal distance traveled in still air, in nautical miles, per 1,000 feet of altitude lost in a glide, and the speed necessary to achieve this must be determined with the engine inoperative, its propeller in the minimum drag position, and landing gear and wing flaps in the most favorable available position.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.73 : [Reference landing approach speed.]

- (a) [For normal, utility, and acrobatic category reciprocating engine-powered airplanes of 6,000 pounds or less maximum weight, the reference landing approach speed, V_{REF} , must not be less than the greater of V_{MC} , determined in Sec. 23.149(b) with the wing flaps in the most extended takeoff position, and $1.3 V_{S0}$.
 - (b) For normal, utility, and acrobatic category reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight, and turbine engine-powered airplanes in the normal, utility, and acrobatic category, the reference landing approach speed, V_{REF} , must not be less than the greater of V_{MC} , determined in Sec. 23.149(c), and $1.3 V_{S0}$.
 - (c) For commuter category airplanes, the reference landing approach speed, V_{REF} , must not be less than the greater of $1.05 V_{MC}$, determined in Sec. 23.149(c), and $1.3 V_{S0}$.]
- Amdt. 23-50, Eff. 03/11/96

FAR 23.75 : Landing [distance.]

[The horizontal distance necessary to land and come to a complete stop from a point 50 feet above the landing surface must be determined, for standard temperatures at each weight and altitude within the operational limits established for landing, as follows :

- (a) A steady approach at not less than V_{REF} , determined in accordance with Sec. 23.73(a), (b), or (c), as appropriate, must be maintained down to the 50 foot height and—
 - (1) The steady approach must be at a gradient of descent not greater than 5.2 percent (3°) down to the 50 foot height.
 - (2) In addition, an applicant may demonstrate by tests that a maximum steady approach gradient steeper than 5.2 percent, down to the 50 foot height, is safe. The gradient must be established as an operating limitation and the information necessary to display the gradient must be available to the pilot by an appropriate instrument.
- (b) [A constant configuration must be maintained throughout the maneuver.]
- (c) The landing must be made without excessive vertical acceleration or tendency to bounce, nose over, ground loop, porpoise, or water loop.
- (d) [It must be shown that a safe transition to the balked landing conditions of Sec. 23.77 can be made from the conditions that exist at the 50-foot height, at maximum landing weight, or at the maximum landing weight for altitude and temperature of Sec. 23.63(c)(2) or (d)(2), as appropriate.
- (e) The brakes must be used so as to not cause excessive wear of brakes or tires.
- (f) Retardation means other than wheel brakes may be used if that means—
 - (1) Is safe and reliable; and
 - (2) Is used so that consistent results can be expected in service.]
- (g) If any device is used that depends on the operation of any engine, and the landing distance would be increased when a landing is made with that engine inoperative, the landing distance must be determined with that engine inoperative unless the use of other compensating means will result in a landing distance not more than that with each engine operating.

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flight with the maximum design rotor tip speed ratio. The rotor tip speed ratio is the ratio of the rotorcraft flight velocity component in the plane of the rotor disc to the rotational tip speed of the rotor blades, and is expressed as follows :

$$\mu = \frac{V \cos \alpha}{\Omega R}$$

where—

- V The airspeed along flight path (ft/s)
- α The angle between the projection, in the plane of symmetry, of the axis of no feathering and a line perpendicular to the flight path (positive when axis is pointing aft) (rad)
- Ω The angular velocity of rotor (rad/s)
- R The rotor radius (ft)

FAR 29.341 : Gust loads.

Each rotorcraft must be designed to withstand, at each critical airspeed including hovering, the loads resulting from vertical and horizontal gusts of 30 feet per second.

FAR 29.351 : Yawing conditions.

- (a) Each rotorcraft must be designed for the loads resulting from the maneuvers specified in paragraphs (b) and (c) of this section, with—
 - (1) Unbalanced aerodynamic moments about the center of gravity which the aircraft reacts to in a rational or conservative manner considering the principal masses furnishing the reacting inertia forces; and
 - (2) Maximum main rotor speed.
- (b) To produce the load required in paragraph (a) of this section, in unaccelerated flight with zero yaw, at forward speeds from zero up to $0.6 V_{NE}$ —
 - (1) [Displace the cockpit directional control suddenly to the maximum deflection limited by the control stops or by the maximum pilot force specified in Sec. 29.397(a)] ;
 - (2) Attain a resulting sideslip angle or 90°, whichever is less; and
 - (3) Return the directional control suddenly to neutral.
- (c) To produce the load required in paragraph (a) of this section, in unaccelerated flight with zero yaw, at forward speeds from $0.6 V_{NE}$ up to V_{NE} or V_{H} , whichever is less—
 - (1) [Displace the cockpit directional control suddenly to the maximum deflection limited by the control stops or by the maximum pilot force specified in Sec. 29.397(a)] ;
 - (2) Attain a resulting sideslip angle or 15°, whichever is less, at the lesser speed of V_{NE} or V_{H} ;
 - (3) Vary the sideslip angles of paragraphs (b)(2) and (c)(2) of this section directly with speed; and
 - (4) Return the directional control suddenly to neutral.

Amdt. 29-41, Eff. 11/28/97

FAR 29.309 : Design limitations.

The following values and limitations must be established to show compliance with the structural requirements of this subpart :

- (a) The design maximum and design minimum weights.
- (b) The main rotor r.p.m. ranges, power on and power off.
- (c) The maximum forward speeds for each main rotor r.p.m. within the ranges determined under paragraph (b) of this section.
- (d) The maximum rearward and sideward flight speeds.
- (e) The center of gravity limits corresponding to the limitations determined under paragraphs (b), (c), and (d) of this section.
- (f) The rotational speed ratios between each powerplant and each connected rotating component.
- (g) The positive and negative limit maneuvering load factors.

73.2 Flight Loads**FAR 29.321 : General.**

- (a) The flight load factor must be assumed to act normal to the longitudinal axis of the rotorcraft, and to be equal in magnitude and opposite in direction to the rotorcraft inertia load factor at the center of gravity.
- (b) Compliance with the flight load requirements of this subpart must be shown—
 - (1) At each weight from the design minimum weight to the design maximum weight ; and
 - (2) With any practical distribution of disposable load within the operating limitations in the Rotorcraft Flight Manual.

FAR 29.337 : Limit maneuvering load factor.

The rotorcraft must be designed for—

- (a) [A limit maneuvering load factor ranging from a positive limit of 3.5 to a negative limit of -1.0 ; or
- (b) Any positive limit maneuvering load factor not less than 2.0 and any negative limit maneuvering load factor of not less than -0.5 for which—]
 - (1) The probability of being exceeded is shown by analysis and flight tests to be extremely remote ; and
 - (2) The selected values are appropriate to each weight condition between the design maximum and design minimum weights.

Amdt. 29-30, Eff. 4/5/90

FAR 29.339 : Resultant limit maneuvering loads.

The loads resulting from the application of limit maneuvering load factors are assumed to act at the center of each rotor hub and at each auxiliary lifting surface, and to act in directions and with distributions of load among the rotors and auxiliary lifting surfaces, so as to represent each critical maneuvering condition, including power-on and power-off

FAR 23.77 : Balked landing.

- (a) [Each normal, utility, and acrobatic category reciprocating engine-powered airplane of 6,000 pounds or less maximum weight must be able to maintain a steady gradient of climb at sea level of at least 3.3 percent with—

- (1) Takeoff power on each engine ;
- (2) The landing gear extended ;
- (3) The wing flaps in the landing position, except that if the flaps may safely be retracted in two seconds or less without loss of altitude and without sudden changes of angle of attack, they may be retracted ; and
- (4) A climb speed equal to V_{REF} , as defined in Sec. 23.73(a).

- (b) Each normal, utility, and acrobatic category reciprocating engine-powered airplane of more than 6,000 pounds maximum weight and each normal, utility, and acrobatic category turbine engine-powered airplane must be able to maintain a steady gradient of climb of at least 2.5 percent with—

- (1) Not more than the power that is available on each engine eight seconds after initiation of movement of the power controls from the minimum flight idle position ;
 - (2) The landing gear extended ;
 - (3) The wing flaps in the landing position ; and
 - (4) A climb speed equal to V_{REF} , as defined in Sec. 23.73(b).
- (c) Each commuter category airplane must be able to maintain a steady gradient of climb of at least 3.2 percent with—
 - (1) Not more than the power that is available on each engine eight seconds after initiation of movement of the power controls from minimum flight idle position ;
 - (2) Landing gear extended ;
 - (3) Wing flaps in the landing position ; and
 - (4) A climb speed equal to V_{REF} , as defined in Sec. 23.73(c)]

Amdt. 23-50, Eff. 03/11/96

29.3 Flight Characteristics**FAR 23.141 : General.**

[The airplane must meet the requirements of Secs. 23.143 through 23.253 at all practical loading conditions and operating altitudes for which certification has been requested, not exceeding the maximum operating altitude established under Sec. 23.1527, and without requiring exceptional piloting skill, alertness, or strength.]

Amdt. 23-45, Eff. 09/07/93

29.4 Controllability and Maneuverability**FAR 23.143 : General.**

- (a) [The airplane must be safely controllable and maneuverable during all flight phases including—

- (1) Takeoff;
 - (2) Climb;
 - (3) Level flight;
 - (4) Descent;
 - (5) Go-around ; and
 - (6) Landing (power on and power off) with the wing flaps extended and retracted.]
- (b) It must be possible to make a smooth transition from one flight condition to another (including turns and slips) without danger of exceeding the limit load factor, under any probable operating condition, (including, for multiengine airplanes, those conditions normally encountered in the sudden failure of any engine).
- (c) [If marginal conditions exist with regard to required pilot strength, the control forces necessary must be determined by quantitative tests. In no case may the control forces under the conditions specified in paragraphs (a) and (b) of this section exceed those prescribed in the following table :

Values in pounds force applied to the relevant control	Pitch	Roll	Yaw
(a) For temporary application :			
Stick	60	30	-
Wheel (Two hands on rim)	75	50	-
Wheel (One hand on rim)	50	25	-
Rudder Pedal	-	-	150
(b) For prolonged application	10	5	20

Amdt. 23-50, Eff. 03/11/96

FAR 23.145 : Longitudinal control.

- (a) With the airplane as nearly as possible in trim at $1.3 V_{S1}$, it must be possible, at speeds below the trim speed, to pitch the nose downward so that the rate of increase in airspeed allows prompt acceleration to the trim speed with—
- (1) Maximum continuous power on each engine;
 - (2) Power off; and
 - (3) Wing flap and landing gear—
 - (i) retracted, and
 - (ii) extended.
- (b) [Unless otherwise required, it must be possible to carry out the following maneuvers without requiring the application of single-handed control forces exceeding those specified in Sec. 23.143(c). The trimming controls must not be adjusted during the maneuvers :]
- (1) With the landing gear extended, the flaps retracted, and the airplane as nearly as possible in trim at $1.4 V_{S1}$, extend the flaps as rapidly as possible and allow the airspeed to transition from $1.4 V_{S1}$ to $1.4 V_{S0}$;
 - (i) With power off ; and
 - (ii) With the power necessary to maintain level flight in the initial condition.

73.1 General

FAR 29.301 : Loads.

- (a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.
- (b) Unless otherwise provided, the specified air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the rotorcraft. These loads must be distributed to closely approximate or conservatively represent actual conditions.
- (c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

FAR 29.303 : Factor of safety.

Unless otherwise provided, a factor of safety of 1.5 must be used. This factor applies to external and inertia loads unless its application to the resulting internal stresses is more conservative.

FAR 29.305 : Strength and deformation.

- (a) The structure must be able to support limit loads without detrimental or permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation.
- (b) The structure must be able to support ultimate loads without failure. This must be shown by—
- (1) Applying ultimate loads to the structure in a static test for at least three seconds ; or
 - (2) Dynamic tests simulating actual load application.

FAR 29.307 : Proof of structure.

- (a) [Compliance with the strength and deformation requirements of this subpart must be shown for each critical loading condition accounting for the environment to which the structure will be exposed in operation. Structural analysis (static or fatigue) may be used only if the structure conforms to those structures for which experience has shown this method to be reliable. In other cases, substantiating load tests must be made.]
- (b) Proof of compliance with the strength requirements of this subpart must include—
- (1) Dynamic and endurance tests of rotors, rotor drives, and rotor controls;
 - (2) Limit load tests of the control system, including control surfaces;
 - (3) Operation tests of the control system;
 - (4) Flight stress measurement tests ;
 - (5) Landing gear drop tests ; and
 - (6) Any additional tests required for new or unusual design features.

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- (2) [With landing gear and flaps extended, power off, and the airplane as nearly as possible in trim at $1.3 V_{S0}$, quickly apply takeoff power and retract the flaps as rapidly as possible to the recommended go around setting and allow the airspeed to transition from $1.3 V_{S0}$ to $1.3 V_{S1}$. Retract the gear when a positive rate of climb is established.
- (3) With landing gear and flaps extended, in level flight, power necessary to attain level flight at $1.1 V_{S0}$, and the airplane as nearly as possible in trim, it must be possible to maintain approximately level flight while retracting the flaps as rapidly as possible with simultaneous application of not more than maximum continuous power. If gated flap positions are provided, the flap retraction may be demonstrated in stages with power and trim reset for level flight at $1.1 V_{S1}$, in the initial configuration for each stage—
- (i) From the fully extended position to the most extended gated position ;
 - (ii) Between intermediate gated positions, if applicable; and
 - (iii) From the least extended gated position to the fully retracted position.
- (4) With power off, flaps and landing gear retracted and the airplane as nearly as possible in trim at $1.4 V_{S1}$, apply takeoff power rapidly while maintaining the same airspeed.
- (5) With power off, landing gear and flaps extended, and the airplane as nearly as possible in trim at $1.4 V_{REF}$, obtain and maintain airspeeds between $1.1 V_{S0}$ and either $1.7 V_{S0}$ or V_{FE} , whichever is lower without requiring the application of two-handed contact forces exceeding those specified in Sec. 23.143(c).
- (6) With maximum takeoff power, landing gear retracted, flaps in the takeoff position, and the airplane as nearly as possible in trim at V_{FE} appropriate to the takeoff flap position, retract the flaps as rapidly as possible while maintaining constant speed.
- (c) At speeds above V_{MO}/M_{MO} , and up to the maximum speed shown under Sec. 23.251, a maneuvering capability of $1.5g$ must be demonstrated to provide a margin to recover from upset or inadvertent speed increase.
- (d) It must be possible, with a pilot control force of not more than 10 pounds, to maintain a speed of not more than V_{FE} during a power-off glide with landing gear and wing flaps extended, for any weight of the airplane, up to and including the maximum weight.]
- (e) By using normal flight and power controls, except as otherwise noted in paragraphs (e)(1) and (e)(2) of this section, it must be possible to establish a zero rate of descent at an attitude suitable for a controlled landing without exceeding the operational and structural limitations of the airplane, as follows :
- (1) For single-engine and multiengine airplanes, without the use of the primary longitudinal control system.
 - (2) For multiengine airplanes—
 - (i) Without the use of the primary directional control; and
 - (ii) If a single failure of any one connecting or transmitting link would affect both the longitudinal and directional primary control system, without the primary longitudinal and directional control system.

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FAR 23.147 : Directional and lateral control.

- (a) [For each multiengine airplane, it must be possible, while holding the wings level within 5 degrees, to make sudden changes in heading safely in both directions. This ability must be shown at 1.4 V_{S1} with heading changes up to 15 degrees (except that the heading change at which the rudder force corresponds to the limits specified in Sec. 23.143 need not be exceeded), with the—
- (1) Critical engine inoperative and its propeller in the minimum drag position;
 - (2) Remaining engines at maximum continuous power;
 - (3) Landing gear—
 - (i) Retracted, and
 - (ii) Extended;
 - (4) Flaps retracted.
- (b) For each multiengine airplane, it must be possible to regain full control of the airplane without exceeding a bank angle of 45 degrees, reaching a dangerous attitude or encountering dangerous characteristics, in the event of a sudden and complete failure of the critical engine, making allowance for a delay of two seconds in the initiation of recovery action appropriate to the situation, with the airplane initially in trim, in the following conditions :
- (1) Maximum continuous power on each engine;
 - (2) The wing flaps retracted;
 - (3) The landing gear retracted;
 - (4) A speed equal to that at which compliance with Sec. 23.69(a) has been shown; and
 - (5) All propeller controls in the position at which compliance with Sec. 23.69(a) has been shown.
- (c) For all airplanes, it must be shown that the airplane is safely controllable without the use of the primary lateral control system in any all-engine configuration(s) and at any speed or altitude within the approved operating envelope. It must also be shown that the airplane's flight characteristics are not impaired below a level needed to permit continued safe flight and the ability to maintain attitudes suitable for a controlled landing without exceeding the operational and structural limitations of the airplane. If a single failure of any one connecting or transmitting link in the lateral control system would also cause the loss of additional control system(s), compliance with the above requirement must be shown with those additional systems also assumed to be inoperative.]
- Amdt. 23-50, Eff. 3/11/96
- FAR 23.149 : Minimum control speed.**
- (a) [V_{MC} is the calibrated airspeed at which, when the critical engine is suddenly made inoperative, it is possible to maintain control of the airplane with that engine still inoperative, and thereafter maintain straight flight at the same speed with an angle of bank of not more than 5 degrees. The method used to simulate critical engine failure must represent the most critical mode of powerplant failure expected in service with respect to controllability.]

Chapitre 73

Subpart C : Strength Requirements

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72.5 Miscellaneous Flight Requirements

FAR 29.251 : Vibration.

Each part of the rotorcraft must be free from excessive vibration under each appropriate speed and power condition.

- (b) V_{MC} for takeoff must not exceed $1.2 V_{S1}$, where V_{S1} is determined at the maximum takeoff weight. V_{MC} must be determined with the most unfavorable weight and center of gravity position and with the airplane airborne and the ground effect negligible, for the takeoff configuration(s) with—
- (1) Maximum available takeoff power initially on each engine;
 - (2) The airplane trimmed for takeoff;
 - (3) Flaps in the takeoff position(s);
 - (4) Landing gear retracted; and
 - (5) All propeller controls in the recommended takeoff position throughout.
- (c) For all airplanes except reciprocating engine-powered airplanes of 6,000 pounds or less maximum weight, the conditions of paragraph (a) of this section must also be met for the landing configuration with—
- (1) Maximum available takeoff power initially on each engine;
 - (2) The airplane trimmed for an approach, with all engines operating, at V_{REF} , at an approach gradient equal to the steepest used in the landing distance demonstration of Sec. 23.75;
 - (3) Flaps in the landing position;
 - (4) Landing gear extended; and
 - (5) All propeller controls in the position recommended for approach with all engines operating.
- (d) A minimum speed to intentionally render the critical engine inoperative must be established and designated as the safe, intentional, one-engine-inoperative speed, V_{SEP} .
- (e) At V_{MC} , the rudder pedal force required to maintain control must not exceed 150 pounds and it must not be necessary to reduce power of the operative engine(s). During the maneuver, the airplane must not assume any dangerous attitude and it must be possible to prevent a heading change of more than 20° .
- (f) At the option of the applicant, to comply with the requirements of Sec. 23.51(c)(1), V_{MCG} may be determined. V_{MCG} is the minimum control speed on the ground, and is the calibrated airspeed during the takeoff run at which, when the critical engine is suddenly made inoperative, it is possible to maintain control of the airplane using the rudder control alone (without the use of nosewheel steering), as limited by 150 pounds of force, and using the lateral control to the extent of keeping the wings level to enable the takeoff to be safely continued. In the determination of V_{MCG} , assuming that the path of the airplane accelerating with all engines operating is along the centerline of the runway, its path from the point at which the critical engine is made inoperative to the point at which recovery to a direction parallel to the centerline is completed may not deviate more than 30 feet laterally from the centerline at any point. V_{MCG} must be established with—
- (1) The airplane in each takeoff configuration or, at the option of the applicant, in the most critical takeoff configuration;
 - (2) Maximum available takeoff power on the operating engines;
 - (3) The most unfavorable center of gravity;
 - (4) The airplane trimmed for takeoff; and
 - (5) The most unfavorable weight in the range of takeoff weights.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.151 : Acrobatic maneuvers.

Each acrobatic and utility category airplane must be able to perform safely the acrobatic maneuvers for which certification is requested. Safe entry speeds for these maneuvers must be determined.

FAR 23.153 : Control during landings.

[It must be possible, while in the landing configuration, to safely complete a landing without exceeding the one-hand control force limits specified in Sec. 23.143(c) following an approach to land—

- (a) At a speed of V_{REF} minus 5 knots;
 - (b) With the airplane in trim, or as nearly as possible in trim and without the trimming control being moved throughout the maneuver;
 - (c) At an approach gradient equal to the steepest used in the landing distance demonstration of Sec. 23.75; and
 - (d) With only those power changes, if any, that would be made when landing normally from an approach at V_{REF} .]
- Amdt. 23-50, Eff. 03/11/96

FAR 23.155 : Elevator control force in maneuvers.

- (a) The elevator control force needed to achieve the positive limit maneuvering load factor may not be less than—
 - (1) For wheel controls, $\frac{W}{100}$ (where W is the maximum weight) or 20 pounds, whichever is greater, except that it need not be greater than 50 pounds; or
 - (2) For stick controls, $\frac{W}{150}$ (where W is the maximum weight) or 15 pounds, whichever is greater, except that it need not be greater than 35 pounds.
 - (b) [The requirement of paragraph (a) of this section must be met at 75 percent of maximum continuous power for reciprocating engines, or the maximum continuous power for turbine engines, and with the wing flaps and landing gear retracted—
 - (1) In a turn, with the trim setting used for wings level flight at V_O ; and]
 - (2) In a turn with the trim setting used for the maximum wings level flight speed, except that the speed may not exceed V_{NE} or V_{MO}/M_{MO} , whichever is appropriate.
 - (c) [There must be no excessive decrease in the gradient of the curve of stick force versus maneuvering load factor with increasing load factor.]
- Amdt. 23-50, Eff. 03/11/96

FAR 23.157 : Rate of roll.

- (a) *Takeoff.* It must be possible, using a favorable combination of controls, to roll the airplane from a steady 30° banked turn through an angle of 60°, so as to reverse the direction of the turn within—
 - (1) For an airplane of 6,000 pounds or less maximum weight, 5 seconds from initiation of roll; and
 - (2) For an airplane of over 6,000 pounds maximum weight, $\frac{W+600}{1300}$ seconds, but not more than 10 seconds, where W is the weight in pounds.

- (2) Critical center of gravity;
- (3) Power required to maintain an approximate constant height in ground effect;
- (4) The landing gear extended; and
- (5) The helicopter trimmed for hovering.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.177 : [Static directional stability.]

[Static directional stability must be positive with throttle and collective controls held constant at the trim conditions specified in Sec. 29.175(a), (b), and (c). Sideslip angle must increase steadily with directional control deflection for sideslip angles up to $\pm 10^\circ$ from trim. Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.181 : [Dynamic stability : category A rotorcraft.]

[Any short-period oscillation occurring at any speed from V_Y to V_{NE} must be positively damped with the primary flight controls free and in a fixed position.]

Amdt. 29-24, Eff. 12/6/84

72.4 Ground and Water Handling Characteristics**FAR 29.231 : General.**

The rotorcraft must have satisfactory ground and water handling characteristics, including freedom from uncontrollable tendencies in any condition expected in operation.

FAR 29.235 : Taxing condition.

The rotorcraft must be designed to withstand the loads that would occur when the rotorcraft is taxied over the roughest ground that may reasonably be expected in normal operation.

FAR 29.239 : Spray characteristics.

If certification for water operation is requested, no spray characteristics during taxiing, takeoff, or landing may obscure the vision of the pilot or damage the rotors, propellers, or other parts of the rotorcraft.

FAR 29.241 : Ground resonance.

The rotorcraft may have no dangerous tendency to oscillate on the ground with the rotor turning.

- (b) With the throttle and collective pitch held constant during the maneuvers specified in Sec. 29.175(a) through (c), the slope of the control position versus speed curve must be positive throughout the full range of altitude for which certification is requested.
- (c) During the maneuver specified in Sec. 29.175(d), the longitudinal control position versus speed curve may have a negative slope within the specified speed range if the negative motion is not greater than 10 percent of total control travel.

Amdt. 29-24, Eff. 12/6/84

FAR 29.175 : Demonstration of static longitudinal stability.

- (a) [*Climb*. Static longitudinal stability must be shown in the climb condition at speeds from 0.85 V_Y or 15 knots below V_Y , whichever is less, to 1.2 V_Y or 15 knots above V_Y , whichever is greater, with—]
- (1) Critical weight ;
 - (2) Critical center of gravity ;
 - (3) Maximum continuous power ;
 - (4) The landing gear retracted ; and
 - (5) The rotorcraft trimmed at V_Y .
- (b) [*Cruise*. Static longitudinal stability must be shown in the cruise condition at speeds from 0.7 V_H or 0.7 V_{NE} , whichever is less to 1.1 V_H or 1.1 V_{NE} , whichever is less, with—]
- (1) Critical weight ;
 - (2) Critical center of gravity ;
 - (3) Power for level flight at 0.9 V_H or 0.9 V_{NE} , whichever is less ;
 - (4) The landing gear retracted ; and
 - (5) The rotorcraft trimmed at 0.9 V_H or 0.9 V_{NE} , whichever is less.

- (c) [*Autorotation*. Static longitudinal stability must be shown in autorotation at airspeeds from 0.5 times the speed for minimum rate of descent, or 0.5 times the maximum range glide speed for Category A rotorcraft, to V_{NE} or to 1.1 V_{NE} (power-off) if V_{NE} (power-off) is established under Sec. 29.1505(c), and with—]

- (1) Critical weight ;
- (2) Critical center of gravity ;
- (3) Power off ;
- (4) The landing gear—
 - (i) Retracted ;
 - (ii) Extended ; and

- (5) The rotorcraft trimmed at appropriate speeds found necessary by the Administrator to demonstrate stability throughout the prescribed speed range.

- (d) [*Hovering*. For helicopters, the longitudinal cyclic control must operate with the sense, direction of motion, and position as prescribed in Sec. 29.173 between the maximum approved rearward speed and a forward speed of 17 knots with—]

- (1) Critical weight ;

- (b) The requirement of paragraph (a) of this section must be met when rolling the airplane in each direction with—

- (1) Flaps in the takeoff position ;
 - (2) Landing gear retracted ;
 - (3) For a single-engine airplane, at maximum takeoff power ; and for a multiengine airplane with the critical engine inoperative and the propeller in the minimum drag position, and the other engines at maximum takeoff power ; and
 - (4) The airplane trimmed at a speed equal to the greater of 1.2 V_{S1} or 1.1 V_{MC} , or as nearly as possible in trim for straight flight.
- (c) *Approach*. It must be possible, using a favorable combination of controls, to roll the airplane from a steady 30° banked turn through an angle of 60°, so as to reverse the direction of the turn within :
- (1) For an airplane of 6,000 pounds or less maximum weight, 4 seconds from initiation of roll ; and
 - (2) For an airplane of over 6,000 pounds maximum weight, $\frac{W+2800}{2200}$ seconds, but not more than 7 seconds, where W is the weight in pounds.
- (d) [The requirement of paragraph (c) of this section must be met when rolling the airplane in each direction in the following conditions—]
- (1) Flaps in the landing position(s) ;
 - (2) Landing gear extended ;
 - (3) All engines operating at the power for a 3 degree approach ; and
 - (4) The airplane trimmed at V_{REF} .]

Amdt. 23-50, Eff. 03/11/96

29.5 trim

FAR 23.161 : Trim.

- (a) *General*. [Each airplane must meet the trim requirements of this section after being trimmed and without further pressure upon, or movement of, the primary controls or their corresponding trim controls by the pilot or the automatic pilot. In addition, it must be possible, in other conditions of loading, configuration, speed and power to ensure that the pilot will not be unduly fatigued or distracted by the need to apply residual control forces exceeding those for prolonged application of Sec. 23.143(c). This applies in normal operation of the airplane and, if applicable, to those conditions associated with the failure of one engine for which performance characteristics are established.]

- (b) *Lateral and directional trim*. The airplane must maintain lateral and directional trim in level flight with the landing gear and wing flaps retracted as follows :

- (1) [For normal, utility and acrobatic category airplanes, at a speed of 0.9 V_H , V_C , or V_{MO}/M_{MO} , whichever is lowest ; and
 - (2) For commuter category airplanes, at all speeds from 1.4 V_{S1} to the lesser of V_H or V_{MO}/M_{MO} .
- (c) *Longitudinal trim*. The airplane must maintain longitudinal trim under each of the following conditions :

- (1) A climb with—
 - (i) Takeoff power, landing gear retracted, wing flaps in the takeoff position(s), at the speeds used in determining the climb performance required by Sec. 23.65; and
 - (ii) Maximum continuous power at the speeds and in the configuration used in determining the climb performance required by Sec. 23.69(a).
- (2) Level flight at all speeds from the lesser of V_H and either V_{NO} or V_{MO}/M_{MO} (as appropriate), to $1.4 V_{S1}$, with the landing gear and flaps retracted.
- (3) A descent at V_{NO} or V_{MO}/M_{MO} , whichever is applicable, with power off and with the landing gear and flaps retracted.
- (4) Approach with landing gear extended and with—
 - (i) A 3 degree angle of descent, with flaps retracted and at a speed of $1.4 V_{S1}$;
 - (ii) A 3 degree angle of descent, flaps in the landing position(s) at V_{REF} ; and
 - (iii) An approach gradient equal to the steepest used in the landing distance demonstrations of Sec. 23.75, flaps in the landing position(s) at V_{REF} .
- (d) In addition, each multiengine airplane must maintain longitudinal and directional trim, and the lateral control force must not exceed 5 pounds at the speed used in complying with Sec. 23.67(a), (b)(2), or (c)(3), as appropriate, with—
 - (1) The critical engine inoperative, and if applicable, its propeller in the minimum drag position;
 - (2) The remaining engines at maximum continuous power;
 - (3) The landing gear retracted;
 - (4) [Wing flaps retracted; and]
 - (5) An angle of bank of not more than 5°.
- (e) [In addition, each commuter category airplane for which, in the determination of the takeoff path in accordance with Sec. 23.57, the climb in the takeoff configuration at V_2 extends beyond 400 feet above the takeoff surface, it must be possible to reduce the longitudinal and lateral control forces to 10 pounds and 5 pounds, respectively, and the directional control force must not exceed 50 pounds at V_2 with—
 - (1) The critical engine inoperative and its propeller in the minimum drag position;
 - (2) The remaining engine(s) at takeoff power;
 - (3) Landing gear retracted;
 - (4) Wing flaps in the takeoff position(s); and
 - (5) An angle of bank not exceeding 5°.]

Amdt. 23-50, EFF. 03/11/96

29.6 Stability

FAR 23.171 : General.

The airplane must be longitudinally, directionally, and laterally stable under Secs. 23.173 through 23.181. In addition, the airplane must show suitable stability and control "feel" (static stability) in any condition normally encountered in service, if flight tests show it is necessary for safe operation.

- (d) The rotorcraft, after (1) failure of one engine, in the case of multiengine rotorcraft that meet transport category A engine isolation requirements, or (2) complete power failure in the case of other rotorcraft, must be controllable over the range of speeds and altitudes for which certification is requested when such power failures occur with maximum continuous power and critical weight. No corrective action time delay for any condition following power failure may be less than—
 - (i) For the cruise condition, one second, or normal pilot reaction time (whichever is greater); and
 - (ii) For any other condition, normal pilot reaction time.
- (e) For helicopters for which a V_{NE} (power-off) is established under Sec. 29.1505(c), compliance must be demonstrated with the following requirements with critical weight, critical center of gravity, and critical rotor r.p.m. :
 - (1) The helicopter must be safely slowed to V_{NE} (power-off), without exceptional pilot skill after the last operating engine is made inoperative at power-on V_{NE} .
 - (2) At a speed of $1.1 V_{NE}$ (power-off), the margin of cyclic control must allow satisfactory roll and pitch control with power off.

Amdt. 29-24, EFF. 12/6/84

FAR 29.151 : Flight controls.

- (a) [Longitudinal, lateral, directional, and collective controls may not exhibit excessive breakout force, friction, or preload.
- (b) Control system forces and free play may not inhibit a smooth, direct rotorcraft response to control system input.]

Amdt. 29-24, EFF. 12/6/84

FAR 29.161 : Trim control.

- The trim control—
 - (a) [Must trim any steady longitudinal, lateral, and collective control forces to zero in level flight at any appropriate speed; and]
 - (b) May not introduce any undesirable discontinuities in control force gradients.

Amdt. 29-24, EFF. 12/6/84

FAR 29.171 : Stability : general.

The rotorcraft must be able to be flown, without undue pilot fatigue or strain, in any normal maneuver for a period of time as long as that expected in normal operation. At least three landings and takeoffs must be made during this demonstration.

FAR 29.173 : Static longitudinal stability.

- (a) [The longitudinal control must be designed so that a rearward movement of the control is necessary to obtain a speed less than the trim speed, and a forward movement of the control is necessary to obtain a speed more than the trim speed.

- (3) For power-on operations, under any condition of speed, power, and rotor r.p.m. for which certification is requested; and
- (4) For power-off operations, under any condition of speed and rotor r.p.m. for which certification is requested that is attainable with the controls rigged in accordance with the approved rigging instructions and tolerances;
- (b) Be able to maintain any required flight condition and make a smooth transition from any flight condition to any other flight condition without exceptional piloting skill, alertness, or strength, and without danger of exceeding the limit load factor under any operating condition probable for the type, including—
- (1) Sudden failure of one engine, for multiengine rotorcraft meeting transport category A engine isolation requirements;
 - (2) Sudden, complete power failure, for other rotorcraft; and
 - (3) Sudden, complete control system failures specified in Sec. 29.695 of this Part; and
- (c) Have any additional characteristics required for night or instrument operation, if certification for those kinds of operation is requested. Requirements for helicopter instrument flight are contained in Appendix B of this Part.
- Amdt. 29-24, Eff. 12/6/84

FAR 29.143 : Controllability and maneuverability.

- (a) The rotorcraft must be safely controllable and maneuverable—
- (1) During steady flight; and
 - (2) During any maneuver appropriate to the type, including—
 - (i) Takeoff;
 - (ii) Climb;
 - (iii) Level flight;
 - (iv) Turning flight;
 - (v) Glide; and
 - (vi) Landing (power on and power off).
- (b) The margin of cyclic control must allow satisfactory roll and pitch control at V_{NE} with—
- (1) Critical weight;
 - (2) Critical center of gravity;
 - (3) Critical rotor r.p.m.; and
 - (4) Power off (except for helicopters demonstrating compliance with paragraph (e) of this section) and power on.
- (c) A wind velocity of not less than 17 knots must be established in which the rotorcraft can be operated without loss of control on or near the ground in any manner appropriate to the type (such as crosswind takeoffs, sideward flight, and rearward flight), with—
- (1) [Critical weight;
 - (2) Critical center of gravity; and
 - (3) Critical motor r.p.m.]

FAR 23.173 : Static longitudinal stability.

Under the conditions specified in Sec. 23.175 and with the airplane trimmed as indicated, the characteristics of the elevator control forces and the friction within the control system must be as follows :

- (a) A pull must be required to obtain and maintain speeds below the specified trim speed and a push required to obtain and maintain speeds above the specified trim speed. This must be shown at any speed that can be obtained, except that speeds requiring a control force in excess of 40 pounds or speeds above the maximum allowable speed or below the minimum speed for steady uninstalled flight, need not be considered.
 - (b) The airspeed must return to within the tolerances specified for applicable categories of airplanes when the control force is slowly released at any speed within the speed range specified in paragraph (a) of this section. The applicable tolerances are—
 - (1) The airspeed must return to within plus or minus 10 percent of the original trim airspeed; and
 - (2) For commuter category airplanes, the airspeed must return to within plus or minus 7.5 percent of the original trim airspeed for the cruising condition specified in Sec. 23.175(b).]
 - (c) The stick force must vary with speed so that any substantial speed change results in a stick force clearly perceptible to the pilot.
- Amdt. 23-34, Eff. 02/17/87

FAR 23.175 : Demonstration of static longitudinal stability.

- (a) [*Climb*. The stick force curve must have a stable slope at speeds between 85 and 115 percent of the trim speed, with—
 - (1) Flaps retracted;
 - (2) Landing gear retracted;
 - (3) Maximum continuous power; and
 - (4) The airplane trimmed at the speed used in determining the climb performance required by Sec. 23.69(a).
- (b) *Cruise*. With flaps and landing gear retracted and the airplane in trim with power for level flight at representative cruising speeds at high and low altitudes, including speeds up to V_{NO} or V_{MO}/M_{MO} as appropriate, except that the speed need not exceed V_H —
 - (1) For normal, utility, and acrobatic category airplanes, the stick force curve must have a stable slope at all speeds within a range that is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 40 knots plus the resulting free return speed range, above and below the trim speed, except that the slope need not be stable—
 - (i) At speeds less than $1.3 V_{S1}$; or
 - (ii) For airplanes with V_{NE} established under Sec. 23.1505(a), at speeds greater than V_{NE} ; or
 - (iii) For airplanes with V_{MO}/M_{MO} established under Sec. 23.1505(c), at speeds greater than V_{FC}/M_{FC} .

- (2) For commuter category airplanes, the stick force curve must have a stable slope at all speeds within a range of 50 knots plus the resulting free return speed range, above and below the trim speed, except that the slope need not be stable—

- (i) At speeds less than $1.4 V_{S1}$; or
- (ii) At speeds greater than V_{FC}/M_{FC} ; or
- (iii) At speeds that require a stick force greater than 50 pounds.

- (c) *Landing.* The stick force curve must have a stable slope at speeds between $1.1 V_{S1}$ and $1.8 V_{S1}$ with—

- (1) Flaps in the landing position;
- (2) Landing gear extended; and
- (3) The airplane trimmed at—
 - (i) V_{HEF} , or the minimum trim speed if higher, with power off; and
 - (ii) V_{HEF} with enough power to maintain a 3 degree angle of descent.]

Amdt. 23-50, Eff. 3/11/96

FAR 23.177 : Static directional and lateral stability.

- (a) [The static directional stability, as shown by the tendency to recover from a wings level sideslip with the rudder free, must be positive for any landing gear and flap position appropriate to the takeoff, climb, cruise, approach, and landing configurations. This must be shown with symmetrical power up to maximum continuous power, and at speeds from $1.2 V_{S1}$ up to the maximum allowable speed for the condition being investigated. The angle of sideslip for these tests must be appropriate to the type of airplane. At larger angles of sideslip, up to that at which full rudder is used or a control force limit in Sec. 23.143 is reached, whichever occurs first, and at speeds from $1.2 V_{S1}$ to V_O , the rudder pedal force must not reverse.

- (b) The static lateral stability, as shown by the tendency to raise the low wing in a sideslip, must be positive for all landing gear and flap positions. This must be shown with symmetrical power up to 75 percent of maximum continuous power at speeds above $1.2 V_{S1}$ in the takeoff configuration(s) and at speeds above $1.3 V_{S1}$ in other configurations, up to the maximum allowable speed for the configuration being investigated, in the takeoff, climb, cruise, and approach configurations. For the landing configuration, the power must be that necessary to maintain a 3 degree angle of descent in coordinated flight. The static lateral stability must not be negative at $1.2 V_{S1}$ in the takeoff configuration, or at $1.3 V_{S1}$ in other configurations. The angle of sideslip for these tests must be appropriate to the type of airplane, but in no case may the constant heading sideslip angle be less than that obtainable with a 10 degree bank, or if less, the maximum bank angle obtainable with full rudder deflection or 150 pound rudder force.

- (c) Paragraph (b) of this section does not apply to acrobatic category airplanes certified for inverted flight.

- (d) In straight, steady slips at $1.2 V_{S1}$ for any landing gear and flap positions, and for any symmetrical power conditions up to 50 percent of maximum continuous power, the aileron and rudder control movements and forces must increase steadily, but not necessarily in constant proportion, as the angle of sideslip is increased up to

- (c) It must be possible to make a safe landing on a prepared landing surface if complete power failure occurs during normal cruise.]

Amdt. 29-39, Eff. 6/10/96

FAR 29.85 : Balked landing : Category A.

[For Category A rotorcraft, the balked landing path with the critical engine inoperative must be established so that—

- (a) The transition from each stage of the maneuver to the next stage can be made smoothly and safely;
- (b) From the LDP on the approach path selected by the applicant, a safe climbout can be made at speeds allowing compliance with the climb requirements of Sec. 29.67(a)(1) and (2); and

- (c) The rotorcraft does not descend below 15 feet above the landing surface. For elevated heliport operations, descent may be below the level of the landing surface provided the deck edge clearance of Sec. 29.60 is maintained and the descent (loss of height) below the landing surface is determined.]

Amdt. 29-44, Eff. 11/17/99

FAR 29.87 : [Height-velocity envelope.]

- (a) [If there is any combination of height and forward velocity (including hover) under which a safe landing cannot be made after failure of the critical engine and with the remaining engines (where applicable) operating within approved limits, a height-velocity envelope must be established for—

- (1) All combinations of pressure altitude and ambient temperature for which takeoff and landing are approved; and
- (2) Weight from the maximum weight (at sea level) to the highest weight approved for takeoff and landing at each altitude. For helicopters, this weight need not exceed the highest weight allowing hovering out-of-ground effect at each altitude.

- (b) For single-engine or multiengine rotorcraft that do not meet the Category A engine isolation requirements, the height-velocity envelope for complete power failure must be established.]

Amdt. 29-39, Eff. 6/10/96

72.3 Flight Characteristics

FAR 29.141 : General.

The rotorcraft must—

- (a) [Except as specifically required in the applicable section, meet the flight characteristics requirements of this subpart—
 - (1) At the approved operating altitudes and temperatures;]
 - (2) Under any critical loading condition within the range of weights and centers of gravity for which certification is requested; and

FAR 29.77 : Landing Decision Point (LDP) : Category A.

- (a) [The LDP is the last point in the approach and landing path from which a balked landing can be accomplished in accordance with Sec. 29.85.
- (b) Determination of the LDP must include the pilot recognition time interval following failure of the critical engine.]

Amdt. 29-44, Eff. 11/17/99

FAR 29.79 : [Landing : Category A.]

- (a) [For Category A rotorcraft—

- (1) The landing performance must be determined and scheduled so that if the critical engine fails at any point in the approach path, the rotorcraft can either land and stop safely or climb out and attain a rotorcraft configuration and speed allowing compliance with the climb requirement of Sec. 29.67(a)(2) ;
 - (2) The approach and landing paths must be established with the critical engine inoperative so that the transition between each stage can be made smoothly and safely ;
 - (3) The approach and landing speeds must be selected by the applicant and must be appropriate to the type of rotorcraft ; and
 - (4) The approach and landing path must be established to avoid the critical areas of the height-velocity envelope determined in accordance with Sec. 29.87.
- (b) It must be possible to make a safe landing on a prepared landing surface after complete power failure occurring during normal cruise.]

Amdt. 29-39, Eff. 6/10/96

FAR 29.81 : Landing distance : Category A.

[The horizontal distance required to land and come to a complete stop (or to a speed of approximately 3 knots for water landings) from a point 50 ft above the landing surface must be determined from the approach and landing paths established in accordance with Sec. 29.79.]

Amdt. 29-44, Eff. 11/17/99

FAR 29.83 : [Landing : Category B.]

- (a) [For each Category B rotorcraft, the horizontal distance required to land and come to a complete stop (or to a speed of approximately 3 knots for water landings) from a point 50 feet above the landing surface must be determined with—
- (1) Speeds appropriate to the type of rotorcraft and chosen by the applicant to avoid the critical areas of the height-velocity envelope established under Sec. 29.87 ; and
 - (2) The approach and landing made with power on and within approved limits.
- (b) Each multiengine Category B rotorcraft that meets the powerplant installation requirements for Category A must meet the requirements of—
- (1) Sections 29.79 and 29.81 ; or
 - (2) Paragraph (a) of this section.

the maximum appropriate to the type of airplane. At larger slip angles, up to the angle at which the full rudder or aileron control is used or a control force limit contained in Sec. 23.143 is reached, the aileron and rudder control movements and forces must not reverse as the angle of sideslip is increased. Rapid entry into, and recovery from, a maximum sideslip considered appropriate for the airplane must not result in uncontrollable flight characteristics.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.179 : Instrumented stick force measurements.

[Removed.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.181 : Dynamic stability.

- (a) Any short period oscillation not including combined lateral-directional oscillations occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the airplane must be heavily damped with primary controls—
- (1) Free ; and
 - (2) In a fixed position.
- (b) Any combined lateral-directional oscillations ("Dutch roll") occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the airplane must be damped to $\frac{1}{10}$ amplitude in 7 cycles with the primary controls—
- (1) Free ; and
 - (2) In a fixed position.
- (c) [If it is determined that the function of a stability augmentation system, reference Sec. 23.672, is needed to meet the flight characteristic requirements of this part, the primary control requirements of paragraphs (a)(2) and (b)(2) of this section are not applicable to the tests needed to verify the acceptability of that system.
- (d) During the conditions as specified in Sec. 23.175, when the longitudinal control force required to maintain speeds differing from the trim speed by at least ± 15 percent is suddenly released, the response of the airplane must not exhibit any dangerous characteristics nor be excessive in relation to the magnitude of the control force released. Any long-period oscillation of flight path, phugoid oscillation, that results must not be so unstable as to increase the pilot's workload or otherwise endanger the airplane.]

Amdt. 23-45, Eff. 09/07/93

29.7 Stalls**FAR 23.201 : Wings level stall.**

- (a) [It must be possible to produce and to correct roll by unreversed use of the rolling control and to produce and to correct yaw by unreversed use of the directional control, up to the time the airplane stalls.

- (b) The wings level stall characteristics must be demonstrated in flight as follows. Starting from a speed at least 10 knots above the stall speed, the elevator control must be pulled back so that the rate of speed reduction will not exceed one knot per second until a stall is produced, as shown by either :
- (1) An uncontrollable downward pitching motion of the airplane ;
 - (2) A downward pitching motion of the airplane that results from the activation of a stall avoidance device (for example, stick pusher) ; or
 - (3) The control reaching the stop.
- (c) Normal use of elevator control for recovery is allowed after the downward pitching motion of paragraphs (b)(1) or (b)(2) of this section has unmistakably been produced, of after the control has been held against the stop for not less than the longer of two seconds or the time employed in the minimum steady slight speed determination of Sec. 23.49.
- (d) During the entry into and the recovery from the maneuver, it must be possible to prevent more than 15 degrees of roll or yaw by the normal use of controls.
- (e) Compliance with the requirements of this section must be shown under the following conditions :
- (1) *Wing Flaps* : Retracted, fully extended, and each intermediate normal operating position.
 - (2) *Landing Gear* : Retracted and extended.
 - (3) *Cowl Flaps* : Appropriate to configuration.
 - (4) *Power* :
 - (i) Power off ; and
 - (ii) 75 percent maximum continuous power. However, if the power-to-weight ratio at 75 percent of maximum continuous power result in extreme nose-high attitudes, the test may be carried out with the power required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 V_{50} , except that the power may not be less than 50 percent of maximum continuous power.
 - (5) *Trim* : The airplane trimmed at a speed as near 1.5 V_{S1} as practicable.
 - (6) *Propeller* : Full increase r.p.m. position for the power off condition.]
- Amdt. 23-50, Eff. 03/11/96

FAR 23.203 : Turning flight and accelerated turning stalls.

- [Turning flight and accelerated turning stalls must be demonstrated in tests as follows :
- (a) Establish and maintain a coordinated turn in a 30° bank. Reduce speed by steadily and progressively tightening the turn with the elevator until the airplane is stalled, as defined in Sec. 23.201(b). The rate of speed reduction must be constant, and—
 - (1) For a turning flight stall, may not exceed one knot per second ; and
 - (2) For an accelerated turning stall, be 3 to 5 knots per second with steadily increasing normal acceleration.
 - (b) After the airplane has stalled, as defined in Sec. 23.201(b), it must be possible to regain wings level flight by normal use of the flight controls, but without increasing power and without—]

- (iii) The speed selected by the applicant.
- (b) [For multiengine Category B rotorcraft meeting the Category A engine isolation requirements, the steady rate of climb (or descent) must be determined at the speed for best rate of climb (or minimum rate of descent) at each altitude, temperature, and weight at which the rotorcraft is expected to operate, with the critical engine inoperative and the remaining engines at maximum continuous power including continuous OEI power, if approved, and at 30-minute OEI power for rotorcraft for which certification for the use of 30-minute OEI power is requested]
- Amdt. 29-44, Eff. 11/17/99
- FAR 29.71 : Helicopter angle of glide : Category B.**
- [For each category B helicopter, except multiengine helicopters meeting the requirements of Sec. 29.67(b) and the powerplant installation requirements of category A, the steady angle of glide must be determined in autorotation—
- (a) At the forward speed for minimum rate of descent as selected by the applicant ;
 - (b) At the forward speed for best glide angle ;
 - (c) At maximum weight ; and
 - (d) At the rotor speed or speeds selected by the applicant.]
- Amdt. 29-12, Eff. 2/1/77

FAR 29.73 : [Redesignated.]

Section 29.73 is redesignated as Sec. 29.49. The section number "29.73" is no longer used in Part 29.

Amdt. 29-39, Eff. 6/10/96

FAR 29.75 : Landing : [general.]

- (a) [For each rotorcraft—
- (1) The corrected landing data must be determined for a smooth, dry, hard, and level surface ;
 - (2) The approach and landing must not require exceptional piloting skill or exceptionally favorable conditions ; and
 - (3) The landing must be made without excessive vertical acceleration or tendency to bounce, nose over, ground loop, portpoise, or water loop.
- (b) The landing data required by Secs. 29.77, 29.79, 29.81, 29.83, and 29.85 must be determined—
- (1) At each weight, altitude, and temperature for which landing data are approved ;
 - (2) With each operating engine within approved operating limitations ; and
 - (3) With the most unfavorable center of gravity.]

Amdt. 29-39, Eff. 6/10/96

FAR 29.65 : Climb : all engines operating.

- (a) [The steady rate of climb must be determined—
- (1) With maximum continuous power ;
 - (2) With the landing gear retracted ; and
 - (3) At V_Y for standard sea level conditions and at speeds selected by the applicant for other conditions.]
- (b) For each category B rotorcraft except helicopters, the rate of climb determined under paragraph (a) of this section must provide a steady climb gradient of at least 1 : 6 under standard sea level conditions.
- (c) [[Removed.]]

Amdt. 29-39, Eff. 6/10/96

FAR 29.67 : Climb : One-engine-inoperative (OEI).

- (a) For Category A rotorcraft, in the critical takeoff configuration existing along the takeoff path, the following apply :
- (1) The steady rate of climb without ground effect, 200 feet above the takeoff surface, must be at least 100 feet per minute for each weight, altitude, and temperature for which takeoff data are to be scheduled with—
 - (i) The critical engine inoperative and the remaining engines within approved operating limitations, except that for rotorcraft for which the use of 30-second/2-minute OEI power is requested, only the 2-minute OEI power may be used in showing compliance with this paragraph ;
 - (ii) The landing gear extended ; and
 - (iii) The takeoff safety speed selected by the applicant.
 - (2) [The steady rate of climb without ground effect, 1000 feet above the takeoff surface must be at least 150 feet per minute, for each weight, altitude, and temperature for which takeoff data are to be scheduled with—
 - (i) The critical engine inoperative and the remaining engines at maximum continuous power including continuous OEI power, if approved, or at 30-minute OEI power for rotorcraft for which certification for use of 30-minute OEI power is requested.]
 - (ii) The most unfavorable center of gravity for climb following takeoff ;
 - (iii) The landing gear retracted ; and
 - (iv) The speed selected by the applicant.
 - (3) The steady rate of climb (or descent) in feet per minute, at each altitude and temperature at which the rotorcraft is expected to operate and at any weight within the range of weights for which certification is requested, must be determined with—
 - (i) [The critical engine inoperative and the remaining engines at maximum continuous power including continuous OEI power, if approved, and at 30-minute OEI power for rotorcraft for which certification for the use of 30-minute OEI power is requested.]
 - (ii) The landing gear retracted ; and

- (1) Excessive loss of altitude ;
 - (2) Undue pitchup ;
 - (3) Uncontrollable tendency to spin ;
 - (4) [Exceeding a bank angle of 60 degrees in the original direction of the turn or 30 degrees in the opposite direction in the case of turning flight stalls ;
 - (5) Exceeding a bank angle of 90 degrees in the original direction of the turn or 60 degrees in the opposite direction in the case of accelerated turning stalls ; and
 - (6) Exceeding the maximum permissible speed or allowable limit load factor.
- (c) Compliance with the requirements of this section must be shown under the following conditions :
- (1) *Wings Flaps* : Retracted, fully extended, and each intermediate normal operating position ;
 - (2) *Landing Gear* : Retracted and extended ;
 - (3) *Cowl Flaps* : Appropriate to configuration ;
 - (4) [Power :
 - (i) Power off ; and
 - (ii) 75 percent maximum continuous power. However, if the power-to-weight ratio at 75 percent of maximum continuous power results in extreme nose-up attitudes, the test may be carried out with the power required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 V_{SO} , except that the power may not be less than 50 percent of maximum continuous power.]
 - (5) *Trim* : The airplane trimmed at a speed as near 1.5 V_{S1} as practicable.
 - (6) [Propeller : Full increase rpm position for the power off condition.]

Amdt. 23-50, Eff. 3/11/96

FAR 23.205 : [Removed.]

[Removed.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.207 : Stall warning.

- (a) There must be a clear and distinctive stall warning, with the flaps and landing gear in any normal position, in straight and turning flight.
- (b) The stall warning may be furnished either through the inherent aerodynamic qualities of the airplane or by a device that will give clearly distinguishable indications under expected conditions of flight. However, a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself.
- (c) [During the stall tests required by Sec. 23.201 (b) and Sec. 23.203(a)(1), the stall warning must begin at a speed exceeding the stalling speed by a margin of not less than 5 knots and must continue until the stall occurs.
- (d) When following procedures furnished in accordance with Sec. 23.1585, the stall warning must not occur during a takeoff with all engines operating, a takeoff continued with one engine inoperative, or during an approach to landing.

(e) During the stall tests required by Sec. 23.203(e)(2), the stall warning must begin sufficiently in advance of the stall for the stall to be averted by pilot action taken after the stall warning first occurs.

(f) For acrobatic category airplanes, an artificial stall warning may be mutable, provided that it is armed automatically during takeoff and rearmed automatically in the approach configuration.]

Amdt. 23-50, EFF. 03/11/96

29.8 Spinning

FAR 23.221 : Spinning.

(a) [Normal category airplanes. A single-engine, normal category airplane must be able to recover from a one-turn spin or a three-second spin, whichever takes longer, in not more than one additional turn after initiation of the first control action for recovery, or demonstrate compliance with the optional spin resistant requirements of this section.

(1) The following apply to one turn or three-second spins :

(i) For both the flaps-retracted and flaps-extended conditions, the applicable airspeed limit and positive limit maneuvering load factor must not be exceeded ;

(ii) No control forces or characteristic encountered during the spin or recovery may adversely affect prompt recovery ;

(iii) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin ; and

(iv) For the flaps-extended condition, the flaps may be retracted during the recovery but not before rotation has ceased.

(2) At the applicant's option, the airplane may be demonstrated to be spin resistant by the following :

(i) During the stall maneuvers contained in Sec. 23.201, the pitch control must be pulled back and held against the stop. Then, using ailerons and rudders in the proper direction, it must be possible to maintain wings-level flight within 15 degrees of bank and to roll the airplane from a 30 degree bank in one direction to a 30 degree bank in the other direction ;

(ii) Reduce the airplane speed using pitch control at a rate of approximately 1 knot per second until the pitch control reaches the stop ; then, with the pitch control pulled back and held against the stop, apply full rudder control in a manner to promote spin entry for a period of 7 seconds or through a 360 degree heading change, whichever occurs first. If the 360 degree heading change is reached first, it must have taken no fewer than 4 seconds. This maneuver must be performed first with the ailerons in the neutral position, and then with the ailerons deflected opposite the direction of turn in the most adverse manner. Power and airplane configuration must be set in accordance with Sec. 23.201(e) without change during the maneuver. At the end of 7 seconds or a 360 degree heading change, the airplane must respond immediately and normally to primary

(b) For elevated heliports, the takeoff distance is the horizontal distance along the takeoff path from the start of the takeoff to the point at which the rotorcraft attains and maintains a speed of at least V_{ROSS} and establishes a positive rate of climb, assuming the critical engine failure occurs at the engine failure point prior to the takeoff decision point.]

Amdt. 29-39, EFF. 6/10/96

FAR 29.62 : Rejected takeoff : Category A.

The rejected takeoff distance and procedures for each condition where takeoff is approved will be established with—

(a) [The takeoff path requirements of Secs. 29.59 and 29.60 being used up to the TDP where the critical engine failure is recognized and the rotorcraft is landed and brought to a complete stop on the takeoff surface ;]

(b) The remaining engines operating within approved limits ;

(c) The landing gear remaining extended throughout the engine rejected takeoff ; and

(d) The use of only the primary controls until the rotorcraft is on the ground. Secondary controls located on the primary control may not be used until the rotorcraft is on the ground. Means other than wheel brakes may be used to stop the rotorcraft if the means are safe and reliable and consistent results can be expected under normal operating conditions.

Amdt. 29-44, EFF. 11/17/99

FAR 29.63 : Takeoff : Category B.

[The horizontal distance required to take off and climb over a 50-foot obstacle must be established with the most unfavorable center of gravity. The takeoff may be begun in any manner if—]

(a) The takeoff surface is defined ;

(b) Adequate safeguards are maintained to ensure proper center of gravity and control positions ; and

(c) A landing can be made safely at any point along the flight path if an engine fails.

Amdt. 29-12, EFF. 2/1/77

FAR 29.64 : [Climb : general.]

[Compliance with the requirements of Sec. 29.65 and 29.67 must be shown at each weight, altitude, and temperature within the operational limits established for the rotorcraft and with the most unfavorable center of gravity for each configuration. Cowl flaps, or other means of controlling the engine-cooling air supply, will be in the position that provides adequate cooling at the temperatures and altitudes for which certification is requested.]

Amdt. 29-39, EFF. 6/10/96

- (4) Only primary controls may be used while attaining V_{ross} and while establishing a positive rate of climb. Secondary controls that are located on the primary controls may be used after a positive rate of climb and V_{ross} are established but in no case less than 3 seconds after the critical engine is made inoperative; and
- (5) After attaining V_{ross} and a positive rate of climb, the landing gear may be retracted.
- (b) During the takeoff path determination made in accordance with paragraph (a) of this section and after attaining V_{ross} and a positive rate of climb, the climb must be continued at a speed as close as practicable to, but not less than, V_{ross} until the rotorcraft is 200 feet above the takeoff surface. During this interval, the climb performance must meet or exceed that required by Sec. 29.67(a)(1).
- (c) [During the continued takeoff, the rotorcraft shall not descend below 15 feet above the takeoff surface when the takeoff decision point is above 15 feet.
- (d) From 200 feet above the takeoff surface, the rotorcraft takeoff path must be level or positive until a height 1,000 feet above the takeoff surface is attained with not less than the rate of climb required by Sec. 29.67(a)(2). Any secondary or auxiliary control may be used after attaining 200 feet above the takeoff surface.
- (e) Takeoff distance will be determined in accordance with Sec. 29.61.]

Amdt. 29-44, Eff. 11/17/99

FAR 29.60 : [Elevated heliport takeoff path : Category A.]

- (a) [The elevated heliport takeoff path extends from the point of commencement of the takeoff procedure to a point in the takeoff path at which the rotorcraft is 1,000 feet above the takeoff surface and compliance with Sec. 29.67(a)(2) is shown. In addition—
- (1) The requirements of Sec. 29.59(a) must be met;
- (2) While attaining V_{ross} and a positive rate of climb, the rotorcraft may descend below the level of the takeoff surface if, in so doing and when clearing the elevated heliport edge every part of the rotorcraft clears all obstacles by at least 15 feet;
- (3) The vertical magnitude of any descent below the takeoff surface must be determined; and
- (4) After attaining V_{ross} and a positive rate of climb, the landing gear may be retracted.
- (b) The scheduled takeoff weight must be such that the climb requirements of Sec. 29.67(a)(1) and (a)(2) will be met.
- (c) Takeoff distance will be determined in accordance with Sec. 29.61.]

Amdt. 29-39, Eff. 6/10/96

FAR 29.61 : [Takeoff distance : Category A.]

- (a) [The normal takeoff distance is the horizontal distance along the takeoff path from the start of the takeoff to the point at which the rotorcraft attains and remains at least 35 feet above the takeoff surface, attains and maintains a speed of at least V_{ross} , and establishes a positive rate of climb, assuming the critical engine failure occurs at the engine failure point prior to the takeoff decision point.

flight controls applied to regain coordinated, unstalled flight without reversal of control effect and without exceeding the temporary control forces specified by Sec. 23.143(c); and

- (iii) Compliance with Secs. 23.201 and 23.203 must be demonstrated with the airplane in uncoordinated flight, corresponding to one ball width displacement on a slip-skid indicator, unless one ball width displacement cannot be obtained with full rudder, in which case the demonstration must be with full rudder applied.
- (b) *Utility category airplanes.* A utility category airplane must meet the requirements of paragraph (a) of this section. In addition, the requirements of paragraph (c) of this section and Sec. 23.807(b)(7) must be met if approval for spinning is requested.
- (c) *Acrobatic category airplanes.* An acrobatic category airplane must meet the requirements of paragraph (a) of this section and Sec. 23.807(b)(6). In addition, the following requirements must be met in each configuration for which approval for spinning is requested :
- (1) The airplane must recover from any point in a spin up to and including six turns, or any greater number of turns for which certification is requested, in not more than one and one-half additional turns after initiation of the first control action for recovery. However, beyond 3 turns, the spin may be discontinued if spiral characteristics appear.
- (2) The applicable airspeed limits and limit maneuvering load factors must not be exceeded. For flaps-extended configurations for which approval is requested, the flaps must not be retracted during the recovery.
- (3) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin.
- (4) There must be no characteristics during the spin (such as excessive rates of rotation or extreme oscillatory motion) that might prevent a successful recovery due to disorientation or incapacitation of the pilot.]

Amdt. 23-50, Eff. 03/11/96

29.9 Ground and Water Handling Characteristics**FAR 23.231 : Longitudinal stability and control.**

- (a) A landplane may have no uncontrollable tendency to nose over in any reasonably expected operating condition, including rebound during landing or takeoff. Wheel brakes must operate smoothly and may not induce any undue tendency to nose over.
- (b) A seaplane or amphibian may not have dangerous or uncontrollable porpoising characteristics at any normal operating speed on the water.

FAR 23.233 : Directional stability and control.

- (a) [A 90 degree cross-component of wind velocity, demonstrated to be safe for taxiing, takeoff, and landing must be established and must be not less than $0.2 V_{SO}$.]
- (b) The airplane must be satisfactorily controllable in power-off landings at normal landing speed, without using brakes or engine power to maintain a straight path until the speed has decreased to at least 50 percent of the speed at touchdown.

(c) The airplane must have adequate directional control during taxiing.

(d) Seaplanes must demonstrate satisfactory directional stability and control for water operations up to the maximum wind velocity specified in paragraph (a) of this section.

Amdt. 23-50, Eff. 03/11/96

FAR 23.235 : [Operation on unpaved surfaces.]

[The airplane must be demonstrated to have satisfactory characteristics and the shock-absorbing mechanism must not damage the structure of the airplane when the airplane is taxied on the roughest ground that may reasonably be expected in normal operation and when takeoffs and landings are performed on unpaved runways having the roughest surface that may reasonably be expected in normal operation.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.237 : [Operation on water.]

[A wave height, demonstrated to be safe for operation, and any necessary water handling procedures for seaplanes and amphibians must be established.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.239 : Spray characteristics.

Spray may not dangerously obscure the vision of the pilots or damage the propellers or other parts of a seaplane or amphibian at any time during taxiing, takeoff, and landing.

29.10 Miscellaneous Flight Requirements

FAR 23.251 : Vibration and buffeting.

[There must be no vibration or buffeting severe enough to result in structural damage, and each part of the airplane must be free from excessive vibration, under any appropriate speed and power conditions up to V_D/M_D . In addition, there must be no buffeting in any normal flight condition severe enough to interfere with the satisfactory control of the airplane or cause excessive fatigue to the flightcrew. Stall warning buffeting within these limits is allowable.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.253 : High speed characteristics.

If a maximum operating speed V_{MO}/M_{MO} is established under Sec. 23.1505(c), the following speed increase and recovery characteristics must be met :

(a) Operating conditions and characteristics likely to cause inadvertent speed increases (including upsets in pitch and roll) must be simulated with the airplane trimmed at any likely speed up to V_{MO}/M_{MO} . These conditions and characteristics include gust upsets, inadvertent control movements, low stick force gradients in relation to control friction, passenger movement, leveling off from climb, and descent from Mach to airspeed limit altitude.

FAR 29.51 : Takeoff data : general.

(a) [The takeoff data required by Secs. 29.53, 29.55, 29.59, 29.60, 29.61, 29.62, 29.63, and 29.67 must be determined—]

(1) At each weight, altitude, and temperature selected by the applicant ; and

(2) With the operating engines within approved operating limitations.

(b) Takeoff data must—

(1) Be determined on a smooth, dry, hard surface; and

(2) Be corrected to assume a level takeoff surface.

(c) No takeoff made to determine the data required by this section may require exceptional piloting skill or alertness, or exceptionally favorable conditions.

Amdt. 29-39, Eff. 6/10/96

FAR 29.53 : Takeoff : Category A.

[The takeoff performance must be determined and scheduled so that, if one engine fails at any time after the start of takeoff, the rotorcraft can—]

(a) Return to, and stop safely on, the takeoff area; or

(b) Continue the takeoff and climbout, and attain a configuration and airspeed allowing compliance with Sec. 29.67(a)(2).]

Amdt. 29-39, Eff. 6/10/96

FAR 29.55 : [Takeoff decision point (TDP) : Category A.]

(a) [The TDP is the first point from which a continued takeoff capability is assured under Sec. 29.59 and is the last point in the takeoff path from which a rejected takeoff is assured within the distance determined under Sec. 29.62.

(b) The TDP must be established in relation to the takeoff path using no more than two parameters; e.g., airspeed and height, to designate the TDP.

(c) Determination of the TDP must include the pilot recognition time interval following failure of the critical engine.]

Amdt. 29-39, Eff. 6/10/96

FAR 29.59 : Takeoff path : Category A.

(a) The takeoff path extends from the point of commencement of the takeoff procedure to a point at which the rotorcraft is 1,000 feet above the takeoff surface and compliance with Sec. 29.67(a)(2) is shown. In addition—

(1) The takeoff path must remain clear of the height-velocity envelope established in accordance with Sec. 29.87;

(2) The rotorcraft must be flown to the engine failure point; at which point, the critical engine must be made inoperative and remain inoperative for the rest of the takeoff;

(3) After the critical engine is made inoperative, the rotorcraft must continue to the takeoff decision point, and then attain V_{gross} ;

- (b) Compliance with the performance requirements of this subpart must be shown—
- (1) For still air at sea level with a standard atmosphere; and
 - (2) [For the approved range of atmospheric variables.]
- (c) The available power must correspond to engine power, not exceeding the approved power, less—
- (1) Installation losses; and
 - (2) [The power absorbed by the accessories and services at the values for which certification is requested and approved.]
- (d) For reciprocating engine-powered rotorcraft, the performance, as affected by engine power, must be based on a relative humidity of 80 percent in a standard atmosphere.
- (e) For turbine engine-powered rotorcraft, the performance, as affected by engine power, must be based on relative humidity of—
- (1) 80 percent, at and below standard temperature; and
 - (2) 34 percent, at and above standard temperature plus 50 degrees F.
- Between these two temperatures, the relative humidity must vary linearly.
- (f) [For turbine-engine-powered rotorcraft, a means must be provided to permit the pilot to determine prior to takeoff that each engine is capable of developing the power necessary to achieve the applicable rotorcraft performance prescribed in this subpart.]

Amdt. 29-24, Eff. 12/6/84

FAR 29.49 : [Performance at minimum operating speed.]

- (a) [For each Category A helicopter, the hovering performance must be determined over the ranges of weight, altitude, and temperature for which takeoff data are scheduled—
- (1) With not more than takeoff power ;
 - (2) With the landing gear extended; and
 - (3) At a height consistent with the procedure used in establishing the takeoff, climbout, and rejected takeoff paths.
- (b) For each Category B helicopter, the hovering performance must be determined over the ranges of weight, altitude, and temperature for which certification is requested, with—
- (1) Takeoff power ;
 - (2) The landing gear extended ; and
 - (3) The helicopter in ground effect at a height consistent with normal takeoff procedures.
- (c) For each helicopter, the out-of-ground effect hovering performance must be determined over the ranges of weight, altitude, and temperature for which certification is requested with takeoff power.
- (d) For rotorcraft other than helicopters, the steady rate of climb at the minimum operating speed must be determined over the ranges of weight, altitude, and temperature for which certification is requested with—
- (1) Takeoff power ; and
 - (2) The landing gear extended.]

Amdt. 29-39, Eff. 6/10/96

- (b) Allowing for pilot reaction time after occurrence of the effective inherent or artificial speed warning specified in Sec. 23.1303, it must be shown that the airplane can be recovered to a normal attitude and its speed reduced to V_{MO}/M_{MO} , without—
- (1) [Exceeding V_D/M_D , the maximum speed shown under Sec. 23.251, or the structural limitations; or
 - (2) Buffeting that would impair the pilot's ability to read the instruments or to control the airplane for recovery.]
- (c) There may be no control reversal about any axis at any speed up to the maximum speed shown under Sec. 23.251. Any reversal of elevator control force or tendency of the airplane to pitch, roll, or yaw must be mild and readily controllable, using normal piloting techniques.

Amdt. 23-50, Eff. 03/11/96

- (b) [*Normal main rotor high pitch limits (power-on).*] For rotorcraft, except helicopters required to have a main rotor low speed warning under paragraph (e) of this section, it must be shown with power on and without exceeding approved engine maximum limitations, that main rotor speeds substantially less than the minimum approved main rotor speed will not occur under any sustained flight condition. This must be met by—
- (1) Appropriate setting of the main rotor high pitch stop;
 - (2) Inherent rotorcraft characteristics that make unsafe low main rotor speeds unlikely ; or
 - (3) Adequate means to warn the pilot of unsafe main rotor speeds.
- (c) *Normal main rotor low pitch limit (power off).* It must be shown, with power off, that—
- (1) The normal main rotor low pitch limit provides sufficient rotor speed, in any autorotative condition, under the most critical combinations of weight and airspeed ; and
 - (2) It is possible to prevent overspeeding of the rotor without exceptional piloting skill.
- (d) *Emergency high pitch.* If the main rotor high pitch stop is set to meet paragraph (b)(1) of this section, and if that stop cannot be exceeded inadvertently, additional pitch may be made available for emergency use.
- (e) [*Main rotor low speed warning for helicopters.*] For each single engine helicopter, and each multiengine helicopter that does not have an approved device that automatically increases power on the operating engines when one engine fails, there must be a main rotor low speed warning which meets the following requirements :
- (1) The warning must be furnished to the pilot in all flight conditions, including power-on and power-off flight, when the speed of a main rotor approaches a value that can jeopardize safe flight.
 - (2) The warning may be furnished either through the inherent aerodynamic qualities of the helicopter or by a device.
 - (3) The warning must be clear and distinct under all conditions, and must be clearly distinguishable from all other warnings. A visual device that requires the attention of the crew within the cockpit is not acceptable by itself.
 - (4) If a warning device is used, the device must automatically deactivate and reset when the low-speed condition is corrected. If the device has an audible warning, it must also be equipped with a means for the pilot to manually silence the audible warning before the low-speed condition is corrected.]

Amdt. 29-15, EF. 3/1/78

72.2 Performance

FAR 29.45 : General.

- (a) The performance prescribed in this subpart must be determined—
- (1) With normal piloting skill ; and
 - (2) Without exceptionally favorable conditions.

- (5) Operation of the rotorcraft at a total weight greater than the maximum certificated weight established under paragraph (a) of this section is limited by appropriate operating limitations under Sec. 29.865 (a) and (d) of this part.]

Amdt. 29-43, Eff. 10/5/99

FAR 29.27 : Center of gravity limits.

The extreme forward and [aft centers of gravity and, where critical, the extreme lateral centers of gravity must be established for each weight established under Sec. 29.25. Such an extreme may not lie beyond—]

- (a) The extremes selected by the applicant ;
(b) The extremes within which the structure is proven ; or
(c) The extremes within which compliance with the applicable flight requirements is shown.

Amdt. 29-3, Eff. 2/25/68

FAR 29.29 : Empty weight and corresponding center of gravity.

- (a) The empty weight and corresponding center of gravity must be determined by weighing the rotorcraft without the crew and payload, but with—

- (1) Fixed ballast ;
(2) Unusable fuel ; [and
(3) Full operating fluids, including—

- (i) Oil ;
(ii) Hydraulic fluid ; and
(iii) Other fluids required for normal operation of rotorcraft systems, except water intended for injection in the engines.]

- (b) The condition of the rotorcraft at the time of determining empty weight must be one that is well defined and can be easily repeated, particularly with respect to the weights of fuel, oil, coolant, and installed equipment.

Amdt. 29-15, Eff. 3/1/78

FAR 29.31 : Removable ballast.

Removable ballast may be used in showing compliance with the flight requirements of this subpart.

FAR 29.33 : Main rotor speed and pitch limits.

- (a) *Main rotor speed limits.* A range of main rotor speeds must be established that—

- (1) With power on, provides adequate margin to accommodate the variations in rotor speed occurring in any appropriate maneuver, and is consistent with the kind of governor or synchronizer used ; and
(2) With power off, allows each appropriate autorotative maneuver to be performed throughout the ranges of airspeed and weight for which certification is requested.

Chapitre 30

Subpart C : Structure

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72.1 General

FAR 29.21 : Proof of compliance.

[Each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested. This must be shown—]

- (a) By tests upon a rotorcraft of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and
- (b) By systematic investigation of each required combination of weight and center of gravity, if compliance cannot be reasonably inferred from combinations investigated.

Amdt. 29-24, Eff. 12/6/84

FAR 29.25 : Weight limits.

- (a) *Maximum weight.* The maximum weight (the highest weight at which compliance with each applicable requirement of this Part is shown) or, at the option of the applicant, the highest weight for each altitude and for each practically separable operating condition, such as takeoff, enroute operation, and landing, must be established so that it is not more than—

- (1) The highest weight selected by the applicant;
- (2) The design maximum weight (the highest weight at which compliance with each applicable structural loading condition of this Part is shown); or
- (3) The highest weight at which compliance with each applicable flight requirement of this Part is shown.

- (b) *Minimum weight.* The minimum weight (the lowest weight at which compliance with each applicable requirement of this Part is shown) must be established so that it is not less than—

- (1) The lowest weight selected by the applicant;
- (2) The design minimum weight (the lowest weight at which compliance with each structural loading condition of this Part is shown); or
- (3) The lowest weight at which compliance with each applicable flight requirement of this Part is shown.

- (c) [*Total weight with jettisonable external load.* A total weight for the rotorcraft with a jettisonable external load attached that is greater than the maximum weight established under paragraph (a) of this section may be established for any rotorcraft-load combination if—

- (1) The rotorcraft-load combination does not include human external cargo,
- (2) Structural component approval for external load operations under either Sec. 29.865 or under equivalent operational standards is obtained,
- (3) The portion of the total weight that is greater than the maximum weight established under paragraph (a) of this section is made up only of the weight of all or part of the jettisonable external load.
- (4) Structural components of the rotorcraft are shown to comply with the applicable structural requirements of this part under the increased loads and stresses caused by the weight increase over that established under paragraph (a) of this section, and

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30.1 General

FAR 23.301 : Loads.

- (a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.
- (b) Unless otherwise provided, the air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the airplane. These loads must be distributed to conservatively approximate or closely represent actual conditions. Methods used to determine load intensities and distribution on canard and tandem wing configurations must be validated by flight test measurement unless the methods used for determining those loading conditions are shown to be reliable or conservative on the configuration under consideration.
- (c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.
- (d) [Simplified structural design criteria may be used if they result in design loads not less than those prescribed in Secs. 23.331 through 23.521. For airplane configurations described in appendix A, Sec. 23.1, the design criteria of appendix A of this part are an approved equivalent of Secs. 23.321 through 23.459. If appendix A of this part is used, the entire appendix must be substituted for the corresponding sections of this part.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.302 : [Canard or tandem wing configurations.]

[The forward structure of a canard or tandem wing configuration must :

- (a) Meet all requirements of subpart C and subpart D of this part applicable to a wing; and
- (b) Meet all requirements applicable to the function performed by these surfaces]
- Amdt. 23-42, Eff. 02/04/91

FAR 23.303 : Factor of safety.

Unless otherwise provided, a factor of safety of 1.5 must be used.

FAR 23.305 : Strength and deformation.

- (a) The structure must be able to support limit loads without detrimental, permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation.
- (b) [The structure must be able to support ultimate loads without failure for at least three seconds, except local failures or structural instabilities between limit and ultimate load are acceptable only if the structure can sustain the required ultimate load for at least three seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the three second limit does not apply.]

Amdt. 23-45, Eff. 09/07/93

Chapitre 72

Subpart B : Flight

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FAR 29.1 : Applicability.

- (a) This Part prescribes airworthiness standards for the issue of type certificates, and changes to those certificates, for transport category rotorcraft.
- (b) Transport category rotorcraft must be certificated in accordance with either the Category A or Category B requirements of this Part. A multiengine rotorcraft may be type certificated as both Category A and Category B with appropriate and different operating limitations for each category.
- (c) Rotorcraft with a maximum weight greater than 20,000 pounds and 10 or more passenger seats must be type certificated as Category A rotorcraft.
- (d) Rotorcraft with a maximum weight greater than 20,000 pounds and nine or less passenger seats may be type certificated as Category B rotorcraft provided the Category A requirements of Subparts C, D, E, and F of this Part are met.
- (e) [Rotorcraft with a maximum weight of 20,000 pounds or less but with 10 or more passenger seats may be type certificated as Category B rotorcraft, provided the Category A requirements of Secs. 29.67(a)(2), 29.87, 29.1517, and subparts C, D, E, and F of this part are met.]
- (f) Rotorcraft with a maximum weight of 20,000 pounds or less and nine or less passenger seats may be type certificated as Category B rotorcraft.
- (g) Each person who applies under Part 21 for a certificate or change described in paragraphs (a) through (f) of this section must show compliance with the applicable requirements of this Part.

Amdt. 29-39, Eff. 6/10/96

FAR 29.2 : [Special retroactive requirements.]

[For each rotorcraft manufactured after September 16, 1992, each applicant must show that each occupant's seat is equipped with a safety belt and shoulder harness that meets the requirements of paragraphs (a), (b), and (c) of this section.]

- (a) Each occupant's seat must have a combined safety belt and shoulder harness with a single-point release. Each pilot's combined safety belt and shoulder harness must allow each pilot, when seated with safety belt and shoulder harness fastened, to perform all functions necessary for flight operations. There must be a means to secure belts and harnesses, when not in use, to prevent interference with the operation of the rotorcraft and with rapid egress in an emergency.
- (b) Each occupant must be protected from serious head injury by a safety belt plus a shoulder harness that will prevent the head from contacting any injurious object.
- (c) The safety belt and shoulder harness must meet the static and dynamic strength requirements, if applicable, specified by the rotorcraft type certification basis.
- (d) For purposes of the section, the date of manufacture is either—

- (1) The date the inspection acceptance records, or equivalent, reflect that the rotorcraft is complete and meets the FAA-Approved Type Design Data; or
- (2) The date that the foreign civil airworthiness authority certifies the rotorcraft is complete and issues an original standard airworthiness certificate, or equivalent, in that country.]

Amdt. 29-32, Eff. 9/16/91

FAR 23.307 : Proof of structure.

- (a) Compliance with the strength and deformation requirements of Sec. 23.305 must be shown for each critical load condition. Structural analysis may be used only if the structure conforms to those for which experience has shown this method to be reliable. In other cases, substantiating load tests must be made. Dynamic tests, including structural flight tests, are acceptable if the design load conditions have been simulated.
- (b) Certain parts of the structure must be tested as specified in Subpart D of this part.

30.2 Flight Loads**FAR 23.321 : General.**

- (a) Flight load factors represent the ratio of the aerodynamic force component (acting normal to the assumed longitudinal axis of the airplane) to the weight of the airplane. A positive flight load factor is one in which the aerodynamic force acts upward, with respect to the airplane.
- (b) Compliance with the flight load requirements of this subpart must be shown—
 - (1) At each critical altitude within the range in which the airplane may be expected to operate;
 - (2) At each weight from the design minimum weight to the design maximum weight; and
 - (3) For each required altitude and weight, for any practicable distribution of disposable load within the operating limitations specified in Secs. 23.1583 through 23.1589.
- (c) [When significant, the effects of compressibility must be taken into account]

Amdt. 23-45, Eff. 09/07/93

FAR 23.331 : Symmetrical flight conditions.

- (a) The appropriate balancing horizontal tail load must be accounted for in a rational or conservative manner when determining the wing loads and linear inertia loads corresponding to any of the symmetrical flight conditions specified in Secs. 23.331 through 23.341.
- (b) The incremental horizontal tail loads due to maneuvering and gusts must be reacted by the angular inertia of the airplane in a rational or conservative manner.
- (c) [Mutual influence of the aerodynamic surfaces must be taken into account when determining flight loads.]

Amdt. 23-42, Eff. 02/04/91

FAR 23.333 : Flight envelope.

- (a) *General.* Compliance with the strength requirements of this subpart must be shown at any combination of airspeed and load factor on and within the boundaries of a flight envelope (similar to the one in paragraph (d) of this section) that represents the envelope of the flight loading conditions specified by the maneuvering and gust criteria of paragraphs (b) and (c) of this section respectively.

- (b) *Maneuvering envelope*. Except where limited by maximum (static) lift coefficients, the airplane is assumed to be subjected to symmetrical maneuvers resulting in the following limit load factors :
- (1) The positive maneuvering load factor specified in Sec. 23.337 at speeds up to V_D ;
- (2) The negative maneuvering load factor specified in Sec. 23.337 at V_C ; and
- (3) Factors varying linearly with speed from the specified value at V_C to 0.0 at V_D for the normal [and commuter category,] and -1.0 at V_D for the acrobatic and utility categories.
- (c) *Gust envelope*.
- (1) The airplane is assumed to be subjected to symmetrical vertical gusts in level flight. The resulting limit load factors must correspond to the conditions determined as follows :
- (i) Positive (up) and negative (down) gusts of 50 f.p.s. at V_C must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 50 f.p.s. at 20,000 feet to 25 f.p.s. at 50,000 feet.
- (ii) Positive and negative gusts of 25 f.p.s. at V_D must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 25 f.p.s. at 20,000 feet to 12.5 f.p.s. at 50,000 feet.
- (iii) [In addition, for commuter category airplanes, positive (up) and negative (down) rough air gusts of 66 f.p.s. at V_B must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 66 f.p.s. at 20,000 feet to 38 f.p.s. at 50,000 feet.]
- (2) The following assumptions must be made :
- (i) The shape of the gust is—

$$U = \frac{U_{de}}{2} \left(1 - \cos \frac{2\pi s}{25C} \right)$$

where—

- s :Distance penetrated into gust (ft.) ;
- C :Mean geometric chord of wing (ft.) ;
- U_{de} :Derived gust velocity referred to in subparagraph (1) of this section.
- (ii) Gust load factors vary linearly with speed between V_C and V_D .
- (d) [*Flight envelope*].
- Amdt. 23-34, Eff. 02/17/87

FAR 23.335 : Design airspeeds.

Except as provided in paragraph (a)(4) of this section, the selected design airspeeds are equivalent airspeeds (EAS).

- (a) *Design cruising speed*, V_C . For V_C , the following apply :

- (1) [Where $\frac{W}{S}$ = wing loading at the design maximum takeoff weight, V_C (in knots) may not be less than—

Chapitre 71

Subpart A : General

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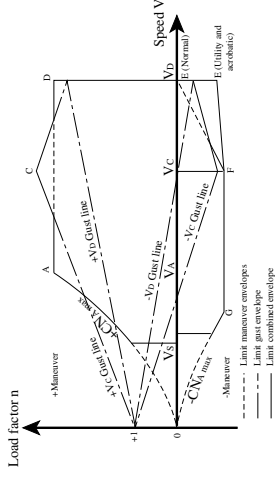


FIG. 30.1 – Note : Point G need not be investigated when the supplementary condition specified in Sec. 23.569 is investigated.

- (i) $33 \sqrt{\frac{W}{S}}$ (for normal, utility, and commuter category airplanes); and
 - (ii) $36 \sqrt{\frac{W}{S}}$ (for acrobatic category airplanes).]
- (2) For values of $\frac{W}{S}$ more than 20, the multiplying factors may be decreased linearly with $\frac{W}{S}$ to a value of 28.6 where $\frac{W}{S} = 100$.
- (3) V_C need not be more than $0.9 V_H$ at sea level.
- (4) At altitudes where an M_D is established, a cruising speed M_C limited by compressibility may be selected.
- (b) *Design dive speed, V_D .* For V_D , the following apply :
- (1) V_D/M_D may not be less than $1.25 V_C/M_C$; and
 - (2) With V_{Cmin} , the required minimum design cruising speed, V_D (in knots) may not be less than—
 - (i) $1.40 V_{Cmin}$ (for normal and commuter category airplanes) ;
 - (ii) $1.50 V_{Cmin}$ (for utility category airplanes) ; and
 - (iii) $1.55 V_{Cmin}$ (for acrobatic category airplanes).
- (3) For values of $\frac{W}{S}$ more than 20, the multiplying factors in paragraph (b)(2) of this section may be decreased linearly with $\frac{W}{S}$ to a value of 1.35 where $\frac{W}{S} = 100$.
- (4) Compliance with paragraphs (b)(1) and (2) of this section need not be shown if V_D/M_D is selected so that the minimum speed margin between V_C/M_C and V_D/M_D is the greater of the following :
- (i) The speed increase resulting when, from the initial condition of stabilized flight at V_C/M_C , the airplane is assumed to be upset, flown for 20 seconds along a flight path 7.5° below the initial path, and then pulled up with a load factor of 1.5 (0.5 g. acceleration increment). At least 75 percent maximum continuous power for reciprocating engines, and maximum cruising power for turbines, or, if less, the power required for V_C/M_C for both kinds of engines, must be assumed until the pullup is initiated, at which point power reduction and pilot-controlled drag devices may be used ; [and either :]

- (ii) Mach 0.05 for normal, utility, and acrobatic category airplanes (at altitudes where M_D is established) ; or
 - (iii) [Mach 0.07 for commuter category airplanes (at altitudes where M_D is established) unless a rational analysis, including the effects of automatic systems, is used to determine a lower margin. If a rational analysis is used, the minimum speed margin must be enough to provide for atmospheric variations (such as horizontal gusts), and the penetration of jet streams or cold fronts), instrument errors, airframe production variations, and must not be less than Mach 0.05.]
 - (c) *Design maneuvering speed* V_A . For V_A , the following applies :
 - (1) V_A may not be less than $V_S \sqrt{n_z}$ where—
 - (i) V_S is a computed stalling speed with flaps retracted at the design weight, normally based on the maximum airplane normal force coefficients, C_{NA} ; and
 - (ii) n_z is the limit maneuvering load factor used in design.
 - (2) The value of V_A need not exceed the value of V_C used in design.
 - (d) *Design speed for maximum gust intensity*, V_B . For V_B , the following apply :
 - (1) V_B may not be less than the speed determined by the intersection of the line representing the maximum positive lift, C_{NMAX} , and the line representing the rough air gust velocity on the gust V -n diagram, or $V_{S1} \sqrt{n_g}$, whichever is less, where :]
 - (i) n_g the positive airplane gust load factor due to gust, at speed V_C (in accordance with Sec. 23.341), and at the particular weight under consideration ; and
 - (ii) V_{S1} is the stalling speed with the flaps retracted at the particular weight under consideration.
 - (2) V_B need not be greater than V_C .
- Amdt. 23-48, Eff. 03/11/96
- FAR 23.337 : Limit maneuvering load factors.**
- (a) The positive limit maneuvering load factor n_{zcl} may not be less than—
 - (1) $2.1 + \frac{2400}{W+1000}$ for normal and commuter category airplanes, where W = design maximum takeoff weight, except that n_{zcl} need not be more than 3.8 ;]
 - (2) 4.4 for utility category airplanes ; or
 - (3) 6.0 for acrobatic category airplanes.
 - (b) The negative limit maneuvering load factor may not be less than—
 - (1) 0.4 times the positive load factor for the normal, utility, and commuter categories ; or
 - (2) 0.5 times the positive load factor for the acrobatic category.
 - (c) Maneuvering load factors lower than those specified in this section may be used if the airplane has design features that make it impossible to exceed these values in flight.
- Amdt. 23-48, Eff. 03/11/96

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FAR 23.341 : Gust load factors.

- (a) [Each airplane must be designed to withstand loads on each lifting surface resulting from gusts specified in Sec. 23.333(c).]
- (b) The gust load for a canard or tandem wing configuration must be computed using a rational analysis, or may be computed in accordance with paragraph (c) of this section, provided that the resulting net loads are shown to be conservative with respect to the gust criteria of Sec. 23.333(c).
- (c) In the absence of a more rational analysis, the gust load factors must be computed as follows—]

$$n = 1 + \frac{K_g U_{de} V_a}{498 \frac{W}{S}}$$

where—

- K_g :gust alleviation factor $K_g = 0.88 \frac{W}{S} + \mu_g$;
 μ_g :Airplane mass ratio $\mu_g = 2 \frac{(W/S)}{\rho} C a g$
 U_{de} :Derived gust velocities referred to in Sec. 23.333(c) (f.p.s.) ;
 ρ :Density of air (slugs/cu. ft.) ;
 $\frac{W}{S}$:[wing loading (p.s.f.) due to the applicable weight of the airplane in the particular load case.]
 C :Mean geometric chord (ft.) ;
 g :Acceleration due to gravity (ft./sec.2) ;
 V :airplane equivalent speed (knots) ;
 a :Slope of the airplane normal force coefficient curve C_{NA} per radian if the gust loads are applied to the wings and horizontal tail surfaces simultaneously by a rational method. The wing lift curve slope C_L per radian may be used when the gust load is applied to the wings only and the horizontal tail gust loads are treated as a separate condition.

Amndt. 23-48, Eff. 03/11/96

FAR 23.343 : [Design fuel loads.]

- (a) [The disposable load combinations must include each fuel load in the range from zero fuel to the selected maximum fuel load.
- (b) If fuel is carried in the wings, the maximum allowable weight of the airplane without any fuel in the wing tank(s) must be established as "maximum zero wing fuel weight," if it is less than the maximum weight.
- (c) For commuter category airplanes, a structural reserve fuel condition, not exceeding fuel necessary for 45 minutes of operation at maximum continuous power, may be selected. If a structural reserve fuel condition is selected, it must be used as the minimum fuel weight condition for showing compliance with the flight load requirements prescribed in this part and—

- (1) The structure must be designed to withstand a condition of zero fuel in the wing at limit loads corresponding to :
 - (i) Ninety percent of the maneuvering load factors defined in Sec. 23.337, and
 - (ii) Gust velocities equal to 85 percent of the values prescribed in Sec. 23.333(c).
- (2) The fatigue evaluation of the structure must account for any increase in operating stresses resulting from the design condition of paragraph (c)(1) of this section.
- (3) The flutter, deformation, and vibration requirements must also be met with zero fuel in the wings.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.345 : High lift devices.

- (a) [If flaps or similar high lift devices are to be used for takeoff, approach or landing, the airplane, with the flaps fully extended at V_F , is assumed to be subjected to symmetrical maneuvers and gusts within the range determined by—
 - (1) Maneuvering, to a positive limit load factor of 2.0 ; and
 - (2) Positive and negative gust of 25 feet per second acting normal to the flight path in level flight.
- (b) V_F must be assumed to be not less than 1.4 V_S or 1.8 V_{SF} , whichever is greater, where—
 - (1) V_S is the computed stalling speed with flaps retracted at the design weight ; and
 - (2) V_{SF} is the computed stalling speed with flaps fully extended at the design weight.
- (3) If an automatic flap load limiting device is used, the airplane may be designed for the critical combinations of airspeed and flap position allowed by that device.
- (c) In determining external loads on the airplane as a whole, thrust, slipstream, and pitching acceleration may be assumed to be zero.
- (d) The flaps, their operating mechanism, and their supporting structures, must be designed to withstand the conditions prescribed in paragraph (a) of this section. In addition, with the flaps fully extended at V_F , the following conditions, taken separately, must be accounted for :
 - (1) A head-on gust having a velocity of 25 feet per second (EAS), combined with propeller slipstream corresponding to 75 percent of maximum continuous power ; and
 - (2) The effects of propeller slipstream corresponding to maximum takeoff power.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.347 : Unsymmetrical flight conditions.

- (a) [The airplane is assumed to be subjected to the unsymmetrical flight conditions of Secs. 23.349 and 23.351. Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner, considering the principal masses furnishing the reacting inertia forces.

Huitième partie

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- (b) Acrobatic category airplanes certified for flick maneuvers (snap roll) must be designed for additional asymmetric loads acting on the wing and the horizontal tail.]
Amdt. 23-48, Eff. 03/11/96

FAR 23.349 : Rolling conditions.

The wing and wing bracing must be designed for the following loading conditions :

- (a) Unsymmetrical wing loads appropriate to the category. Unless the following values result in unrealistic loads, the rolling accelerations may be obtained by modifying the symmetrical flight conditions in Sec. 23.333(d) as follows :

- (1) For the acrobatic category, in conditions A and F, assume that 100 percent of the semispan wing airload acts on one side of the plane of symmetry and 60 percent of this load acts on the other side.
(2) [For the normal, utility, and commuter categories, in Condition A, assume that 100 percent of the semispan wing airload acts on one side of the airplane and 75 percent of this load acts on the other side.]

- (b) The loads resulting from the aileron deflections and speeds specified in Sec. 23.455, in combination with an airplane load factor of at least two thirds of the positive maneuvering load factor used for design. Unless the following values result in unrealistic loads, the effect of aileron displacement on wing torsion may be accounted for by adding the following increment to the basic airfoil moment coefficient over the aileron portion of the span in the critical condition determined in Sec. 23.333(d) :

$$\Delta c_{m} = -0.01\delta$$

where—

Δc_{m} : is the moment coefficient increment ; and

δ : is the down aileron deflection in degrees in the critical condition.

Amdt. 23-48, Eff. 03/11/96

FAR 23.351 : Yawing conditions.

[The airplane must be designed for yawing loads on the vertical surfaces resulting from the loads specified in Secs. 23.441 through 23.445.]
Amdt. 23-42, Eff. 02/04/91

FAR 23.361 : Engine torque.

- (a) Each engine mount and its supporting structure must be designed for the effects of—

- (1) A limit engine torque corresponding to takeoff power and propeller speed acting simultaneously with 75 percent of the limit loads from flight condition A of Sec. 23.333(d) ;
(2) [A limit engine torque corresponding to maximum continuous power and propeller speed acting simultaneously with the limit loads from flight condition A of Sec. 23.333(d) ; and]
(3) For turbo-propeller installations, in addition to the conditions specified in paragraphs (a)(1) and (a)(2) of this section, a limit engine torque corresponding to takeoff power and propeller speed, multiplied by a factor accounting for

propeller control system malfunction, including quick feathering, acting simultaneously with 1g level flight loads. In the absence of a rational analysis, a factor of 1.6 must be used.

- (b) For turbine engine installations, the engine mounts and supporting structure must be designed to withstand each of the following :

(1) A limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming).

(2) A limit engine torque load imposed by the maximum acceleration of the engine.

- (c) [The limit engine torque to be considered under paragraph (a) of this section must be obtained by multiplying the mean torque by a factor of—]

(1) 1.25 for turbo-propeller installations ;

(2) 1.33 for engines with five or more cylinders; and

(3) Two, three, or four, for engines with four, three, or two cylinders, respectively.

Amdt. 23-45, Eff. 09/07/93

FAR 23.363 : Side load on engine mount.

- (a) Each engine mount and its supporting structure must be designed for a limit load factor in a lateral direction, for the side load on the engine mount, of not less than—

(1) 1.33, or

(2) One-third of the limit load factor for flight condition A.

- (b) The side load prescribed in paragraph (a) of this section may be assumed to be independent of other flight conditions.

FAR 23.365 : Pressurized cabin loads.

For each pressurized compartment, the following apply :

- (a) The airplane structure must be strong enough to withstand the flight loads combined with pressure differential loads from zero up to the maximum relief valve setting.

- (b) The external pressure distribution in flight, and any stress concentrations, must be accounted for.

- (c) If landings may be made, with the cabin pressurized, landing loads must be combined with pressure differential loads from zero up to the maximum allowed during landing.

- (d) The airplane structure must be strong enough to withstand the pressure differential loads corresponding to the maximum relief valve setting multiplied by a factor of 1.33, omitting other loads.

- (e) If a pressurized cabin has two or more compartments separated by bulkheads or a floor, the primary structure must be designed for the effects of sudden release of pressure in any compartment with external doors or windows. This condition must be investigated for the effects of failure of the largest opening in the compartment. The effects of intercompartmental venting may be considered.

29.1189(c) – Shut-off means.

29.1191(a)(1) – Firewalls.

29.1193(e) – Cowling and engine compartment covering.

29.1195(a) and (d) – Fire extinguishing systems (one shot).

29.1197 – Fire extinguishing agents.

29.1199 – Extinguishing agent containers.

29.1201 – Fire extinguishing system materials.

29.1305(a) (6) and (b) – Powerplant instruments.

29.1309(b)(2) (i) and (d) – Equipment, systems, and installations.

29.1323(c)(1) – Airspeed indicating system.

29.1331(b) – Instruments using a power supply.

29.1351(d)(2) – Electrical systems and equipment : General (operation without normal electrical power).

29.1587(a) – Performance information.

NOTE : In complying with the paragraphs listed in paragraph C27.2 above, relevant material in the AC “Certification of Transport Category Rotorcraft” should be used.]
Amdt. 27-33, Eff. 8/8/96

FAR 27.C1 : [General.]

[A small multiengine rotorcraft may not be type certificated for Category A operation unless it meets the design installation and performance requirements contained in this appendix in addition to the requirements of this part.]
Amdt. 27-33, Eff. 8/8/96

FAR 27.C2 : [Applicable part 29 sections.]

[The following sections of part 29 of this chapter must be met in addition to the requirements of this part :

- 29.45(a) and (b)(2) – General.
- 29.49(a) – Performance at minimum operating speed.
- 29.51 – Takeoff data : General.
- 29.53 – Takeoff : Category A.
- 29.55 – Takeoff decision point : Category A.
- 29.59 – Takeoff path : Category A.
- 29.60 – Elevated heliport takeoff path : Category A.
- 29.61 – Takeoff distance : Category A.
- 29.62 – Rejected takeoff : Category A.
- 29.64 – Climb : General.
- 29.65(a) – Climb : AEO.
- 29.67(a) – Climb : OEI.
- 29.75 – Landing : General.
- 29.77 – Landing decision point : Category A.
- 29.79 – Landing : Category A.
- 29.81 – Landing distance (Ground level sites) : Category A.
- 29.85 – Balked landing : Category A.
- 29.87(a) – Height-velocity envelope.
- 29.547(a) and (b) – Main and tail rotor structure.
- 29.861(a) – Fire protection of structure, controls, and other parts.
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- 29.908(a) – Cooling fans.
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- 29.927(c)(1) – Additional tests.
- 29.953(a) – Fuel system independence.
- 29.1027(a) – Transmission and gearboxes : General.
- 29.1045(a)(1), (b), (c), (d), and (f) – Climb cooling test procedures.
- 29.1047(a) – Takeoff cooling test procedures.
- 29.1181(a) – Designated fire zones : Regions included.
- 29.1187(e) – Drainage and ventilation of fire zones.

FAR 23.367 : [Unsymmetrical loads due to engine failure.]

(a) [Turbo-propeller airplanes must be designed for the unsymmetrical loads resulting from the failure of the critical engine including the following conditions in combination with a single malfunction of the propeller drag limiting system, considering the probable pilot corrective action on the flight controls :

- (1) At speeds between V_{MC} and V_D , the loads resulting from power failure because of fuel flow interruption are considered to be limit loads.
- (2) At speeds between V_{MC} and V_C , the loads resulting from the disconnection of the engine compressor from the turbine or from loss of the turbine blades are considered to be ultimate loads.
- (3) The time history of the thrust decay and drag buildup occurring as a result of the prescribed engine failures must be substantiated by test or other data applicable to the particular engine-propeller combination.
- (4) The timing and magnitude of the probable pilot corrective action must be conservatively estimated, considering the characteristics of the particular engine-propeller airplane combination.

(b) Pilot corrective action may be assumed to be initiated at the time maximum yawing velocity is reached, but not earlier than 2 seconds after the engine failure. The magnitude of the corrective action may be based on the limit pilot forces specified in Sec. 23.397 except that lower forces may be assumed where it is shown by analysis or test that these forces can control the yaw and roll resulting from the prescribed engine failure conditions.]

Amdt. 23-7, Eff. 09/14/69

FAR 23.369 : Rear lift truss.

(a) [If a rear lift truss is used, it must be designed to withstand conditions of reversed airflow at a design speed of—

$$V = 8.7 \sqrt{\frac{W}{S}} + 8.7 \text{ (knots)}$$

where—

$\frac{W}{S}$ = wing loading at design maximum takeoff weight.]

(b) Either aerodynamic data for the particular wing section used, or a value of C_L equaling -0.8 with a chordwise distribution that is triangular between a peak at the trailing edge and zero at the leading edge, must be used.

Amdt. 23-48, Eff. 03/11/96

FAR 23.371 : Gyroscopic and aerodynamic loads.

(a) [Each engine mount and its supporting structure must be designed for the gyroscopic, inertial, and aerodynamic loads that result, with the engine(s) and propeller(s), if applicable, at maximum continuous r.p.m., under either :

- (1) The conditions prescribed in Sec. 23.351 and Sec. 23.423; or
- (2) All possible combinations of the following—
 - (i) A yaw velocity of 2.5 radians per second ;

- (ii) A pitch velocity of 1.0 radian per second;
- (iii) A normal load factor of 2.5; and
- (iv) Maximum continuous thrust.

(b) For airplanes approved for aerobatic maneuvers, each engine mount and its supporting structure must meet the requirements of paragraph (a) of this section and be designed to withstand the load factors expected during combined maximum yaw and pitch velocities.

(c) For airplanes certificated in the commuter category, each engine mount and its supporting structure must meet the requirements of paragraph (a) of this section and the gust conditions specified in Sec. 23.341 of this part.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.373 : [Speed control devices.]

[If speed control devices (such as spoilers and drag flaps) are incorporated for use in enroute conditions—

(a) The airplane must be designed for the symmetrical maneuvers and gusts prescribed in Secs. 23.333, 23.337, and, 23.341, and the yawing maneuvers and lateral gusts in Secs. 23.441 and 23.443, with the device extended at speeds up to the placard device extended speed; and

(b) If the device has automatic operating or load limiting features, the airplane must be designed for the maneuver and gust conditions prescribed in paragraph (a) of this section at the speeds and corresponding device positions that the mechanism allows.]

Amdt. 23-7, Eff. 09/14/69

30.3 Control Surface and System Loads

FAR 23.391 : Control surface loads.

[The control surface loads specified in Secs. 23.397 through 23.459 are assumed to occur in the conditions described in Secs. 23.331 through 23.351.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.393 : [Loads parallel to hinge line.]

(a) [Control surfaces and supporting hinge brackets must be designed to withstand inertial loads acting parallel to the hinge line.

(b) In the absence of more rational data, the inertial loads may be assumed to be equal to $K W$, where—

- (1) $K = 24$ vertical surfaces;
- (2) $K = 12$ for horizontal surfaces; and
- (3) $W =$ weight of the movable surfaces.]

Amdt. 23-48, Eff. 03/11/96

Chapitre 70

Appendix C : Criteria for Category A

Sommaire

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FAR 23.395 : Control system [loads.]

(a) Each flight control system and its supporting structure must be designed for loads corresponding to at least 125 percent of the computed hinge moments of the movable control surface in the conditions prescribed in Secs. 23.391 through 23.459. In addition, the following apply :

(1) The system limit loads need not exceed the higher of the loads that can be produced by the pilot and automatic devices operating the controls. However, autopilot forces need not be added to pilot forces. The system must be designed for the maximum effort of the pilot or autopilot, whichever is higher. In addition, if the pilot and the autopilot act in opposition, the part of the system between them may be designed for the maximum effort of the one that imposes the lesser load. [Pilot forces used for design need not exceed the maximum forces prescribed in Sec. 23.397(b).]

(2) The design must, in any case, provide a rugged system for service use, considering jamming, ground gusts, taxiing downwind, control inertia, and friction. [Compliance with this subparagraph may be shown by designing for loads resulting from application of the minimum forces prescribed in Sec. 23.397(b).]

(b) A 125 percent factor on computed hinge moments must be used to design elevator, aileron, and rudder systems. However, a factor as low as 1.0 may be used if hinge moments are based on accurate flight test data, the exact reduction depending upon the accuracy and reliability of the data.

(c) [Pilot forces used for design are assumed to act at the appropriate control grips or pads as they would in flight, and to react at the attachments of the control system to the control surface horns.]

Amdt. 23-7, Eff. 09/14/69

FAR 23.397 : Limit control forces and torques.

(a) In the control surface flight loading condition, the airloads on movable surfaces and the corresponding deflections need not exceed those that would result in flight from the application of any pilot force within the ranges specified in paragraph (b) of this section. In applying this criterion, the effects of control system boost and servo-mechanisms, and the effects of tabs must be considered. The automatic pilot effort must be used for design if it alone can produce higher control surface loads than the human pilot.

(b) The limit pilot forces and torques are as follows :

Control	Maximum forces or torques for design weight, W equal to or less than 5,000 pounds ¹	Minimum forces or torques ²
Aileron :		
Stick	67 lbs	40 lbs
Wheel ³	50 D in. lbs. ⁴	40 D in. lbs. ⁴
Elevator :		
Stick	167 lbs	100 lbs.
Wheel (symmetrical)	200 lbs.	100 lbs
Wheel (unsymmetrical) ⁵	-	100 lbs
Rudder	200 lbs.	[150 lbs.]

¹ For design weight (W) more than 5,000 pounds, the specified maximum values must be increased linearly with weight to 1.18 times the specified values at a design weight of 12,500 pounds, and for commuter category airplanes, the specified values must be increased linearly with weight to 1.35 times the specified values at a design weight of 19,000 pounds.

² If the design of any individual set of control systems or surfaces makes these specified minimum forces or torques inapplicable, values corresponding to the present hinge moments obtained under Sec. 23.415, but not less than 0.6 of the specified minimum forces or torques, may be used.

³ The critical parts of the aileron control system must also be designed for a single tangential force with a limit value of 1.25 times the couple force determined from the above criteria.

⁴ D = wheel diameter (inches).

⁵ The unsymmetrical force must be applied at one of the normal handgrip points on the control wheel.

Amdt. 23-45, Eff. 09/07/93

FAR 23.399 : Dual control system.

(a) [Each dual control system must be designed to withstand the force of the pilots operating in opposition, using individual pilot forces not less than the greater of—

(1) 0.75 times those obtained under Sec. 23.395; or

(2) The minimum forces specified in Sec. 23.397(b).]

(b) Each dual control system must be designed to withstand the force of the pilots applied together, in the same direction, using individual pilot forces not less than 0.75 times those obtained under Sec. 23.395.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.405 : Secondary control system.

Secondary controls, such as wheel brakes, spoilers, and tab controls, must be designed for the maximum forces that a pilot is likely to apply to those controls.

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(2) There must be means in the generating system to automatically de-energize and disconnect from the main bus any power source developing hazardous overvoltage.

(3) Each required flight instrument using a power supply (electric, vacuum, etc.) must have a visual means integral with the instrument to indicate the adequacy of the power being supplied.

(4) When multiple systems performing like functions are required, each system must be grouped, routed, and spaced so that physical separation between systems is provided to ensure that a single malfunction will not adversely affect more than one system.

(5) For systems that operate the required flight instruments at each pilot's station—

(i) Only the required flight instruments for the first pilot may be connected to that operating system ;

(ii) Additional instruments, systems, or equipment may not be connected to an operating system for a second pilot unless provisions are made to ensure the continued normal functioning of the required instruments in the event of any malfunction of the additional instruments, systems, or equipment which is not shown to be extremely improbable;

(iii) The equipment, systems, and installations must be designed so that one display of the information essential to the safety of flight which is provided by the instruments will remain available to a pilot, without additional crewmember action, after any single failure or combination of failures that is not shown to be extremely improbable; and

(iv) For single-pilot configuration, instruments which require a static source must be provided with a means of selecting an alternate source and that source must be calibrated.]

Amdt. 27-19, Eff. 3/2/83

FAR 27.B9 : [IX.RotorcraftFlightManual.]

[A Rotorcraft Flight Manual or Rotorcraft Flight Manual IFR Supplement must be provided and must contain—

(a) *Limitations.* The approved IFR flight envelope, the IFR flightcrew composition, the revised kinds of operation, and the steepest IFR precision approach gradient for which the helicopter is approved ;

(b) *Procedures.* Required information for proper operation of IFR systems and the recommended procedures in the event of stability augmentation or electrical system failures ; and

(c) *Performance.* If V_{Si} differs from V_r , climb performance at V_{Si} and with maximum continuous power throughout the ranges of weight, altitude, and temperature for which approval is requested.]

Amdt. 27-19, Eff. 3/2/83

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- (5) Any aperiodic response may not achieve double amplitude in less than 6 seconds.

(b) For helicopters approved with a minimum crew of two pilots—

- (1) Any oscillation having a period of less than 5 seconds must damp to $\frac{1}{2}$ amplitude in not more than two cycles.
- (2) Any oscillation having a period of 5 seconds or more but less than 10 seconds must be damped.
- (3) Any oscillation having a period of 10 seconds or more may not achieve double amplitude in less than 10 seconds.]

Amdt. 27-19, Eff. 3/2/83

FAR 27.B7 : [VII.Stabilityaugmentationssystem(SAS).]

- (a) [If a SAS is used, the reliability of the SAS must be related to the effects of its failure. The occurrence of any failure condition which would prevent continued safe flight and landing must be extremely improbable. For any failure condition of the SAS which is not shown to be extremely improbable—

- (1) The helicopter must be safely controllable and capable of prolonged instrument flight without undue pilot effort. Additional unrelated probable failures affecting the control system must be considered; and
- (2) The flight characteristics requirements in Subpart B of Part 27 must be met throughout a practical flight envelope.
- (b) The SAS must be designed so that it cannot create a hazardous deviation in flight path or produce hazardous loads on the helicopter during normal operation or in the event of malfunction or failure, assuming corrective action begins within an appropriate period of time. Where multiple systems are installed, subsequent malfunction conditions must be considered in sequence unless their occurrence is shown to be improbable.]

Amdt. 27-19, Eff. 3/2/83

FAR 27.B8 : [VIII.Equipment,systems,and installation.]

[The basic equipment and installation must comply with Secs. 29.1303, 29.1431, and 29.1433 through Amendment 29-14, with the following exceptions and additions :

- (a) *Flight and Navigation Instruments.*
- (1) A magnetic gyro-stabilized direction indicator instead of a gyroscopic direction indicator required by Sec. 29.1303(h); and
- (2) A standby attitude indicator which meets the requirements of Secs. 29.1303(g)(1) through (7) instead of a rate-of-turn indicator required by Sec. 29.1303(g). For two-pilot configurations, one pilot's primary indicator may be designed for this purpose. If standby batteries are provided, they may be charged from the aircraft electrical system if adequate isolation is incorporated.
- (b) *Miscellaneous requirements.*
- (1) Instrument systems and other systems essential for IFR flight that could be adversely affected by icing must be adequately protected when exposed to the continuous and intermittent maximum icing conditions defined in Appendix C of Part 29 of this chapter, whether or not the rotorcraft is certified for operation in icing conditions.

FAR 23.407 : Trim tab effects.

The effects of trim tabs on the control surface design conditions must be accounted for only where the surface loads are limited by maximum pilot effort. In these cases, the tabs are considered to be deflected in the direction that would assist the pilot. These deflections must correspond to the maximum degree of "out of trim" expected at the speed for the condition under consideration.

FAR 23.409 : Tabs.

Control surface tabs must be designed for the most severe combination of airspeed and tab deflection likely to be obtained within the flight envelope for any usable loading condition.

FAR 23.415 : Ground gust conditions.

- (a) The control system must be investigated as follows for control surface loads due to ground gusts and taxiing downwind :
- (1) If an investigation of the control system for ground gust loads is not required by subparagraph (2) of this paragraph, but the applicant elects to design a part of the control system of these loads, these loads need only be carried from control surface horns through the nearest stops or gust locks and their supporting structures.
- (2) [If pilot forces less than the minimums specified in Sec. 23.397(b) are used for design, the effects of surface loads due to ground gusts and taxiing downwind must be investigated for the entire control system according to the formula :

$$H = K c S q$$

where—

H : limit hinge moment
(ft.-lbs.);

c : mean chord of the control surface aft of the hinge line
(ft.);

S : area of control surface aft of the hinge line
(sq. ft.);

q : dynamic pressure based on a design speed not less than $14.6 \sqrt{\frac{W}{S}} + 14.6$ (f.p.s.) where $\frac{W}{S}$ = wing loading at design maximum weight, except that the design speed need not exceed 88 (f.p.s.);
(p.s.f.)

K : limit hinge moment factor for ground gusts derived in paragraph (b) of this section. (For alerons and elevators, a positive value of K indicates a moment tending to depress the surface and a negative value of K indicates a moment tending to raise the surface).]

- (b) The limit hinge moment factor K for ground gusts must be derived as follows :

Surface	K	Position of controls
(a) Alleron	0.75	Control column locked or lashed in mid-position.
(b) Aileron	± 0.50	Ailerons at full throw; + moment on one alleron, - moment on the other.
(c) Elevator	± 0.75	(c) Elevator full up (-).
(d) Elevator	-	(d) Elevator full down (+).
(e) Rudder	± 0.75	(e) Rudder in neutral.
(f) Rudder	-	(f) Rudder at full throw.

- (c) [At all weights between the empty weight and the maximum weight declared for tie-down stated in the appropriate manual, any declared tie-down points and surrounding structure, control system, surfaces and associated gust locks, must be designed to withstand the limit load conditions that exist when the airplane is tied down and that result from wind speeds up to 65 knots horizontally from any direction.]

Amdt. 23-48, Eff. 03/11/96

30.4 Horizontal Stabilizing and Balancing Surfaces

FAR 23.421 : Balancing loads.

- (a) A horizontal [surface] balancing load is a load necessary to maintain equilibrium in any specified flight condition with no pitching acceleration.
- (b) Horizontal [balancing] surfaces must be designed for the balancing loads occurring at any point on the limit maneuvering envelope and in the flap conditions specified in Sec. 23.345.

Amdt. 23-42, Eff. 02/04/91

FAR 23.423 : Maneuvering loads.

[Each horizontal surface and its supporting structure, and the main wing of a canard or tandem wing configuration, if that surface has pitch control, must be designed for the maneuvering loads imposed by the following conditions :

- (a) A sudden movement of the pitching control, at the speed V_A , to the maximum aft movement, and the maximum forward movement, as limited by the control stops, or pilot effort, whichever is critical.
- (b) A sudden aft movement of the pitching control at speeds above V_A , followed by a forward movement of the pitching control resulting in the following combinations of normal and angular acceleration :

Condition	Normal acceleration (n)	Angular acceleration (radian/sec ²)
Nose-up pitching	1.0	$+\frac{39}{80} n_m (n_m - 1.5)$
Nose-down pitching	n_m	$-\frac{39}{80} n_m (n_m - 1.5)$

where-

- (1) n_m = positive limit maneuvering load factor used in the design of the airplane; and
- (2) V = initial speed in knots.

- (i) The helicopter trimmed and power adjusted for level flight at $1.1 V_{min}$; and
- (ii) Landing gear retracted (if retractable).
- (4) *Descent*. Stability must be shown throughout the speed range 20 knots either side of trim with-
- (i) The helicopter trimmed at $0.8 V_H$ or $0.8 V_{NE}$; (or $0.8 V_e$ for the landing gear extended case), whichever is lower;
- (ii) Power required for 1,000 fpm descent at trim speed; and
- (iii) Landing gear extended and retracted, if applicable.
- (5) *Approach*. Stability must be shown throughout the speed range from 0.7 times the minimum recommended approach speed to 20 knots above the maximum recommended approach speed with-
- (i) The helicopter trimmed at the recommended approach speed or speeds;
- (ii) Landing gear extended and retracted, if applicable; and
- (iii) Power required to maintain a 3° glide path and power required to maintain the steepest approach gradient for which approval is requested.
- (c) Helicopters approved for a minimum crew of two pilots must comply with the provisions of paragraphs IV(b)(2) and IV(b)(5) of this Appendix.]
- Amdt. 27-19, Eff. 3/2/83

FAR 27.B5 : [V.Staticlateral-directional stability.]

- (a) [Static directional stability must be positive throughout the approved ranges of airspeed, power, and vertical speed. In straight, steady sideslips up to $\pm 10^\circ$ from trim, directional control position must increase in approximately constant proportion to angle of sideslip. At greater angles up to the maximum sideslip angle appropriate to the type, increased directional control position must produce increased angle of sideslip.
- (b) During sideslips up to $\pm 10^\circ$ from trim throughout the approved ranges of airspeed, power, and vertical speed, there must be no negative directional stability perceptible to the pilot through lateral control motion or force. Longitudinal cyclic movement with sideslip must not be excessive.]

Amdt. 27-19, Eff. 3/2/83

FAR 27.B6 : [V1.Dynamicstability.]

- (a) [For single-pilot approval-
- (1) Any oscillation having a period of less than 5 seconds must damp to $\frac{1}{2}$ amplitude in not more than one cycle.
- (2) Any oscillation having a period of 5 seconds or more but less than 10 seconds must damp to $\frac{1}{2}$ amplitude in not more than two cycles.
- (3) Any oscillation having a period of 10 seconds or more but less than 20 seconds must be damped.
- (4) Any oscillation having a period of 20 seconds or more may not achieve double amplitude in less than 20 seconds.

FAR 27.B1 : [I.General.]

[A normal category helicopter may not be type certificated for operation under the instrument flight rules (IFR) of this chapter unless it meets the design and installation requirements contained in this Appendix.]
Amdt. 27-19, Eff. 3/2/83

FAR 27.B2 : [II.Definitions.]

- (a) [V_{Y_i} means instrument climb speed, utilized instead of V_Y for compliance with the climb requirements for instrument flight.
(b) V_{NE_i} means instrument flight never exceed speed, utilized instead of V_{NE} for compliance with maximum limit speed requirements for instrument flight.
(c) V_{mini} means instrument flight minimum speed, utilized in complying with minimum limit speed requirements for instrument flight.]

Amdt. 27-19, Eff. 3/2/83

FAR 27.B3 : [III.Trim.]

[It must be possible to trim the cyclic, collective, and directional control forces to zero at all approved IFR airspeeds, power settings, and configurations appropriate to the type.]
Amdt. 27-19, Eff. 3/2/83

FAR 27.B4 : [IV.Static longitudinal stability.]

- (a) [*General.* The helicopter must possess positive static longitudinal control force stability at critical combinations of weight and center of gravity at the conditions specified in paragraph IV(b) or (c) of this Appendix, as appropriate. The stick force must vary with speed so that any substantial speed change results in a stick force clearly perceptible to the pilot. For single-pilot approval, the airspeed must return to within 10 percent of the trim speed when the control force is slowly released for each trim condition specified in paragraph IV(b) of this Appendix.

(b) For single-pilot approval :

- (1) *Climb.* Stability must be shown in climb throughout the speed range 20 knots either side of trim with—
 - (i) The helicopter trimmed at V_{Y_i} ;
 - (ii) Landing gear retracted (if retractable); and
 - (iii) Power required for limit climb rate (at least 1,000 fpm) at V_{Y_i} or maximum continuous power, whichever is less.
- (2) *Cruise.* Stability must be shown throughout the speed range from 0.7 to 1.1 V_H or V_{NE_i} , whichever is lower, not to exceed ± 20 knots from trim with—
 - (i) The helicopter trimmed and power adjusted for level flight at 0.9 V_H or 0.9 V_{NE_i} , whichever is lower and
 - (ii) Landing gear retracted (if retractable).
- (3) *Slow cruise.* Stability must be shown throughout the speed range from 0.9 V_{mini} to 1.3 V_{mini} or 20 knots above trim speed, whichever is greater, with—

The conditions in this paragraph involve loads corresponding to the loads that may occur in a "checked maneuver" (a maneuver in which the pitching control is suddenly displaced in one direction and then suddenly moved in the opposite direction). The deflections and timing of the "checked maneuver" must avoid exceeding the limit maneuvering load factor. The total horizontal surface load for both nose-up and nose-down pitching conditions is the sum of the balancing loads at V and the specified value of the normal load factor n , plus the maneuvering load increment due to the specified value of the angular acceleration.]

Amdt. 23-42, Eff. 02/04/91

FAR 23.425 : Gust loads.

- (a) [Each horizontal surface, other than a main wing, must be designed for loads resulting from—
(1) Gust velocities specified in Sec. 23.333(c) with flaps retracted; and
(2) Positive and negative gusts of 25 f.p.s. nominal intensity at V_F , corresponding to the flight conditions specified in Sec. 23.345(a)(2).]
(b) [[Reserved].]
(c) When determining the total load on the horizontal surfaces for the conditions specified in paragraph (a) of this section, the initial balancing loads for steady unaccelerated flight at the pertinent design speeds V_F , V_C , and V_D must first be determined. The incremental load resulting from the gusts must be added to the initial balancing load to obtain the total load.
(d) In the absence of a more rational analysis, the incremental load due to the gust must be computed as follows only on airplane configurations with aft-mounted, horizontal surfaces, unless its use elsewhere is shown to be conservative:]

$$\Delta L_{ht} = \frac{K_g U_{de} V_{aht} S_{ht}}{498} \left(1 - \frac{d_e}{d_a} \right)$$

where—

ΔL_{ht}	:Incremental horizontal tail load	(lbs.);
K_g	:Gust alleviation factor defined in Sec. 23.341;	
U_{de}	:Derived gust velocity	(f.p.s.);
V	:Airplane equivalent speed	(knots);
a_{ht}	:Slope of aft horizontal tail lift curve]	(per radian);
S_{ht}	:Area of aft horizontal lift surface]	(ft ²);
$\left(1 - \frac{d_e}{d_a}\right)$	:[Downwash factor].	

Amdt. 23-42, Eff. 02/04/91

FAR 23.427 : Unsymmetrical loads.

- (a) [Horizontal surfaces other than main wing and their supporting structure must be designed for unsymmetrical loads arising from yawing and slip-stream effects, in combination with the loads prescribed for the flight conditions set forth in Secs. 23.421 through 23.425.
(b) In the absence of more rational data for airplanes that are conventional in regard to location of engines, wings, horizontal surfaces other than main wing, and fuselage shape—]

- (1) 100 percent of the maximum loading from the symmetrical flight conditions may be assumed on the surface on one side of the plane of symmetry ; and
- (2) The following percentage of that loading must be applied to the opposite side :
 $\% = 100 - 10(nz - 1)$, where nz is the specified positive maneuvering load factor, but this value may not be more than 80 percent.

(c) [For airplanes that are not conventional (such as airplanes with horizontal surfaces other than main wing having appreciable dihedral or supported by the vertical tail surfaces) the surfaces and supporting structures must be designed for combined vertical and horizontal surface loads resulting from each prescribed flight condition taken separately.]

Amdt. 23-42, Eff. 02/04/91

30.5 Vertical Surfaces

FAR 23.441 : Maneuvering loads.

- (a) At speeds up to V_A , the vertical surfaces must be designed to withstand the following conditions. In computing the loads, the yawing velocity may be assumed to be zero :
 - (1) With the airplane in unaccelerated flight at zero yaw, it is assumed that the rudder control is suddenly displaced to the maximum deflection, as limited by the control stops or by limit pilot forces.
 - (2) [With the rudder deflected as specified in paragraph (a)(1) of this section, it is assumed that the airplane yaws to the overswing sideslip angle. In lieu of a rational analysis, an overswing angle equal to 1.5 times the static sideslip angle of paragraph (a)(3) of this section may be assumed.]
 - (3) A yaw angle of 15° with the rudder control maintained in the neutral position (except as limited by pilot strength).
- (b) [For commuter category airplanes, the loads imposed by the following additional maneuver must be substantiated at speeds from V_A to V_D/M_D . When computing the tail loads–
 - (1) The airplane must be yawed to the largest attainable steady state sideslip angle, with the rudder at maximum deflection caused by any one of the following :
 - (i) Control surface stops ;
 - (ii) Maximum available booster effort ;
 - (iii) Maximum pilot rudder force as shown below :
 - (2) The rudder must be suddenly displaced from the maximum deflection to the neutral position.]
- (c) The yaw angles specified in paragraph (a)(3) of this section may be reduced if the yaw angle chosen for a particular speed cannot be exceeded in–
 - (1) Steady slip conditions ;
 - (2) Uncoordinated rolls from steep banks ; or
 - (3) Sudden failure of the critical engine with delayed corrective action.

Amdt. 23-48, Eff. 03/11/96

Chapitre 69

Appendix B : Airworthiness Criteria for Helicopter Instrument Flight

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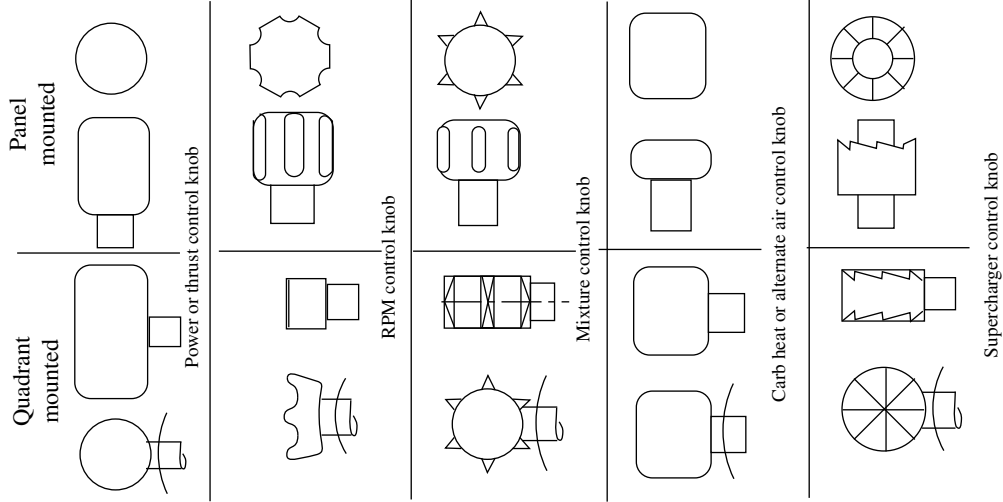


FIG. 30.2 – Maximum Pilot Rudder Force.

FAR 23.443 : Gust loads.

(a) Vertical surfaces must be designed to withstand, in unaccelerated flight at speed V_C , lateral gusts or the values prescribed for V_C in Sec. 23.333(c).

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- (b) In addition, for commuter category airplanes, the airplane is assumed to encounter derived gusts normal to the plane of symmetry while in unaccelerated flight at V_B , V_C , V_D , and V_F . The derived gusts and airplane speeds corresponding to these conditions, as determined by Secs. 23.341 and 23.345, must be investigated. The shape of the gust must be as specified in Sec. 23.333(c)(2)(i).
- (c) [In the absence of a more rational analysis, the gust load must be computed as follows :

$$L_{vi} = \frac{K_{gi} U_{de} V a_{vi} S_{vi}}{498}$$

where—

- L_{vi} Vertical surface loads (lbs.) ;
 K_{gi} gust alleviation factor : $K_{gi} = \frac{0.88 a_{vi}}{0.3 + \mu_{gr}} ;$
 μ_{gr} lateral mass ratio : $\mu_{gr} = \frac{2 W}{\rho c_i g a_{vi} S_{vi}} K^2 ;$
 U_{de} Derived gust velocity (ft.p.s.) ;
 ρ Air density (slugs/cu.ft.) ;
 W the applicable weight of the airplane in the particular load case (lbs.) ;
 S_{vi} Area of vertical surface (ft.²) ;
 c_i Mean geometric chord of vertical surface (ft.) ;
 a_{vi} Lift curve slope of vertical surface (per radian) ;
 K Radius of gyration in yaw (ft.) ;
 l_{vi} Distance from airplane c.g. to lift center of vertical surface (ft.) ;
 g Acceleration due to gravity (ft./sec.²) ; and
 V Equivalent airspeed (knots) ;]

Amdt. 23-48, Eff. 03/11/96

FAR 23.445 : Outboard fins [or winglets.]

- (a) [If outboard fins or winglets are included on the horizontal surfaces or wings, the horizontal surfaces or wings must be designed for their maximum load in combination with loads induced by the fins or winglets and moments or forces exerted on the horizontal surfaces or wings by the fins or winglets.]
- (b) If outboard fins [or winglets] extend above and below the horizontal surface, the critical vertical surface loading (the load per unit area as determined under Secs. 23.441 and 23.443) must be applied to—
- (1) The part of the vertical surfaces above the horizontal surface with 80 percent of that loading applied to the part below the horizontal surface ; and
 - (2) The part of the vertical surfaces below the horizontal surface with 80 percent of that loading applied to the part above the horizontal surface ;
- (c) The end plate effects of outboard fins [or winglets] must be taken into account in applying the yawing conditions of Sec. 23.441 and Sec. 23.443 to vertical surfaces in paragraph (b) of this section.
- (d) [When rational methods are used for computing loads, the maneuvering loads of Sec. 23.441 on the vertical surfaces and the one-g horizontal surface load, including induced loads on the horizontal surface and moments or forces exerted on the horizontal surfaces by the vertical surfaces, must be applied simultaneously for the structural loading condition.]

Amdt. 23-42, Eff. 02/04/91

tested, and lubricated, and the degree of inspection, the applicable wear tolerances, and work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree of complexity requiring specialized maintenance techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross reference to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the aircraft.

- (2) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.
 - (3) Information describing the order and method of removing and replacing products and parts with any necessary precautions to be taken.
 - (4) Other general procedural instructions including procedures for system testing during ground running, symmetry checks, weighing and determining the center of gravity, lifting and shoring, and storage limitations.
 - (c) Diagrams of structural access plates and information needed to gain access for inspections when access plates are not provided.
 - (d) Details for the application of special inspection techniques including radiographic and ultrasonic testing where such processes are specified.
 - (e) Information needed to apply protective treatments to the structure after inspection.
 - (f) All data relative to structural fasteners such as identification, discard recommendations, and torque values.
 - (g) A list of special tools needed.]
- Amdt. 27-18, Eff. 10/14/80

FAR 27.A.4 : Airworthiness Limitations section

The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, structural inspection interval, and related structural inspection procedure approved under Sec. 27.571. If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads : "The Airworthiness Limitations section is FAA approved and specifies maintenance required under Secs. 43.16 and [91.409] of the Federal Aviation Regulations unless an alternative program has been FAA approved."

Amdt. 27-24, Eff. 8/18/90

FAR 27.A1 : [General.]

- (a) [This appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by Sec. 27.1529.
- (b) The Instructions for Continued Airworthiness for each rotorcraft must include the Instructions for Continued Airworthiness for each engine and rotor (hereinafter designated 'products'), for each appliance required by this chapter, and any required information relating to the interface of those appliances and products with the rotorcraft. If Instructions for Continued Airworthiness are not supplied by the manufacturer of an appliance or product installed in the rotorcraft, the Instructions for Continued Airworthiness for the rotorcraft must include the information essential to the continued airworthiness of the rotorcraft.
- (c) The applicant must submit to the FAA a program to show how changes to the Instructions for Continued Airworthiness made by the applicant or by the manufacturers of products and appliances installed in the rotorcraft will be distributed.]

Amdt. 27-18, Eff. 10/14/80

FAR 27.A2 : [Format.]

- (a) [The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.
- (b) The format of the manual or manuals must provide for a practical arrangement.]

Amdt. 27-18, Eff. 10/14/80

FAR 27.A3 : [Content.]

[The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following manuals or sections, as appropriate, and information :

- (a) *Rotorcraft maintenance manual or section.*

- (1) Introduction information that includes an explanation of the rotorcraft's features and data to the extent necessary for maintenance or preventive maintenance.
- (2) A description of the rotorcraft and its systems and installations including its engines, rotors, and appliances.
- (3) Basic control and operation information describing how the rotorcraft components and systems are controlled and how they operate, including any special procedures and limitations that apply.
- (4) Servicing information that covers details regarding servicing points, capacities of tanks, reservoirs, types of fluids to be used, pressures applicable to the various systems, location of access panels for inspection and servicing, locations of lubrication points, lubricants to be used, equipment required for servicing, tow instructions and limitations, mooring, jacking, and leveling information.

- (b) *Maintenance Instructions.*

- (1) Scheduling information for each part of the rotorcraft and its engines, auxiliary power units, rotors, accessories, instruments, and equipment that provides the recommended periods at which they should be cleaned, inspected, adjusted,

30.6 Ailerons and Special Devices**FAR 23.455 : Ailerons.**

- (a) The ailerons must be designed for the loads to which they are subjected—
- (1) In the neutral position during symmetrical flight conditions ; and
- (2) By the following deflections (except as limited by pilot effort), during unsymmetrical flight conditions :
- (i) Sudden maximum displacement of the aileron control at V_A . Suitable allowance may be made for control system deflections.
- (ii) Sufficient deflection at V_C , where V_C is more than V_A , to produce a rate of roll not less than obtained in paragraph (a)(2)(i) of this section.
- (iii) Sufficient deflection at V_D to produce a rate of roll not less than one-third of that obtained in paragraph (a)(2)(i) of this section.

- (b) [Reserved.]

Amdt. 23-48, Eff. 3/11/96

FAR 23.457 : [Removed.]

[Removed.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.459 : Special devices.

The loading for special devices using aerodynamic surfaces (such as slots and spoilers) must be determined from test data.

30.7 Ground Loads**FAR 23.471 : General.**

The limit ground loads specified in this subpart are considered to be external loads and inertia forces that act upon an airplane structure. In each specified ground load condition, the external reactions must be placed in equilibrium with the linear and angular inertia forces in a rational or conservative manner.

FAR 23.473 : Ground load conditions and assumptions.

- (a) The ground load requirements of this subpart must be complied with at the design maximum weight except that Secs. 23.479, 23.481, and 23.483 may be complied with at a design landing weight (the highest weight for landing conditions at the maximum descent velocity) allowed under paragraphs (b) and (c) of this section.
- (b) The design landing weight may be as low as—
- (1) 95 percent of the maximum weight if the minimum fuel capacity is enough for at least one-half hour of operation at maximum continuous power plus a capacity equal to a fuel weight which is the difference between the design maximum weight and the design landing weight ; or
- (2) The design maximum weight less the weight of 25 percent of the total fuel capacity.

- (c) The design landing weight of a multiengine airplane may be less than that allowed under paragraph (b) of this section if—
- (1) [The airplane meets the one-engine-inoperative climb requirements of Sec. 23.67(b)(1) or (c); and]
 - (2) Compliance is shown with the fuel jettisoning system requirements of Sec. 23.1001.
- (d) The selected limit vertical inertia load factor at the center of gravity of the airplane for the ground load conditions prescribed in this subpart may not be less than that which would be obtained when landing with a descent velocity (V), in feet per second, equal to $4.4(W/S)^{\frac{1}{4}}$ except that this velocity need not be more than 10 feet per second and may not be less than seven feet per second.
- (e) Wing lift not exceeding two-thirds of the weight of the airplane may be assumed to exist throughout the landing impact and to act through the center of gravity. The ground reaction load factor may be equal to the inertia load factor minus the ratio of the above assumed wing lift to the airplane weight.
- (f) [If energy absorption tests are made to determine the limit load factor corresponding to the required limit descent velocities, these tests must be made under Sec. 23.723(a).]
- (g) No inertia load factor used for design purposes may be less than 2.67, nor may the limit ground reaction load factor be less than 2.0 at design maximum weight, unless these lower values will not be exceeded in taxiing at speeds up to takeoff speed over terrain as rough as that expected in service.

Amdt. 23-48, Eff. 03/11/96

FAR 23.477 : Landing gear arrangement.

Sections 23.479 through 23.483, or the conditions in Appendix C, apply to airplanes with conventional arrangements of main and nose gear, or main and tail gear.

FAR 23.479 : Level landing conditions.

- (a) For a level landing, the airplane is assumed to be in the following attitudes :
- (1) For airplanes with tail wheels, a normal level flight attitude.
 - (2) For airplanes with nose wheels, attitudes in which—
 - (i) The nose and main wheels contact the ground simultaneously; and
 - (ii) The main wheels contact the ground and the nose wheel is just clear of the ground.

The attitude used in paragraph (a)(2)(i) of this section may be used in the analysis required under paragraph (a)(2)(ii) of this section.

- (b) [When investigating landing conditions, the drag components simulating the forces required to accelerate the tires and wheels up to the landing speed (spin-up) must be properly combined with the corresponding instantaneous vertical ground reactions, and the forward-acting horizontal loads resulting from rapid reduction of the spin-up drag loads (spring-back) must be combined with vertical ground reactions at the instant of the peak forward load, assuming wing lift and a tire-sliding coefficient of friction of 0.8. However, the drag loads may not be less than 25 percent of the maximum vertical ground reactions (neglecting wing lift).]

Chapitre 68

Appendix A : Instructions for Continued Airworthiness

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- (c) In the absence of specific tests or a more rational analysis for determining the wheel spin-up and spring-back loads for landing conditions, the method set forth in appendix D of this part must be used. If appendix D of this part is used, the drag components used for design must not be less than those given by appendix C of this part.]
- (d) For airplanes with tip tanks or large overhung masses (such as turbo-propeller or jet engines) supported by the wing, the tip tanks and the structure supporting the tanks or overhung masses must be designed for the effects of dynamic responses under the level landing conditions of either paragraph (a)(1) or (a)(2)(ii) of this section. In evaluating the effects of dynamic response, an airplane lift equal to the weight of the airplane may be assumed.

Amdt. 23-45, Eff. 09/07/93

FAR 23.481 : Tail down landing conditions.

- (a) For a tail down landing, the airplane is assumed to be in the following attitudes :
- (1) For airplanes with tail wheels, an attitude in which the main and tail wheels contact the ground simultaneously.
 - (2) For airplanes with nose wheels, a stalling attitude, or the maximum angle allowing ground clearance by each part of the airplane, whichever is less.
- (b) For airplanes with either tail or nose wheels, ground reactions are assumed to be vertical, with the wheels up to speed before the maximum vertical load is attained.

FAR 23.483 : One-wheel landing conditions.

For the one-wheel landing condition, the airplane is assumed to be in the level attitude and to contact the ground on one side of the main landing gear. In this attitude, the ground reactions must be the same as those obtained on that side under Sec. 23.479.

FAR 23.485 : Side load conditions.

- (a) For the side load condition, the airplane is assumed to be in a level attitude with only the main wheels contacting the ground and with the shock absorbers and tires in their static positions.
- (b) The limit vertical load factor must be 1.33, with the vertical ground reaction divided equally between the main wheels.
- (c) The limit side inertia factor must be 0.83, with the side ground reaction divided between the main wheels so that—
- (1) $0.5(W)$ is acting inboard on one side; and
 - (2) $0.33(W)$ is acting outboard on the other side.
- (d) [The side loads prescribed in paragraph (c) of this section are assumed to be applied at the ground contact point and the drag loads may be assumed to be zero.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.493 : Braked roll conditions.

Under braked roll conditions, with the shock absorbers and tires in their static positions, the following apply :

- (a) The limit vertical load factor must be 1.33.
- (b) The attitudes and ground contacts must be those described in Sec. 23.479 for level landings.
- (c) A drag reaction equal to the vertical reaction at the wheel multiplied by a coefficient of friction of 0.8 must be applied at the ground contact point of each wheel with brakes, except that the drag reaction need not exceed the maximum value based on limiting brake torque.

FAR 23.497 : Supplementary conditions for tail wheels.

In determining the ground loads on the tail wheel and affected supporting structures, the following apply :

- (a) For the obstruction load, the limit ground reaction obtained in the tail down landing condition is assumed to act up and aft through the axle at 45°. The shock absorber and tire may be assumed to be in their static positions.
- (b) For the side load, a limit vertical ground reaction equal to the static load on the tail wheel, in combination with a side component of equal magnitude, is assumed. In addition—
 - (1) If a swivel is used, the tail wheel is assumed to be swiveled 90° to the airplane longitudinal axis with the resultant ground load passing through the axle ;
 - (2) If a lock, steering device, or shimmy damper is used, the tail wheel is also assumed to be in the trailing position with the side load acting at the ground contact point ; and
 - (3) The shock absorber and tire are assumed to be in their static positions.
- (c) [If a tail wheel, bumper, or an energy absorption device is provided to show compliance with Sec. 23.925(b), the following apply :
 - (1) Suitable design loads must be established for the tail wheel, bumper, or energy absorption device ; and
 - (2) The supporting structure of the tail wheel, bumper, or energy absorption device must be designed to withstand the loads established in paragraph (c)(1) of this section.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.499 : Supplementary conditions for nose wheels.

In determining the ground loads on nose wheels and affected supporting structures, and assuming that the shock absorbers and tires are in their static positions, the following conditions must be met :

- (a) For aft loads, the limit force components at the axle must be—
 - (1) A vertical component of 2.25 times the static load on the wheel ; and
 - (2) A drag component of 0.8 times the vertical load.
- (b) For forward loads, the limit force components at the axle must be—

FAR 27.1587 : Performance information

- (a) The rotorcraft must be furnished with the following information, determined in accordance with Secs. 27.51 through 27.79 and 27.143(c) :

- (1) Enough information to determine the limiting height-speed envelope.
- (2) Information relative to—
 - (i) The hovering ceilings and the steady rates of climb and descent, as affected by any pertinent factors such as airspeed, temperature, and altitude ;
 - (ii) [The maximum safe wind for operation near the ground. If there are combinations of weight, altitude, and temperature for which performance information is provided and at which the rotorcraft cannot land and takeoff safely with the maximum wind value, those portions of the operating envelope and the appropriate safe wind conditions shall be identified in the flight manual ;
 - (iii) For reciprocating engine-powered rotorcraft, the maximum atmospheric temperature at which compliance with the cooling provisions of Secs. 27.1041 through 27.1045 is shown ; and
 - (iv) Glide distance as a function of altitude when autorotating at the speeds and conditions for minimum rate of descent and best glide as determined in Sec. 27.71.]
- (b) The Rotorcraft Flight Manual must contain—
 - (1) [In its performance information section any pertinent information concerning the takeoff weights and altitudes used in compliance with Sec. 27.51 ; and
 - (2) The horizontal takeoff distance determined in accordance with Sec. 27.65 (a)(2)(i).]

Amdt. 27-21, Eff. 12/6/84

FAR 27.1589 : Loading information

There must be loading instructions for each possible loading condition between the maximum and minimum weights determined under Sec. 27.25 that can result in a center of gravity beyond any extreme prescribed in Sec. 27.27, assuming any probable occupant weights.

- (3) Information necessary for marking the instruments required by Secs. 27.1549 through 27.1553.

(c) *Weight and loading distribution.* The weight and center of gravity limits required by Secs. 27.25 and 27.27, respectively, must be furnished. If the variety of possible loading conditions warrants, instructions must be included to allow ready observance of the limitations.

(d) *Flight crew.* When a flight crew of more than one is required, the number and functions of the minimum flight crew determined under Sec. 27.1523 must be furnished.

(e) *Kinds of operation.* Each kind of operation for which the rotorcraft and its equipment installations are approved must be listed.

(f) [[Reserved]]

(g) *Altitude.* The altitude established under Sec. 27.1527 and an explanation of the limiting factors must be furnished.

Amdt. 27-16, Eff. 12/1/78

FAR 27.1585 : Operating Procedures

(a) [Parts of the manual containing operating procedures must have information concerning any normal and emergency procedures and other information necessary for safe operation, including takeoff and landing procedures and associated airspeeds. The manual must contain any pertinent information including—

(1) The kind of takeoff surface used in the tests and each appropriate climbout speed; and

(2) The kind of landing surface used in the tests and appropriate approach and glide airspeeds.]

(b) For multiengine rotorcraft, information identifying each operating condition in which the fuel system independence prescribed in Sec. 27.953 is necessary for safety must be furnished, together with instructions for placing the fuel system in a configuration used to show compliance with that section.

(c) For helicopters for which a V_{NE} (power-off) is established under Sec. 27.1505(c), information must be furnished to explain the V_{NE} (power-off) and the procedures for reducing airspeed to not more than the V_{NE} (power-off) following failure of all engines.

(d) For each rotorcraft showing compliance with Sec. 27.1353(g)(2) or (g)(3), the operating procedures for disconnecting the battery from its charging source must be furnished.

(e) If the unusable fuel supply in any tank exceeds five percent of the tank capacity, or one gallon, whichever is greater, information must be furnished which indicates that when the fuel quantity indicator reads "zero" in level flight, any fuel remaining in the fuel tank cannot be used safely in flight.

(f) Information on the total quantity of usable fuel for each fuel tank must be furnished.

(g) [The airspeeds and rotor speeds for minimum rate of descent and best glide angle as prescribed in Sec. 27.71 must be provided.]

Amdt. 27-21, Eff. 12/6/84

- (1) A vertical component of 2.25 times the static load on the wheel; and
(2) A forward component of 0.4 times the vertical load.

(c) For side loads, the limit force components at ground contact must be—

- (1) A vertical component of 2.25 times the static load on the wheel; and
(2) A side component of 0.7 times the vertical load.

(d) [For airplanes with a steerable nose wheel that is controlled by hydraulic or other power, at design takeoff weight with the nose wheel in any steerable position, the application of 1.33 times the full steering torque combined with a vertical reaction equal to 1.33 times the maximum static reaction on the nose gear must be assumed. However, if a torque limiting device is installed, the steering torque can be reduced to the maximum value allowed by that device.]

(e) For airplanes with a steerable nose wheel that has a direct mechanical connection to the rudder pedals, the mechanism must be designed to withstand the steering torque for the maximum pilot forces specified in Sec. 23.397(b).]

Amdt. 23-48, Eff. 03/11/96

FAR 23.505 : Supplementary conditions for skiplanes.

[In determining ground loads for skiplanes, and assuming that the airplane is resting on the ground with one main ski frozen at rest and the other skis free to slide, a limit side force equal to 0.036 times the design maximum weight must be applied near the tail assembly, with a factor of safety of 1.]

Amdt. 23-7, Eff. 09/14/69

FAR 23.507 : [Jacking loads.]

(a) [The airplane must be designed for the loads developed when the aircraft is supported on jacks at the design maximum weight assuming the following load factors for landing gear jacking points at a three-point attitude and for primary flight structure jacking points in the level attitude :

(1) Vertical-load factor of 1.35 times the static reactions.

(2) Fore, aft, and lateral load factors of 0.4 times the vertical static reactions.

(b) The horizontal loads at the jack points must be reacted by inertia forces so as to result in no change in the direction of the resultant loads at the jack points.

(c) The horizontal loads must be considered in all combinations with the vertical load.]

Amdt. 23-14, Eff. 12/20/73

FAR 23.509 : [Towing loads.]

[The towing loads of this section must be applied to the design of tow fittings and their immediate attaching structure.]

(a) The towing loads specified in paragraph (d) of this section must be considered separately. These loads must be applied at the towing fittings and must act parallel to the ground. In addition—

- (1) A vertical load factor equal to 1.0 must be considered acting at the center of gravity; and

(2) The shock struts and tires must be in their static positions.

(b) For towing points not on the landing gear but near the plane of symmetry of the airplane, the drag and side tow load components specified for the auxiliary gear apply. For towing points located outboard of the main gear, the drag and side tow load components specified for the main gear apply. Where the specified angle of swivel cannot be reached, the maximum obtainable angle must be used.

(c) The towing loads specified in paragraph (d) of this section must be reacted as follows :

(1) The side component of the towing load at the main gear must be reacted by a side force at the static ground line of the wheel to which the load is applied.

(2) The towing loads at the auxiliary gear and the drag components of the towing loads at the main gear must be reacted as follows :

(i) A reaction with a maximum value equal to the vertical reaction must be applied at the axle of the wheel to which the load is applied. Enough airplane inertia to achieve equilibrium must be applied.

(ii) The loads must be reacted by airplane inertia.

(d) The prescribed towing loads are as follows, where W is the design maximum weight :

<i>Tow point</i>	<i>Position</i>	<i>Magnitude</i>	<i>No.</i>	<i>Load Direction</i>
Main gear		0.225W per main gear unit	1.	Forward, parallel to drag axis.
Auxiliary Gear	Swiveled forward	0.3W	2.	Forward, at 30° to drag axis.
			3.	Aft, parallel to drag axis.
			4.	Aft, at 30° to drag axis.
	Swiveled aft	0.3W	5.	Forward.
			6.	Aft.
	Swiveled 45° from forward	0.15W	7.	Forward.
			8.	Aft.
	Swiveled 45° from aft	0.15W	9.	Forward, in plane of wheel.
			10.	Aft, in plane of wheel.
			11.	Forward, in plane of wheel.
			12.	Aft, in plane of wheel.

Amdt. 23-14, Eff. 12/20/73

FAR 23.511 : [Ground load ; unsymmetrical loads on multiple-wheel units.]

(a) [*Pivoting loads.* The airplane is assumed to pivot about on side on the main gear with—

(1) The brakes on the pivoting unit locked ; and

(2) Loads corresponding to a limit vertical load factor of 1, and coefficient of friction of 0.8, applied to the main gear and its supporting structure.

(b) [*Unequal tire loads.* The loads established under Secs. 23.471 through 23.483 must be applied in turn, in a 60/40 percent distribution, to the dual wheels and tires in each dual wheel landing gear unit.

(c) [*Deflated tire loads.* For the deflated tire condition—

(1) 60 percent of the loads established under Secs. 23.471 through 23.483 must be applied in turn to each wheel in a landing gear unit ; and

FAR 27.1559 : Limitations placard

[There must be a placard in clear view of the pilot that specifies the kinds of operations (such as VFR, IFR, day, night, or icing) for which rotorcraft is approved.]
Amdt. 27-21, Eff. 12/6/84

FAR 27.1561 : Safety equipment

(a) Each safety equipment control to be operated by the crew in emergency, such as controls for automatic liferaft releases, must be plainly marked as to its method of operation.

(b) Each location, such as a locker or compartment, that carries any fire extinguishing, signaling, or other life saving equipment, must be so marked.

FAR 27.1565 : Tail rotor

[Each tail rotor must be marked so that its disc is conspicuous under normal daylight ground conditions.]
Amdt. 27-2, Eff. 2/25/68

67.3 Rotorcraft Flight Manual and Approved Manual Material

FAR 27.1581 : General

(a) [*Furnishing information.* A Rotorcraft Flight Manual must be furnished with each rotorcraft, and it must contain the following :

(1) Information required by Secs. 27.1583 through 27.1589.

(2) Other information that is necessary for safe operation because of design, operation, or handling characteristics.

(b) [*Approved information.* Each part of the manual listed in Secs. 27.1583 through 27.1589, that is appropriate to the rotorcraft, must be furnished, verified, and approved, and must be segregated, identified, and clearly distinguished from each unapproved part of that manual.

(c) [Reserved.]

(d) [*Table of contents.* Each Rotorcraft Flight Manual must include a table of contents if the complexity of the manual indicates a need for it.]

Amdt. 27-14, Eff. 3/1/78

FAR 27.1583 : Operating limitations

(a) [*Airspeed and rotor limitations.* Information necessary for the marking of airspeed and rotor limitations on, or near, their respective indicators must be furnished. The significance of each limitation and of the color coding must be explained.

(b) [*Powerplant limitations.* The following information must be furnished :

(1) Limitations required by Sec. 27.1521.

(2) Explanation of the limitations, when appropriate.

- (1) Each fuel tank selector control must be marked to indicate the position corresponding to each tank and to each existing cross feed position ;
- (2) If safe operation requires the use of any tanks in a specific sequence, that sequence must be marked on, or adjacent to, the selector for those tanks ; and
- (3) Each valve control for any engine of a multieengine rotorcraft must be marked to indicate the position corresponding to each engine controlled.
- (c) Usable fuel capacity must be marked as follows :
 - (1) For fuel systems having no selector controls, the usable fuel capacity of the system must be indicated at the fuel quantity indicator.
 - (2) For fuel systems having selector controls, the usable fuel capacity available at each selector control position must be indicated near the selector control.
- (d) For accessory, auxiliary, and emergency controls—
 - (1) Each essential visual position indicator, such as those showing rotor pitch or landing gear position, must be marked so that each crewmember can determine at any time the position of the unit to which it relates; and
 - (2) Each emergency control must be red and must be marked as to method of operation.
- (e) [For rotorcraft incorporating retractable landing gear, the maximum landing gear operating speed must be displayed in clear view of the pilot.]

Amdt. 27-21, Eff. 12/6/84

FAR 27.1557 : Miscellaneous markings and placards

- (a) *Baggage and cargo compartments, and ballast location.* Each baggage and cargo compartment, and each ballast location must have a placard stating any limitations on contents, including weight, that are necessary under the loading requirements.
- (b) *Seats.* If the maximum allowable weight to be carried in a seat is less than 170 pounds, a placard stating the lesser weight must be permanently attached to the seat structure.
- (c) *[Fuel and oil filler openings.* The following apply :
 - (1) Fuel filler openings must be marked at or near the filler cover with—
 - (i) The word "fuel" ;
 - (ii) For reciprocating engine powered rotorcraft, the minimum fuel grade ;
 - (iii) For turbine engine powered rotorcraft, the permissible fuel designations ; and
 - (iv) For pressure fueling systems, the maximum permissible fueling supply pressure and the maximum permissible defueling pressure.
 - (2) Oil filler openings must be marked at or near the filler cover with the word "oil" ;]
- (d) *Emergency exit placards.* Each placard and operating control for each emergency exit must be red. A placard must be near each emergency exit control and must clearly indicate the location of that exit and its method of operation.

Amdt. 27-11, Eff. 2/1/77

- (2) 60 percent of the limit drag and side loads and 100 percent of the limit vertical load established under Secs. 23.485 and 23.493 or lesser vertical load obtained under subparagraph (1) of this paragraph, must be applied in turn to each wheel in the dual wheel landing gear unit.]

Amdt. 23-7, Eff. 09/14/69

30.8 Water Loads**FAR 23.521 : Water load conditions.**

- (a) The structure of seaplanes and amphibians must be designed for water loads developed during takeoff and landing with the seaplane in any attitude likely to occur in normal operation at appropriate forward and sinking velocities under the most severe sea conditions likely to be encountered.
- (b) Unless the applicant makes a rational analysis of the water loads, Secs. 23.523 through 23.537 apply.
- (c) [Removed.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.523 : Design weights and center of gravity positions.]

- (a) *[Design weights.* The water load requirements must be met at each operating weight up to the design landing weight except that, for the takeoff condition prescribed in Sec. 23.531, the design water takeoff weight (the maximum weight for water taxi and takeoff run) must be used.
- (b) *Center of gravity positions.* The critical centers of gravity within the limits for which certification is requested must be considered to reach maximum design loads for each part of the seaplane structure.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.525 : [Application of loads.]

- (a) Unless otherwise prescribed, the seaplane as a whole is assumed to be subjected to the loads corresponding to the load factors specified in Sec. 23.527.
- (b) In applying the loads resulting from the load factors prescribed in Sec. 23.527, the loads may be distributed over the hull or main float bottom (in order to avoid excessive local shear loads and bending moments at the location of water load application) using pressures not less than those prescribed in Sec. 23.533(c).
- (c) For twin float seaplanes, each float must be treated as an equivalent hull on a fictitious seaplane with a weight equal to one-half the weight of the twin float seaplane.
- (d) Except in the takeoff condition of Sec. 23.531, the aerodynamic lift on the seaplane during the impact is assumed to be $\frac{2}{3}$ of the weight of the seaplane.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.527 : [Hull and main float load factors.]

- (a) [Water reaction load factors
- n_w
- must be computed in the following manner :

- (1) For the step landing case

$$n_w = \frac{C_1 V s_0^2}{(\tan \beta)^{\frac{2}{3}} W^{\frac{1}{3}}}$$

- (2) For the bow and stern landing cases

$$n_w = \frac{C_1 V s_0^2}{(\tan \beta)^{\frac{2}{3}} W^{\frac{1}{3}}} \frac{K_1}{(1 + r_x^2)^{\frac{1}{3}}}$$

- (b) The following values are used :

- (1)
- n_w
- = water reaction load factor (that is, the water reaction divided by seaplane weight).

- (2)
- C_1
- = empirical seaplane operations factor equal to 0.012 (except that this factor may not be less than that necessary to obtain the minimum value of step load factor of 2.33).

- (3)
- $V s_0$
- = seaplane stalling speed in knots with flaps extended in the appropriate landing position and with no slipstream effect.

- (4)
- β
- = angle of dead rise at the longitudinal station at which the load factor is being determined in accordance with figure 1 of appendix 1 of this part.

- (5)
- W
- = seaplane design landing weight in pounds.

- (6)
- K_1
- = empirical hull station weighing factor, in accordance with figure 2 of appendix 1 of this part.

- (7)
- r_x
- = ratio of distance, measured parallel to hull reference axis, from the center of gravity of the seaplane to the hull longitudinal station at which the load factor is being computed to the radius of gyration in pitch of the seaplane, the hull reference axis being a straight line, in the plane of symmetry, tangential to the keel at the main step.

- (c) For a twin float seaplane, because of the effect of flexibility of the attachment of the floats to the seaplane, the factor
- K_1
- may be reduced at the bow and stern to 0.8 of the value shown in figure 2 of appendix 1 of this part. This reduction applies only to the design of the carrythrough and seaplane structure.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.529 : [Hull and main float landing conditions.]

- (a) [Symmetrical step, bow, and stern landing. For symmetrical step, bow, and stern landings, the limit water reaction load factors are those computed under Sec 23.527. In addition—

- (1) For symmetrical step landings, the resultant water load must be applied at the keel, through the center of gravity, and must be directed perpendicularly to the keel line ;

- (2) For symmetrical bow landings, the resultant water load must be applied at the keel, one-fifth of the longitudinal distance from the bow to the step, and must be directed perpendicularly to the keel line ; and

FAR 27.1547 : Magnetic direction indicator

- (a) A placard meeting the requirements of this section must be installed on or near the magnetic direction indicator.

- (b) The placard must show the calibration of the instrument in level flight with the engines operating.

- (c) The placard must state whether the calibration was made with radio receivers on or off.

- (d) Each calibration reading must be in terms of magnetic heading in not more than 45 degree increments.

- (e) [If a magnetic nonstabilized direction indicator can have a deviation of more than 10 degrees caused by the operation of electrical equipment, the placard must state which electrical loads, or combination of loads, would cause a deviation of more than 10 degrees when turned on.]

Amdt. 27-13, Eff. 9/1/77

FAR 27.1549 : Powerplant instruments

For each required powerplant instrument, as appropriate to the type of instrument—

- (a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line ;

- (b) Each normal operating range must be marked with a green arc or green line, not extending beyond the maximum and minimum safe limits ;

- (c) Each takeoff and precautionary range must be marked with a yellow arc or yellow line ; and

- (d) Each engine or propeller range that is restricted because of excessive vibration stresses must be marked with red arc or red lines.

- (e) [Each OEI limit or approved operating range must be marked to be clearly differentiated from the markings of paragraph (a) through (d) of this section except that no marking is normally required for the 30-second OEI limit.]

Amdt. 27-29, Eff. 10/17/94

FAR 27.1551 : Oil quantity indicator

Each oil quantity indicator must be marked with enough increments to indicate readily and accurately the quantity of oil.

FAR 27.1553 : Fuel quantity indicator

If the unusable fuel supply for any tank exceeds one gallon, or five percent of the tank capacity, whichever is greater, a red arc must be marked on its indicator extending from the calibrated zero reading to the lowest reading obtainable in level flight.

FAR 27.1555 : Control markings

- (a) [Each cockpit control, other than primary flight controls or control whose function is obvious, must be plainly marked as to its function and method of operation.]

- (b) For powerplant fuel controls—

FAR 27.1527 : [Maximum operating altitude.]

[The maximum altitude up to which operation is allowed, as limited by flight, structural, powerplant, functional, or equipment characteristics, must be established.]
Amdt. 27-14, Eff. 3/1/78

FAR 27.1529 : [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 rotorcraft or issuance of a standard certificate of airworthiness, whichever occurs later.]
Amdt. 27-18, Eff. 10/14/80

67.2 Markings and Placards**FAR 27.1541 : General**

- (a) The rotorcraft must contain—
- (1) The markings and placards specified in Secs. 27.1545 through 27.1565, and
 - (2) Any additional information, instrument markings, and placards required for the safe operation of rotorcraft with unusual design, operating or handling characteristics.
- (b) Each marking and placard prescribed in paragraph (a) of this section—
- (1) Must be displayed in a conspicuous place; and
 - (2) May not be easily erased, disfigured, or obscured.

FAR 27.1543 : Instrument markings : general

For each instrument—

- (a) When markings are on the cover glass of the instrument, there must be means to maintain the correct alignment of the glass cover with the face of the dial; and
- (b) Each arc and line must be wide enough, and located, to be clearly visible to the pilot.

FAR 27.1545 : Airspeed indicator

- (a) [Each airspeed indicator must be marked as specified in paragraph (b) of this section, with the marks located at the corresponding indicated airspeeds.]
- (b) The following markings must be made :
 - (1) A red radial line—
 - (i) For rotorcraft other than helicopters, at V_{NE} ; and
 - (ii) For helicopters, at V_{NE} (power-on).
 - (2) A red, cross-hatched radial line at V_{NE} (power-off) for helicopters, if V_{NE} (power-off) is less than V_{NE} (power-on).
 - (3) For the caution range, a yellow arc.
 - (4) For the safe operating range, a green arc.

Amdt. 27-16, Eff. 12/1/78

- (3) For symmetrical stern landings, the resultant water load must be applied at the keel, at a point 85 percent of the longitudinal distance from the step to the stern post, and must be directed perpendicularly to the keel line.

(b) *Unsymmetrical landing for hull and single float seaplanes.* Unsymmetrical step, bow, and stern landing conditions must be investigated. In addition—

- (1) The loading for each condition consists of an upward component and a side component equal, respectively, to 0.75 and 0.25 tan β times the resultant load in the corresponding symmetrical landing condition; and
- (2) The point of application and direction of the upward component of the load is the same as that in the symmetrical condition, and the point of application of the side component is at the same longitudinal station as the upward component but is directed inward perpendicularly to the plane of symmetry at a point midway between the keel and the chine lines.

(c) *Unsymmetrical landing : twin float seaplanes.* The unsymmetrical loading consists of an upward load at the step of each float of 0.75 and a side load of $0.25 \tan \beta$ at one float times the step landing load reached under Sec. 23.527. The side load is directed inboard, perpendicularly to the plane of symmetry midway between the keel and chine lines of the float, at the same longitudinal station as the upward load.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.531 : [Hull and main float takeoff condition.]

[For the wing and its attachment to the hull or main float—

- (a) The aerodynamic wing lift is assumed to be zero; and
- (b) A downward inertia load, corresponding to a load factor computed from the following formula, must be applied :

$$n = \frac{C_{TO} V_{11}^2}{(\tan \beta)^{\frac{2}{3}} W^{\frac{2}{3}}}$$

where—

n : inertia load factor ;

C_{TO} : empirical seaplane operations factor equal to 0.004 ;

V_{S1} : seaplane stalling speed (knots) at the design takeoff weight with the flaps extended in the appropriate takeoff position ;

β : angle of dead rise at the main step (degrees) ; and

W : design water takeoff weight in pounds.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.533 : [Hull and main float bottom pressures.]

- (a) [*General.* The hull and main float structure, including frames and bulkheads, stringers, and bottom plating, must be designed under this section.
- (b) [*Local pressures.* For the design of the bottom plating and stringers and their attachments to the supporting structure, the following pressure distributions must be applied :

- (1) For an unflared bottom, the pressure at the chine is 0.75 times the pressure at the keel, and the pressures between the keel and chine vary linearly, in accordance with figure 3 of appendix I of this part. The pressure at the keel (p.s.i.) is computed as follows :

$$P_k = \frac{C_2 K_2 V_{S1}^2}{\tan \beta_k}$$

where—

- P_k : pressure (p.s.i.) at the keel ;
 C_2 : Constant $C_2 = 0.00213$;
 K_2 : hull station weighing factor, in accordance with figure 2 of appendix I of this part ;
 V_{S1} : seaplane stalling speed (knots) at the design water takeoff weight with flaps extended in the appropriate takeoff position ; and
 β_k : angle of dead rise at keel, in accordance with figure 1 of appendix I of this part.

- (2) For a flared bottom, the pressure at the beginning of the flare is the same as that for an unflared bottom, and the pressure between the chine and the beginning of the flare varies linearly, in accordance with figure 3 of appendix I of this part. The pressure distribution is the same at that prescribed in paragraph (b)(1) of this section for an unflared bottom except that the pressure at the chine is computed as follows :

$$P_{ch} = \frac{C_3 K_2 V_{S1}^2}{\tan \beta}$$

where—

- P_{ch} : pressure (p.s.i.) at the chine ;
 C_3 : Constant $C_3 = 0.0016$;
 K_2 : hull station weighing factor, in accordance with figure 2 of appendix I of this part ;
 V_{S1} : seaplane stalling speed (knots) at the design water takeoff weight with flaps extended in the appropriate takeoff position ; and
 β : angle of dead rise at appropriate station.

The area over which these pressures are applied must simulate pressures occurring during high localized impacts on the hull or float, but need not extend over an area that would induce critical stresses in the frames or in the overall structure.

- (c) *Distributed pressures.* For the design of the frames, keel, and chine structure, the following pressure distributions apply :

- (1) Symmetrical pressures as computed as follows—

$$P = \frac{C_4 K_2 V_{S0}^2}{\tan \beta}$$

where—

- (ii) The maximum value demonstrated during the type tests ;
 (2) The maximum allowable gas temperature ; and
 (3) The maximum allowable torque.

- (j) *[Rated 30-second OEI power operation.* Rated 30-second OEI power is permitted only on multiengine, turbine-powered rotorcraft, also certificated for the use of rated 2-minute OEI power, and can only be used for continued operation of the remaining engine(s) after a failure or precautionary shutdown of an engine. It must be shown that following application of 30-second OEI power, any damage will be readily detectable by the applicable inspections and other related procedures furnished in accordance with section A27.4 of appendix A of this part and section A33.4 of appendix A of part 33. The use of 30-second OEI power must be limited to not more than 30 seconds for any period in which that power is used, and by—

- (1) The maximum rotational speed, which may not be greater than—
 (i) The maximum value determined by the rotor design ; or
 (ii) The maximum value demonstrated during the type tests ;
 (2) The maximum allowable gas temperature ; and
 (3) The maximum allowable torque.

- (k) *Rated 2-minute OEI power operation.* Rated 2-minute OEI power is permitted only on multiengine, turbine-powered rotorcraft, also certificated for the use of rated 30-second OEI power, and can only be used for continued operation of the remaining engine(s) after a failure or precautionary shutdown of an engine. It must be shown that following application of 2-minute OEI power, any damage will be readily detectable by the applicable inspections and other related procedures furnished in accordance with section A27.4 of appendix A of this part and section A33.4 of appendix A of part 33. The use of 2-minute OEI power must be limited to not more than 2 minutes for any period in which that power is used, and by—

- (1) The maximum rotational speed, which may not be greater than—
 (i) The maximum value determined by the rotor design ; or
 (ii) The maximum value demonstrated during the type tests ;
 (2) The maximum allowable gas temperature ; and
 (3) The maximum allowable torque.]

Amdt. 27-29, Eff. 10/17/94

FAR 27.1523 : Minimum flight crew

The minimum flight crew must be established so that it is sufficient for safe operation, considering—

- (a) The workload on individual crewmembers ;
 (b) The accessibility and ease of operation of necessary controls by the appropriate crewmember ; and
 (c) The kinds of operation authorized under Sec. 27.1525.

FAR 27.1525 : Kinds of operation

[The kinds of operations (such as VFR, IFR, day, night, or icing) for which the rotorcraft is approved are established by demonstrated compliance with the applicable requirements and by the installed equipment.]

Amdt. 27-21, Eff. 12/6/84

- (3) The gas temperature limits for turbine engines over the range of operating and atmospheric conditions for which certification is requested.

- (d) *Fuel grade or designation.* The minimum fuel grade (for reciprocating engines), or fuel designation (for turbine engines), must be established so that it is not less than that required for the operation of the engines within the limitations in paragraphs (b) and (c) of this section.

- (e) *Turboshaft engine torque.* For rotorcraft with main rotors driven by turboshaft engines, and that do not have a torque limiting device in the transmission system, the following apply :

- (1) A limit engine torque must be established if the maximum torque that the engine can exert is greater than—
 - (i) The torque that the rotor drive system is designed to transmit; or
 - (ii) The torque that the main rotor assembly is designed to withstand in showing compliance with Sec. 27.547(e).

- (2) The limit engine torque established under paragraph (e)(1) of this section may not exceed either torque specified in paragraph (e)(1)(i) or (ii) of this section.

- (f) *Ambient temperature.* For turbine engines, ambient temperature limitations (including limitations for winterization installations, if applicable) must be established as the maximum ambient atmospheric temperature at which compliance with the cooling provisions of Secs. 27.1041 through 27.1045 is shown.

- (g) *Two and one-half-minute OEI power operation.* Unless otherwise authorized, the use of 2 1/2-minute OEI power must be limited to engine failure operation of multiengine, turbine-powered rotorcraft for not longer than 2 1/2 minutes after failure of an engine. The use of 2 1/2-minute OEI power must also be limited by—

- (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or
 - (ii) The maximum demonstrated during the type tests ;
- (2) The maximum allowable gas temperature; and
- (3) The maximum allowable torque.

- (h) *Thirty-minute OEI power operation.* Unless otherwise authorized, the use of 30-minute OEI power must be limited to multiengine, turbine-powered rotorcraft for not longer than 30 minutes after failure of an engine. The use of 30-minute OEI power must also be limited by—

- (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or
 - (ii) The maximum value demonstrated during the type tests ;
- (2) The maximum allowable gas temperature; and
- (3) The maximum allowable torque.

- (i) *Continuous OEI power operation.* Unless otherwise authorized, the use of continuous OEI power must be limited to multiengine, turbine-powered rotorcraft for continued flight after failure of an engine. The use of continuous OEI power must also be limited by—

- (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or

P :pressure (p.s.i.) ;
 C_4 :Value of $C_4 = 0.078C_1$ (with C_1 computed under Sec. 23.527) ;
 K_2 :hull station weighing factor ; determined in accordance with figure 2 of appendix I of this part ;
 V_{S0} :seaplane stalling speed (knots) with landing flaps extended in the appropriate position and with no slipstream effect ; and
 β :angle of dead rise at appropriate station.

- (2) The unsymmetrical pressure distribution consists of the pressures prescribed in paragraph (c)(1) of this section on one side of the hull or main float centerline and one-half of that pressure on the other side of the hull or main float centerline in accordance with figure 3 of appendix I of this part.

- (3) These pressures are uniform and must be applied simultaneously over the entire hull or main float bottom. The loads obtained must be carried into the sidewall structure of the hull proper, but need not be transmitted in a fore and aft direction as shear and bending loads.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.535 : [Auxiliary float loads.]

- (a) [General. Auxiliary floats and their attachments and supporting structures must be designed for the conditions prescribed in this section. In the cases specified in paragraphs (b) through (e) of this section, the prescribed water loads may be distributed over the float bottom to avoid excessive local loads, using bottom pressures not less than those prescribed in paragraph (g) of this section.

- (b) *Step loading.* The resultant water load must be applied in the plane of symmetry of the float at a point three-fourths of the distance from the bow to the step and must be perpendicular to the keel. The resultant limit load is computed as follows, except that the value of L need not exceed three times the weight of the displaced water when the float is completely submerged :

$$L = \frac{C_5 V_{S0}^2 W^{\frac{2}{3}}}{(\tan \beta_S (1 + r_y^2))^{\frac{2}{3}}}$$

where—

L :limit load (lbs.) ;
 C_5 :Constant $C_5 = 0.0053$;
 V_{S0} :seaplane stalling speed (knots) with landing flaps extended in the appropriate position and with no slipstream effect ;
 W :seaplane design landing weight in pounds ;
 β_S :angle of dead rise at a station $\frac{3}{4}$ of the distance from the bow to the step, but need not be less than 15 degrees ; and
 r_y :ratio of the lateral distance between the center of gravity and the plane of symmetry of the float to the radius of gyration in roll.

- (c) *Bow loading.* The resultant limit load must be applied in the plane of symmetry of the float at a point one-fourth of the distance from the bow to the step and must

be perpendicular to the tangent to the keel line at that point. The magnitude of the resultant load is that specified in paragraph (b) of this section.

- (d) *Unsymmetrical step loading.* The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (a) of this section and a side component equal to 0.25 tan β times the load specified in paragraph (b) of this section. The side load must be applied perpendicularly to the plane of symmetry of the float at a point midway between the keel and the chine.

- (e) *Unsymmetrical bow loading.* The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (b) of this section and a side component equal to 0.25 tan β times the load specified in paragraph (c) of this section. The side load must be applied perpendicularly to the plane of symmetry at a point midway between the keel and the chine.

- (f) *Immersed float condition.* The resultant load must be applied at the centroid of the cross section of the float at a point one-third of the distance from the bow to the step. The limit load components are as follows :

$$\begin{aligned} \text{vertical} &= \rho g V \\ a_{ft} &= \frac{C_x \rho V^{\frac{3}{2}} (K V_{S0})^2}{2} \\ \text{side} &= \frac{C_y \rho V^{\frac{3}{2}} (K V_{S0})^2}{2} \end{aligned}$$

where—

- ρ : mass density of water (slugs/ft.³) ;
 V : volume of float (ft.³) ;
 C_x : coefficient of drag force, equal to 0.133 ;
 C_y : coefficient of side force, equal to 0.106 ;
 K : $K = 0.8$, except that lower values may be used if it is shown that the floats are incapable of submerging at a speed of $0.8 V_{S0}$ in normal operations ;
 V_{S0} : seaplane stalling speed (knots) with landing flaps extended in the appropriate position and with no slipstream effect ;
and
 g : acceleration due to gravity (ft/sec²).

- (g) *Float bottom pressures.* The float bottom pressures must be established under Sec. 23.533, except that the value of K_2 in the formulae may be taken as 1.0. The angle of dead rise to be used in determining the float bottom pressures is set forth in paragraph (b) of this section.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.537 : [Sawing loads.]

[Sawing design loads must be based on applicable test data.]

Amdt. 23-45, Eff. 09/07/93

FAR 27.1509 : Rotor speed

- (a) *Maximum power-off (autorotation).* The maximum power-off rotor speed must be established so that it does not exceed 95 percent of the lesser of—
- (1) The maximum design r.p.m. determined under Sec. 27.309(b) ; and
 - (2) The maximum r.p.m. shown during the type tests.
- (b) *Minimum power off.* The minimum power-off rotor speed must be established so that it is not less than 105 percent of the greater of—
- (1) The minimum shown during the type tests ; and
 - (2) The minimum determined by design substantiation.
- (c) *Minimum power on.* The minimum power-on rotor speed must be established so that it is—
- (1) Not less than the greater of—
 - (i) The minimum shown during the type tests ; and
 - (ii) The minimum determined by design substantiation ; and
 - (2) Not more than a value determined under Sec. 27.33(a)(1) and (b)(1).

FAR 27.1519 : Weight and center of gravity

[The weight and center of gravity limitations determined under Secs. 27.25 and 27.27, respectively, must be established as operating limitations.]

Amdt. 27-21, Eff. 12/6/84

FAR 27.1521 : Powerplant limitations

- (a) *General.* The powerplant limitations prescribed in this section must be established so that they do not exceed the corresponding limits for which the engines are type certificated.
- (b) *Takeoff operation.* The powerplant takeoff operation must be limited by—
- (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or
 - (ii) The maximum value shown during the type tests ;
 - (2) The maximum allowable manifold pressure (for reciprocating engines) ;
 - (3) The time limit for the use of the power corresponding to the limitations established in paragraphs (b)(1) and (2) of this section ;
 - (4) If the time limit in paragraph (b)(3) of this section exceeds two minutes, the maximum allowable cylinder head, coolant outlet, or oil temperatures ;
 - (5) The gas temperature limits for turbine engines over the range of operating and atmospheric conditions for which certification is requested.
- (c) *Continuous operation.* The continuous operation must be limited by—
- (1) The maximum rotational speed, which may not be greater than—
 - (i) The maximum value determined by the rotor design ; or
 - (ii) The maximum value shown during the type tests ;
 - (2) The minimum rotational speed shown under the rotor speed requirements in Sec. 27.1509(c) ; and

67.1 Operating Limitations

FAR 27.1501 : General

- (a) [Each operating limitation specified in Secs. 27.1503 through 27.1525 and other limitations and information necessary for safe operation, must be established.
- (b) The operating limitations and other information necessary for safe operation must be made available to the crewmembers as prescribed in Secs. 27.1541 through 27.1589.] Amdt. 27-14, Eff. 3/1/78

FAR 27.1503 : Airspeed limitations : general

- (a) An operating speed range must be established.
- (b) When airspeed limitations are a function of weight, weight distribution, altitude, rotor speed, power, or other factors, airspeed limitations corresponding with the critical combinations of these factors must be established.

FAR 27.1505 : Never-exceed speed

- (a) The never-exceed speed, V_{NE} , must be established so that it is—
 - (1) Not less than 40 knots (CAS); and
 - (2) Not more than the lesser of—
 - (i) [0.9 times the maximum forward speeds established under Sec. 27.309;
 - (ii) 0.9 times the maximum speed shown under Secs. 27.251 and 27.629; or
 - (iii) 0.9 times the maximum speed substantiated for advancing blade tip mach number effects.]
- (b) V_{NE} may vary with altitude, r.p.m., temperature, and weight, if—
 - (1) No more than two of the variables (or no more than two instruments integrating more than one of these variables) are used at one time; and
 - (2) The ranges of these variables (or of the indications on instruments integrating more than one of these variables) are large enough to allow an operationally practical and safe variation of V_{NE} .
- (c) For helicopters, a stabilized power-off V_{NE} denoted as V_{NE} (power-off) may be established at a speed less than V_{NE} established pursuant to paragraph (a) of this section, if the following conditions are met :
 - (1) V_{NE} (power-off) is not less than a speed midway between the power-on V_{NE} and the speed used in meeting the requirements of—
 - (i) Sec. 27.65(b) for single engine helicopters; and
 - (ii) Sec. 27.67 for multiengine helicopters.
 - (2) V_{NE} (power-off) is—
 - (i) A constant airspeed;
 - (ii) A constant amount less than power-on V_{NE} ; or
 - (iii) A constant airspeed for a portion of the altitude range for which certification is requested, and a constant amount less than power-on V_{NE} for the remainder of the altitude range.

Amdt. 27-21, Eff. 12/6/84

30.9 Emergency Landing Conditions

FAR 23.561 : General.

- (a) The airplane, although it may be damaged in emergency landing conditions, must be designed as prescribed in this section to protect each occupant under those conditions.
- (b) The structure must be designed to [give each occupant every reasonable chance of escaping serious injury when—]
 - (1) Proper use is made of seats, safety belts, and shoulder harnesses provided for in the design;
 - (2) The occupant experiences the static inertia loads corresponding to the following ultimate load factors—
 - (i) Upward, 3.0g for normal, utility, and commuter category airplanes, or 4.5g for acrobatic category airplanes;
 - (ii) Forward, 9.0g;
 - (iii) Sideward, 1.5g; and
 - (iv) Downward, 6.0g when certification to the emergency exit provisions of Sec. 23.807(d)(4) is requested; and
- (3) The items of mass within the cabin, that could injure an occupant, experience the static inertia loads corresponding to the following ultimate load factors—
 - (i) Upward, 3.0g;
 - (ii) Forward, 18.0g; and
 - (iii) Sideward, 4.5g.
- (c) Each airplane with retractable landing gear must be designed to protect each occupant in a landing—
 - (1) With the wheels retracted;
 - (2) With moderate descent velocity; and
 - (3) Assuming, in the absence of a more rational analysis—
 - (i) A downward ultimate inertia force of 3g; and
 - (ii) A coefficient of friction of 0.5 at the ground.
- (d) If it is not established that a turnover is unlikely during an emergency landing, the structure must be designed to protect the occupants in a complete turnover as follows :
 - (1) The likelihood of a turnover may be shown by an analysis assuming the following conditions—
 - (i) [The most adverse combination of weight and center of gravity position;
 - (ii) [Longitudinal load factor of 9.0g;
 - (iii) [Vertical load factor of 1.0g; and
 - (iv) [For airplanes with tricycle landing gear, the nose wheel strut failed with the nose contacting the ground.]
 - (2) For determining the loads to be applied to the inverted airplane after a turnover, an upward ultimate inertia load factor of 3.0g and a coefficient of friction with the ground of 0.5 must be used.

- (e) [Except as provided in Sec. 23.787(c), the supporting structure must be designed to restrain, under loads up to those specified in paragraph (b)(3) of this section, each item of mass that could injure an occupant if it came loose in a minor crash landing.]

Amdt. 23-48, EF. 03/11/96

FAR 23.562 : Emergency landing dynamic conditions.

- (a) Each seat/restraint system for use in a normal, utility, or acrobatic category airplane must be designed to protect each occupant during an emergency landing when—
- (1) Proper use is made of seats, safety belts, and shoulder harnesses provided for in the design; and
- (2) The occupant is exposed to the loads resulting from the conditions prescribed in this section.
- (b) Except for those seat/restraint systems that are required to meet paragraph (d) of this section, each seat/restraint system for crew or passenger occupancy in a normal, utility, or acrobatic category airplane, must successfully complete dynamic tests or be demonstrated by rational analysis supported by dynamic tests, in accordance with each of the following conditions. These tests must be conducted with an occupant simulated by an anthropomorphic test dummy (ATD) defined by 49 CFR Part 572, subpart B, or an FAA-approved equivalent, with a nominal weight of 170 pounds and seated in the normal upright position.
- (1) For the first test, the change in velocity may not be less than 31 feet per second. The seat/restraint system must be oriented in its nominal position with respect to the airplane and with the horizontal plane of the airplane pitched up 60°, with no yaw, relative to the impact vector. For seat/restraint systems to be installed in the first row of the airplane, peak deceleration must occur in not more than 0.05 seconds after impact and must reach a minimum of 19g. For all other seat/restraint systems, peak deceleration must occur in not more than 0.06 seconds after impact and must reach a minimum of 15g.
- (2) For the second test, the change in velocity may not be less than 42 feet per second. The seat/restraint system must be oriented in its nominal position with respect to the airplane and with the vertical plane of the airplane yawed 10°, with no pitch, relative to the impact vector in a direction that results in the greatest load on the shoulder harness. For seat/restraint systems to be installed in the first row of the airplane, peak deceleration must occur in not more than 0.05 seconds after impact and must reach a minimum of 26g. For all other seat/restraint systems, peak deceleration must occur in not more than 0.06 seconds after impact and must reach a minimum of 21g.
- (3) To account for floor warpage, the floor rails or attachment devices used to attach the seat/restraint system to the airframe structure must be preloaded to misalign with respect to each other by at least 10° vertically (i.e., pitch out of parallel) and one of the rails or attachment devices must be preloaded to misalign by 10° in roll prior to conducting the test defined by paragraph (b)(2) of this section.
- (c) Compliance with the following requirements must be shown during the dynamic tests conducted in accordance with paragraph (b) of this section :

Chapitre 67

Subpart G : Operating Limitations and Information

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FAR 27.1461 : [Equipment containing high energy rotors.]

- (a) [Equipment containing high energy rotors must meet paragraph (b), (c), or (d) of this section.
- (b) High energy rotors contained in equipment must be able to withstand damage caused by malfunctions, vibration, abnormal speeds, and abnormal temperatures. In addition—
- (1) Auxiliary rotor cases must be able to contain damage caused by the failure of high energy rotor blades ; and
 - (2) Equipment control devices, systems, and instrumentation must reasonably ensure that no operating limitations affecting the integrity of high energy rotors will be exceeded in service.
- (c) It must be shown by test that equipment containing high energy rotors can contain any failure of a high energy rotor that occurs at the highest speed obtainable with the normal speed control devices inoperative.
- (d) Equipment containing high energy rotors must be located where rotor failure will neither endanger the occupants nor adversely affect continued safe flight.]

Amdt. 27-2, Eff. 2/25/68

- (1) The seat/restraint system must restrain the ATD although seat/restraint system components may experience deformation, elongation, displacement, or crushing intended as part of the design.
- (2) The attachment between the seat/restraint system and the test fixture must remain intact, although the seat structure may have deformed.
- (3) Each shoulder harness strap must remain on the ATD's shoulder during the impact.
- (4) The safety belt must remain on the ATD's pelvis during the impact.
- (5) The results of the dynamic tests must show that the occupant is protected from serious head injury.
 - (i) When contact with adjacent seats, structure, or other items in the cabin can occur, protection must be provided so that the head impact does not exceed a head injury criteria (HIC) of 1,000.
 - (ii) The value of HIC is defined as—

$$HIC = \left\{ (t_2 - t_1) \left(\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t) dt \right)^{2.5} \right\}_{max}$$

where—

- t_1 : is the initial integration time, expressed in seconds,
 t_2 : is the final integration time, expressed in seconds,
 $(t_2 - t_1)$: is the time duration of the major head impact, expressed in seconds, and
 $a(t)$: is the resultant deceleration at the center of gravity of the head form expressed as a multiple of g (units of gravity).

- (iii) Compliance with the HIC limit must be demonstrated by measuring the head impact during dynamic testing as prescribed in paragraphs (b)(1) and (b)(2) of this section or by a separate showing of compliance with the head injury criteria using test or analysis procedures.
- (6) Loads in individual shoulder harness straps may not exceed 1,750 pounds. If dual straps are used for retaining the upper torso, the total strap loads may not exceed 2,000 pounds.
- (7) The compression load measured between the pelvis and the lumbar spine of the ATD may not exceed 1,500 pounds.
- (d) [For all single-engine airplanes with a V_{S0} of more than 61 knots at maximum weight, and those multiengine airplanes of 6,000 pounds or less maximum weight with a V_{S0} of more than 61 knots at maximum weight that do not comply with Sec. 23.67(a)(1).]
 - (1) The ultimate load factors of Sec. 23.561(b) must be increased by multiplying the load factors by the square of the ratio of the increased stall speed to 61 knots. The increased ultimate load factors need not exceed the values reached at a V_{S0} of 79 knots. The upward ultimate load factor for acrobatic category airplanes need not exceed 5.0 g.
 - (2) The seat/restraint system test required by paragraph (b)(1) of this section must be conducted in accordance with the following criteria :
 - (i) The change in velocity may not be less than 31 feet per second.

- (ii) (A) The peak deceleration (g_p) of 19g and 15g must be increased and multiplied by the square of the ratio of the increased stall speed to 61 knots :

$$g_p = 19.0 \left(\frac{V_{S0}}{61} \right)^2$$

$$\text{or } g_p = 15.0 \left(\frac{V_{S0}}{61} \right)^2$$

- (B) The peak deceleration need not exceed the value reached at a V_{S0} of 79 knots.

- (iii) The peak deceleration must occur in not more than time (t_r), which must be computed as follows :

$$t_r = \frac{31}{32.2 g_p} = \frac{0.96}{g_p}$$

where—

g_p :The peak deceleration calculated in accordance with paragraph (d)(2)(ii) of this section; and

t_r :The rise time (in seconds) to the peak deceleration.

- (e) An alternate approach that achieves an equivalent, or greater, level of occupant protection to that required by this section may be used if substantiated on a rational basis.

Amdt. 23-50, Eff. 03/11/96

30.10 Fatigue Evaluation

FAR 23.571 : [Metallic pressurized cabin structures.]

[For normal, utility, and acrobatic category airplanes, the strength, detail design, and fabrication of the metallic structure of the pressure cabin must be evaluated under one of the following :

- (a) A fatigue strength investigation in which the structure is shown by tests, or by analysis supported by test evidence, to be able to withstand the repeated loads of variable magnitude expected in service ; or]
- (b) A fail safe strength investigation, in which it is shown by analysis, tests, or both that catastrophic failure of the structure is not probable after fatigue failure, or obvious partial failure, of a principal structural element, and that the remaining structures are able to withstand a static ultimate load factor of 75 percent of the limit load factor at V_C , considering the combined effects of normal operating pressures, expected external aerodynamic pressures, and flight loads. These loads must be multiplied by a factor of 1.15 unless the dynamic effect of failure under static load are otherwise considered.

- (c) The damage tolerance evaluation of Sec. 23.573(b).

Amdt. 23-48, Eff. 03/11/96

- (3) There is an aural or visual means for preflight checking of the recorder for proper operation.

- (e) The record container must be located and mounted to minimize the probability of rupture of the container as a result of crash impact and consequent heat damage to the record from fire.

- (f) If the cockpit voice recorder has a bulk erasure device, the installation must be designed to minimize the probability of inadvertent operation and actuation of the device during crash impact.

- (g) Each recorder container must be either bright orange or bright yellow.]

Amdt. 27-22, Eff. 10/11/88

FAR 27.1459 : [Flight recorders.]

- (a) [Each flight recorder required by the operating rules of Subchapter G of this chapter must be installed so that :

- (1) It is supplied with airspeed, altitude, and directional data obtained from sources that meet the accuracy requirements of Secs. 27.1323, 27.1325, and 27.1327 of this part, as applicable;

- (2) The vertical acceleration sensor is rigidly attached, and located longitudinally within the approved center of gravity limits of the rotorcraft;

- (3) It receives its electrical power from the bus that provides the maximum reliability for operation of the flight recorder without jeopardizing service to essential or emergency loads;

- (4) There is an aural or visual means for preflight checking of the recorder for proper recording of data in the storage medium ;

- (5) Except for recorders powered solely by the engine-driven electrical generator system, there is an automatic means to simultaneously stop a recorder that has a data erasure feature and prevent each erasure feature from functioning, within 10 minutes after any crash impact ; and

- (b) Each nonjectable recorder container must be located and mounted so as to minimize the probability of container rupture resulting from crash impact and subsequent damage to the record from fire.

- (c) A correlation must be established between the flight recorder readings of airspeed, altitude, and heading and the corresponding readings (taking into account correction factors) of the first pilot's instruments. This correlation must cover the airspeed range over which the aircraft is to be operated, the range of altitude to which the aircraft is limited, and 360 degrees of heading. Correlation may be established on the ground as appropriate.

- (d) Each recorder container must :

- (1) Be either bright orange or bright yellow ;

- (2) Have a reflective tape affixed to its external surface to facilitate its location under water ; and

- (3) Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such a manner that they are not likely to be separated during crash impact.]

Amdt. 27-22, Eff. 10/11/88

(3) Voice communications of flight crewmembers on the flight deck, using the rotorcraft's interphone system.

(4) Voice or audio signals identifying navigation or approach aids introduced into a headset or speaker.

(5) Voice communications of flight crewmembers using the passenger loudspeaker system, if there is such a system, and if the fourth channel is available in accordance with the requirements of paragraph (c)(4)(ii) of this section.

(b) The recording requirements of paragraph (a)(2) of this section may be met :

(1) By installing a cockpit-mounted area microphone located in the best position for recording voice communications originating at the first and second pilot stations and voice communications of other crewmembers on the flight deck when directed to those stations ; or

(2) By installing a continually energized or voice-actuated lip microphone at the first and second pilot stations. The microphone specified in this paragraph must be so located and, if necessary, the preamplifiers and filters of the recorder must be adjusted or supplemented so that the recorded communications are intelligible when recorded under flight cockpit noise conditions and played back. The level of intelligibility must be approved by the Administrator. Repeated aural or visual playback of the record may be used in evaluating intelligibility.

(c) Each cockpit voice recorder must be installed so that the part of the communication or audio signals specified in paragraph (a) of this section obtained from each of the following sources is recorded on a separate channel :

(1) For the first channel, from each microphone, headset, or speaker used at the first pilot station.

(2) For the second channel, from each microphone, headset, or speaker used at the second pilot station.

(3) For the third channel, from the cockpit-mounted area microphone, or the continually energized or voice-actuated lip microphone at the first and second pilot stations.

(4) For the fourth channel, from :

(i) Each microphone, headset, or speaker used at the stations for the third and fourth crewmembers ; or

(ii) If the stations specified in paragraph (c)(4)(i) of this section are not required or if the signal at such a station is picked up by another channel, each microphone on the flight deck that is used with the passenger loudspeaker system if its signals are not picked up by another channel.

(iii) Each microphone on the flight deck that is used with the rotorcraft's loudspeaker system if its signals are not picked up by another channel.

(d) Each cockpit voice recorder must be installed so that :

(1) It receives its electric power from the bus that provides the maximum reliability for operation of the cockpit voice recorder without jeopardizing service to essential or emergency loads ;

(2) There is an automatic means to simultaneously stop the recorder and prevent each erasure feature from functioning, within 10 minutes after crash impact ; and

FAR 23.572 : [Metallic] wing, empennage, and associated structures.

(a) [For normal, utility, and acrobatic category airplanes, the strength, detail design, and fabrication of those parts of the airframe structure whose failure would be catastrophic must be evaluated under one of the following unless it is shown that the structure, operating stress level, materials and expected uses are comparable, from a fatigue standpoint, to a similar design that has had extensive satisfactory service experience :

(1) A fatigue strength investigation in which the structure is shown by tests, or by analysis supported by test evidence, to be able to withstand the repeated loads of variable magnitude expected in service ; or]

(2) A fail safe strength investigation in which it is shown by analysis, tests, or both, that catastrophic failure of the structure is not probable after fatigue failure, or obvious partial failure, of a principal structural element, and that the remaining structure is able to withstand a static ultimate load factor of 75 percent of the critical limit load at V_C . These loads must be multiplied by a factor of 1.15 unless the dynamic effects of failure under static load are otherwise considered.

(3) The damage tolerance evaluation of Sec. 23.573(b).

(b) Each evaluation required by this section must :

(1) Include typical loading spectra (e.g. taxi, ground-air-ground cycles, maneuver, gust) ;

(2) Account for any significant effects due to the mutual influence of aerodynamic surfaces ; and

(3) Consider any significant effects from propeller slipstream loading, and buffet from vortex impingements.

Amdt. 23-48, Eff. 03/11/96

FAR 23.573 : Damage tolerance and fatigue evaluation of structure.

(a) *Composite airframe structure.* Composite airframe structure must be evaluated under this paragraph instead of Secs. 23.571 and 23.572. The applicant must evaluate the composite airframe structure, the failure of which would result in catastrophic loss of the airplane, in each wing (including canards, tandem wings, and winglets), empennage, their carrythrough and attaching structure, moveable control surfaces and their attaching structure, fuselage, and pressure cabin using the damage-tolerance criteria prescribed in paragraphs (a)(1) through (a)(4) of this section unless shown to be impractical. If the applicant establishes that damage-tolerance criteria is impractical for a particular structure, the structure must be evaluated in accordance with paragraphs (a)(1) and (a)(6) of this section. Where bonded joints are used, the structure must also be evaluated in accordance with paragraph (a)(5) of this section. The effects of material variability and environmental conditions on the strength and durability properties of the composite materials must be accounted for in the evaluations required by this section.

(1) It must be demonstrated by tests, or by analysis supported by tests, that the structure is capable of carrying ultimate load with damage up to the threshold of detectability considering the inspection procedures employed.

- (2) The growth rate or no-growth of damage that may occur from fatigue, corrosion, manufacturing flaws or impact damage, under repeated loads expected in service, must be established by tests or analysis supported by tests.
 - (3) The structure must be shown by residual strength tests, or analysis supported by residual strength tests, to be able to withstand critical limit flight loads, considered as ultimate loads, with the extent of detectable damage consistent with the results of the damage tolerance evaluations. For pressurized cabins, the following loads must be withstood :
 - (i) Critical limit flight loads with the combined effects of normal operating pressure and expected external aerodynamic pressures.
 - (ii) The expected external aerodynamic pressures in 1g flight combined with a cabin differential pressure equal to 1.1 times the normal operating differential pressure without any other load.
 - (4) The damage growth, between initial detectability and the value selected for residual strength demonstrations, factored to obtain inspection intervals, must allow development of an inspection program suitable for application by operation and maintenance personnel.
 - (5) [For any bonded joint, the failure of which would result in catastrophic loss of the airplane, the limit load capacity must be substantiated by one of the following methods-]
 - (i) The maximum disbands of each bonded joint consistent with the capability to withstand the loads in paragraph (a)(3) of this section must be determined by analysis, tests, or both. Disbands of each bonded joint greater than this must be prevented by design features; or
 - (ii) Proof testing must be conducted on each production article that will apply the critical limit design load to each critical bonded joint; or
 - (iii) Repeatable and reliable non-destructive inspection techniques must be established that ensure the strength of each joint.
 - (6) Structural components for which the damage tolerance method is shown to be impractical must be shown by component fatigue tests, or analysis supported by tests, to be able to withstand the repeated loads of variable magnitude expected in service. Sufficient component, subcomponent, element, or component tests must be done to establish the fatigue scatter factor and the environmental effects. Damage up to the threshold of detectability and ultimate load residual strength capability must be considered in the demonstration.
- (b) *Metallic airframe structure.* If the applicant elects to use Sec. 23.571(a)(3) or Sec. 23.572(a)(3), then the damage tolerance evaluation must include a determination of the probable locations and modes of damage due to fatigue, corrosion, or accidental damage. The determination must be by analysis supported by test evidence and, if available, service experience. Damage at multiple sites due to fatigue must be included where the design is such that this type of damage can be expected to occur. The evaluation must incorporate repeated load and static analyses supported by test evidence. The extent of damage for residual strength evaluation at any time within the operational life of the airplane must be consistent with the initial detectability and subsequent growth under repeated loads. The residual strength evaluation must show that the remaining structure is able to withstand critical limit flight loads, considered as ultimate, with the extent of detectable damage

FAR 27.1419 : [Ice protection.]

- (a) [To obtain certification for flight into icing conditions, compliance with this section must be shown.
 - (b) It must be demonstrated that the rotorcraft can be safely operated in the continuous maximum and intermittent maximum icing conditions determined under Appendix C of Part 29 of this chapter within the rotorcraft altitude envelope. An analysis must be performed to establish, on the basis of the rotorcraft's operational needs, the adequacy of the ice protection system for the various components of the rotorcraft.
 - (c) In addition to the analysis and physical evaluation prescribed in paragraph (b) of this section, the effectiveness of the ice protection system and its components must be shown by flight tests of the rotorcraft or its components in measured atmospheric icing conditions and by one or more of the following tests as found necessary to determine the adequacy of the ice protection system :
 - (1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.
 - (2) Flight dry air tests of the ice protection system as a whole, or its individual components.
 - (3) Flight tests of the rotorcraft or its components in measured simulated icing conditions.
 - (d) The ice protection provisions of this section are considered to be applicable primarily to the airframe. Powerplant installation requirements are contained in Subpart E of this Part.
 - (e) A means must be identified or provided for determining the formation of ice on critical parts of the rotorcraft. Unless otherwise restricted, the means must be available for nighttime as well as daytime operation. The rotorcraft flight manual must describe the means of determining ice formation and must contain information necessary for safe operation of the rotorcraft in icing conditions]
- Amdt. 27-19, EFF. 3/2/83
- FAR 27.1435 : Hydraulic systems**
- (a) *Design.* Each hydraulic system and its elements must withstand, without yielding, any structural loads expected in addition to hydraulic loads.
 - (b) *Tests.* Each system must be substantiated by proof pressure tests. When proof tested, no part of any system may fail, malfunction, or experience a permanent set. The proof load of each system must be at least 1.5 times the maximum operating pressure of that system.
 - (c) *Accumulators.* No hydraulic accumulator or pressurized reservoir may be installed on the engine side of any firewall unless it is an integral part of an engine.

FAR 27.1457 : [Cockpit voice recorders.]

- (a) [Each cockpit voice recorder required by the operating rules of this chapter must be approved, and must be installed so that it will record the following :
 - (1) Voice communications transmitted from or received in the rotorcraft by radio.
 - (2) Voice communications of flight crewmembers on the flight deck.

Normally, the maximum value of effective intensity is obtained when t_2 and t_1 are chosen so that the effective intensity is equal to the instantaneous intensity at t_2 and t_1 .

- (f) [Minimum effective intensities for anticollision light. Each anticollision light effective intensity must equal or exceed the applicable values in the following table :

Angle above or below the horizontal plane :	Effective intensity (candles)
0° to 5°	150
5° to 10°	90
10° to 20°	30
20° to 30°	15]

Amdt. 27-10, Eff. 2/5/76

66.5 Safety Equipment

FAR 27.1411 : General

- (a) [Required safety equipment to be used by the crew in an emergency, such as flares and automatic liferaft releases, must be readily accessible.
- (b) Stowage provisions for required safety equipment must be furnished and must—
- (1) Be arranged so that the equipment is directly accessible and its location is obvious; and
- (2) Protect the safety equipment from damage caused by being subjected to the inertia loads specified in Sec. 27.561.]

Amdt. 27-11, Eff. 2/1/77

FAR 27.1413 : Safety belts

[Each safety belt must be equipped with a metal to metal latching device.]

Amdt. 27-21, Eff. 12/6/84

FAR 27.1415 : Ditching equipment

- (a) Emergency flotation and signaling equipment required by any operating rule in this chapter must meet the requirements of this section.
- (b) Each raft and each life preserver must be approved and must be installed so that it is readily available to the crew and passengers. [The storage provisions for life preservers must accommodate one life preserver for each occupant for which certification for ditching is requested.]
- (c) Each raft released automatically or by the pilot must be attached to the rotorcraft by a line to keep it alongside the rotorcraft. This line must be weak enough to break before submerging the empty raft to which it is attached.
- (d) Each signaling device must be free from hazard in its operation and must be installed in an accessible location.

Amdt. 27-11, Eff. 2/1/77

consistent with the results of the damage tolerance evaluations. For pressurized cabins, the following load must be withstood :]

- (1) The normal operating differential pressure combined with the expected external aerodynamic pressures applied simultaneously with the flight loading conditions specified in this part, and
- (2) The expected external aerodynamic pressures in 1g flight combined with a cabin differential pressure equal to 1.1 times the normal operating differential pressure without any other load.

- (c) [[Removed].]

Amdt. 23-48, Eff. 03/11/96

FAR 23.574 : [Metallic damage tolerance and fatigue evaluation of commuter category airplanes.]

[For commuter category airplanes—

- (a) *Metallic damage tolerance.* An evaluation of the strength, detail design, and fabrication must show that catastrophic failure due to fatigue, corrosion, defects, or damage will be avoided throughout the operational life of the airplane. This evaluation must be conducted in accordance with the provisions of Sec. 23.573, except as specified in paragraph (b) of this section, for each part of the structure that could contribute to a catastrophic failure.
- (b) *Fatigue (safe-life) evaluation.* Compliance with the damage tolerance requirements of paragraph (a) of this section is not required if the applicant establishes that the application of those requirements is impractical for a particular structure. This structure must be shown, by analysis supported by test evidence, to be able to withstand the repeated loads of variable magnitude expected during its service life without detectable cracks. Appropriate safe-life scatter factors must be applied.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.575 : [Inspections and other procedures.]

[Each inspection or other procedure, based on an evaluation required by Secs. 23.571, 23.572, 23.573 or 23.574, must be established to prevent catastrophic failure and must be included in the Limitations Section of the Instructions for Continued Airworthiness required by Sec. 23.1529.]

Amdt. 23-48, Eff. 03/11/96

Where "yo" is the "y" coordinate of the Planckian radiator for the value of "x" considered].

Amdt. 27-6, EFF. 8/11/71

FAR 27.1399 : Riding light

- (a) Each riding light required for water operation must be installed so that it can—
 - (1) [Show a white light for at least two nautical miles at night under clear atmospheric conditions; and]
 - (2) Show a maximum practicable unbroken light with the rotorcraft on the water.
 - (b) Externally hung lights may be used.
- Amdt. 27-2, EFF. 2/25/68

FAR 27.1401 : Anticollision light system

- (a) *General.* If certification for night operation is requested, the rotorcraft must have an anticollision light system that—
 - (1) Consists of one or more approved anticollision lights located so that their emitted light will not impair the crew's vision or detract from the conspicuity of the position lights; and
 - (2) Meets the requirements of paragraphs (b) through (f) of this section.
- (b) *Field of coverage.* The system must consist of enough lights to illuminate the vital areas around the rotorcraft, considering the physical configuration and flight characteristics of the rotorcraft. The field of coverage must extend in each direction within at least 30 degrees above and 30 degrees below the horizontal plane of the rotorcraft, except that there may be solid angles of obstructed visibility totalling not more than 0.5 steradians.
- (c) *Flashing characteristics.* The arrangement of the system, that is, the number of light sources, beam width, speed of rotation, and other characteristics, must give an effective flash frequency of not less than 40, nor more than 100, cycles per minute. The effective flash frequency is the frequency at which the rotorcraft's complete anticollision light system is observed from a distance, and applies to each sector of light including any overlaps that exist when the system consists of more than one light source. In overlaps, flash frequencies may exceed 100, but not 180, cycles per minute.
- (d) *Color.* Each anticollision light must be aviation red and must meet the applicable requirements of Sec. 27.1397.]
- (e) *Light intensity.* The minimum light intensities in any vertical plane, measured with the red filter (if used) and expressed in terms of "effective" intensities, must meet the requirements of paragraph (f) of this section. The following relation must be assumed :

$$I_e = \frac{\int_{t_1}^{t_2} I(t) dt}{0.2 + (t_2 - t_1)}$$

where :

I_e	effective intensity	(candels)
$I(t)$	instantaneous intensity as a function of time	(candels)
$t_2 - t_1$	flash time interval	(seconds)

Angle above or below the horizontal plane :	Intensity
0°	1.00 I.
0° to 5°	0.90 I.
5° to 10°	0.80 I.
10° to 15°	0.70 I.
15° to 20°	0.50 I.
20° to 30°	0.30 I.
30° to 40°	0.10 I.
40° to 90°	0.05 I.

FAR 27.1395 : Maximum intensities in over lapping beams of forward and rear position lights

No position light intensity may exceed the applicable values in the following table, except as provided in Sec. 27.1389(b)(3).

Overlaps	Maximum intensity	
	Area A (candles)	Area B (candles)
Green in dihedral angle L	10	1
Red in dihedral angle R	10	1
Green in dihedral angle A	5	1
Red in dihedral angle A	5	1
Rear white in dihedral angle L	5	1
Rear white in dihedral angle R	5	1

Where-

- (a) Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 10 degrees but less than 20 degrees ; and
- (b) Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 20 degrees.

FAR 27.1397 : Color specifications

Each position light color must have the applicable International Commission on Illumination chromaticity coordinates as follows :

- (a) Aviation red—
 - "y" is not greater than 0.335; and
 - "z" is not greater than 0.002.
- (b) Aviation green—
 - "x" is not greater than 0.440-0.320y ;
 - "x" is not greater than y-0.170; and
 - "y" is not less than 0.390-0.170x.
- (c) Aviation white—
 - ["x" is not less than 0.300 and not greater than 0.540 ;
 - "y" is not less than "x-0.040" or "yo -0.010", whichever is the smaller ; and
 - "y" is not greater than "x + 0.020" nor "0.636-0.400x" ;

Chapitre 31

Subpart D : Design and Construction

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FAR 27.1389 : Position light distribution and intensities

- (a) *General.* The intensities prescribed in this section must be provided by new equipment with light covers and color filters in place. Intensities must be determined with the light source operating at a steady value equal to the average luminous output of the source at the normal operating voltage of the rotorcraft. The light distribution and intensity of each position light must meet the requirements of paragraph (b) of this section.
- (b) *Forward and rear position lights.* The light distribution and intensities of forward and rear position lights must be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane, and maximum intensities in overlapping beams, within dihedral angles L, R, and A, and must meet the following requirements :
- (1) *Intensities in the horizontal plane.* Each intensity in the horizontal plane (the plane containing the longitudinal axis of the rotorcraft and perpendicular to the plane of symmetry of the rotorcraft) must equal or exceed the values in Sec. 27.1391.
- (2) *Intensities in any vertical plane.* Each intensity in any vertical plane (the plane perpendicular to the horizontal plane) must equal or exceed the appropriate value in Sec. 27.1393, where I is the minimum intensity prescribed in Sec. 27.1391 for the corresponding angles in the horizontal plane.
- (3) *Intensities in overlaps between adjacent signals.* No intensity in any overlap between adjacent signals may exceed the values in Sec. 27.1395, except that higher intensities in overlaps may be used with main beam intensities substantially greater than the minima specified in Secs. 27.1391 and 27.1393, if the overlap intensities in relation to the main beam intensities do not adversely affect signal clarity. When the peak intensity of the forward position lights is greater than 100 candelas, the maximum overlap intensities between them may exceed the values in Sec. 27.1395 if the overlap intensity in Area A is not more than 10 percent of peak position light intensity and the overlap intensity in Area B is not more than 2.5 percent of peak position light intensity.

FAR 27.1391 : Minimum intensities in the horizontal plane of forward and rear position lights

Each position light intensity must equal or exceed the applicable values in the following table :

Dihedral angle (light included)	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity (candelas)
L and R (forward red and green).	0° to 10° 10° to 20° 20° to 110°	40 30 5
A (rear white)	110° to 180°	20

FAR 27.1393 : Minimum intensities in any vertical plane of forward and rear position lights

Each position light intensity must equal or exceed the applicable values in the following table :

- (c) At least one separate switch must be provided, as applicable—

- (1) For each separately installed landing light; and
- (2) For each group of landing lights installed at a common location.

FAR 27.1385 : Position light system installation

- (a) *General.* Each part of each position light system must meet the applicable requirements of this section, and each system as a whole must meet the requirements of Secs. 27.1387 through 27.1397.
- (b) *Forward position lights.* Forward position lights must consist of a red and a green light spaced laterally as far apart as practicable and installed forward on the rotorcraft so that, with the rotorcraft in the normal flying position, the red light is on the left side and the green light is on the right side. Each light must be approved.
- (c) *Rear position light.* The rear position light must be a white light mounted as far aft as practicable, and must be approved.
- (d) *Circuit.* The two forward position lights and the rear position light must make a single circuit.
- (e) *Light covers and color filters.* Each light cover or color filter must be at least flame resistant and may not change color or shape or lose any appreciable light transmission during normal use.

FAR 27.1387 : Position light system dihedral angles

- (a) [Except as provided in paragraph (e) of this section, each forward and rear position light must, as installed, show unbroken light within the dihedral angles described in this section.]
- (b) Dihedral angle L (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the rotorcraft, and the other at 110 degrees to the left of the first, as viewed when looking forward along the longitudinal axis.
- (c) Dihedral angle R (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the rotorcraft, and the other at 110 degrees to the right of the first, as viewed when looking forward along the longitudinal axis.
- (d) Dihedral angle A (aft) is formed by two intersecting vertical planes making angles of 70 degrees to the right and to the left, respectively, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.
- (e) [If the rear position light, when mounted as far aft as practicable in accordance with Sec. 27.1385(c), cannot show unbroken light within dihedral angle A (as defined in paragraph (d) of this section), a solid angle or angles of obstructed visibility totaling not more than 0.04 steradians is allowable within that dihedral angle, if such solid angle is within a cone whose apex is at the rear position light and whose elements make an angle of 30° with a vertical line passing through the rear position light.]

Amdt. 27-7, Eff. 11/5/71

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FAR 23.601 : General.

The suitability of each questionable design detail and part having an important bearing on safety in operations, must be established by tests.

FAR 23.603 : Materials and workmanship.

- (a) [The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must—
 - (1) Be established by experience or tests ;]
 - (2) Meet approved specifications that ensure their having the strength and other properties assumed in the design data ; [and
 - (3) Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.]
 - (b) Workmanship must be of a high standard.
- Amdt. 23-23, Eff. 12/01/78

FAR 23.605 : Fabrication methods.

- (a) [The methods of fabrication used must produce consistently sound structures. If a fabrication process (such as gluing, spot welding, or heat-treating) requires close control to reach this objective, the process must be performed under an approved process specification.
 - (b) Each new aircraft fabrication method must be substantiated by a test program]
- Amdt. 23-23, Eff. 12/01/78

FAR 23.607 : [Fasteners.]

- (a) [Each removable fastener must incorporate two retaining devices if the loss of such fastener would preclude continued safe flight and landing.
 - (b) Fasteners and their locking devices must not be adversely affected by the environmental conditions associated with the particular installation.
 - (c) No self-locking nut may be used on any bolt subject to rotation in operation unless a non-friction locking device is used in addition to the self-locking device.]
- Amdt. 23-48, Eff. 03/11/96

FAR 23.609 : Protection of structure.

- Each part of the structure must—
- (a) Be suitably protected against deterioration or loss of strength in service due to any cause, including—
 - (1) Weathering ;
 - (2) Corrosion ; and
 - (3) Abrasion ; and
 - (b) Have adequate provisions for ventilation and drainage.

FAR 27.1361 : Master switch

- (a) There must be a master switch arrangement to allow ready disconnection of each electric power source from the main bus. The point of disconnection must be adjacent to the sources controlled by the switch.
- (b) Load circuits may be connected so that they remain energized after the switch is opened, if they are protected by circuit protective devices, rated at five amperes or less, adjacent to the electric power source.
- (c) The master switch or its controls must be installed so that the switch is easily discernible and accessible to a crewmember in flight.

FAR 27.1365 : Electric cables

- (a) Each electric connecting cable must be of adequate capacity.
 - (b) Each cable that would overheat in the event of circuit overload or fault must be at least flame resistant and may not emit dangerous quantities of toxic fumes.
 - (c) [Insulation on electrical wire and cable installed in the rotorcraft must be self-extinguishing when tested in accordance with Appendix F, Part I(a)(3) of part 25 of this chapter.]
- Amdt. 27-35, Eff. 9/8/98

FAR 27.1367 : Switches

- Each switch must be—
- (a) Able to carry its rated current ;
 - (b) Accessible to the crew ; and
 - (c) Labeled as to operation and the circuit controlled.

66.4 Lights**FAR 27.1381 : Instrument lights**

- The instrument lights must—
- (a) Make each instrument, switch, and other devices for which they are provided easily readable ; and
 - (b) Be installed so that—
 - (1) Their direct rays are shielded from the pilot's eyes ; and
 - (2) No objectionable reflections are visible to the pilot.

FAR 27.1383 : Landing lights

- (a) Each required landing or hovering light must be approved.
- (b) Each landing light must be installed so that—
 - (1) No objectionable glare is visible to the pilot ;
 - (2) The pilot is not adversely affected by halation ; and
 - (3) It provides enough light for night operation, including hovering and landing.

- (d) No explosive or toxic gases emitted by any battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation, may accumulate in hazardous quantities within the rotorcraft.
- (e) No corrosive fluids or gases that may escape from the battery may damage surrounding structures or adjacent essential equipment.
- (f) Each nickel cadmium battery installation capable of being used to start an engine or auxiliary power unit must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.
- (g) [Nickel cadmium battery installations capable of being used to start an engine or auxiliary power unit must have—
- (1) A system to control the charging rate of the battery automatically so as to prevent battery overheating;
 - (2) A battery temperature sensing and over-temperature warning system with a means for disconnecting the battery from its charging source in the event of an over-temperature condition; or
 - (3) A battery failure sensing and warning system with a means for disconnecting the battery from its charging source in the event of battery failure.]

Amdt. 27-14, Eff. 3/1/78

FAR 27.1357 : Circuit protective devices

- (a) Protective devices, such as fuses or circuit breakers, must be installed in each electrical circuit other than—
- (1) The main circuits of starter motors; and
 - (2) Circuits in which no hazard is presented by their omission.
- (b) [A protective device for a circuit essential to flight safety may not be used to protect any other circuit.]
- (c) Each resettable circuit protective device ("trip free" device in which the tripping mechanism cannot be overridden by the operating control) must be designed so that—
- (1) A manual operation is required to restore service after tripping; and
 - (2) If an overload or circuit fault exists, the device will open the circuit regardless of the position of the operating control.
- (d) If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be located and identified so that it can be readily reset or replaced in flight.
- (e) If fuses are used, there must be one spare of each rating, or 50 percent spare fuses of each rating, whichever is greater.

Amdt. 27-13, Eff. 9/1/77

FAR 23.611 : Accessibility [provisions.]

[For each part that requires maintenance, inspection, or other servicing, appropriate means must be incorporated into the aircraft design to allow such servicing to be accomplished.]

Amdt. 23-48, Eff. 03/11/96

FAR 23.613 : Material strength properties and design values.

- (a) Material strength properties must be based on enough tests of material meeting specifications to establish design values on a statistical basis.
- (b) [Design values must be chosen to minimize the probability of structural failure due to material variability. Except as provided in paragraph (e) of this section, compliance with this paragraph must be shown by selecting design values that ensure material strength with the following probability :
 - (1) Where applied loads are eventually distributed through a single member within an assembly, the failure of which would result in loss of structural integrity of the component; 99 percent probability with 95 percent confidence.
 - (2) For redundant structure, in which the failure of individual elements would result in applied loads being safely distributed to other load carrying members; 90 percent probability with 95 percent confidence.
- (c) The effects of temperature on allowable stresses used for design in an essential component or structure must be considered where thermal effects are significant under normal operating conditions.
- (d) The design of the structure must minimize the probability of catastrophic fatigue failure, particularly at points of stress concentration.
- (e) Design values greater than the guaranteed minimums required by this section may be used where only guaranteed minimum values are normally allowed if a "premium selection" of the material is made in which a specimen of each individual item is tested before use to determine that the actual strength properties of that particular item will equal or exceed those used in design.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.615 : [Removed.]

[Removed.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.617 : [Deleted.]

[Deleted.]

Amdt. 23-7, Eff. 09/14/69

FAR 23.619 : Special factors.

[The factor of safety prescribed in Sec. 23.303 must be multiplied by the highest pertinent special factors of safety prescribed in Secs. 23.621 through 23.625 for each part of the structure whose strength is—

- (1) Uncertain :

- (2) Likely to deteriorate in service before normal replacement ; or
 - (3) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.]
- Amtd. 23-7, EFF. 09/14/69

FAR 23.621 : Casting factors.

- (a) *General.* The factors, tests, and inspections specified in paragraphs (b) through (d) of this section must be applied in addition to those necessary to establish foundry quality control. The inspections must meet approved specifications. Paragraphs (c) and (d) of this section apply to any structural castings except castings that are pressure tested as parts of hydraulic or other fluid systems and do not support structural loads.
- (b) *Bearing stresses and surfaces.* The casting factors specified in paragraphs (c) and (d) of this section—
 - (1) Need not exceed 1.25 with respect to bearing stresses regardless of the method of inspection used ; and
 - (2) Need not be used with respect to the bearing surfaces of a part whose bearing factor is larger than the applicable casting factor.
- (c) *Critical castings.* For each casting whose failure would preclude continued safe flight and landing of the airplane or result in serious injury to occupants, the following apply :
 - (1) [Each critical casting must either—
 - (i) Have a casting factor of not less than 1.25 and receive 100 percent inspection by visual, radiographic, and either magnetic particle, penetrant or other approved equivalent non-destructive inspection method ; or
 - (ii) Have a casting factor of not less than 2.0 and receive 100 percent visual inspection and 100 percent approved non-destructive inspection. When an approved quality control procedure is established and an acceptable statistical analysis supports reduction, non-destructive inspection may be reduced from 100 percent, and applied on a sampling basis.]
 - (2) For each critical casting with a casting factor less than 1.50, three sample castings must be static tested and shown to meet—
 - (i) The strength requirements of Sec. 23.305 at an ultimate load corresponding to a casting factor of 1.25; and
 - (ii) The deformation requirements of Sec. 23.305 at a load of 1.15 times the limit load.
- (3) Examples of these castings are structural attachment fittings, parts of flight control systems, control surface hinges and balance weight attachments, seat, berth, safety belt, and fuel and oil tank supports and attachments, and cabin pressure valves.
- (d) *Non-critical castings.* For each casting other than those specified in paragraph (c) [or (e)] of this section, the following apply :
 - (1) Except as provided in subparagraphs (2) and (3) of this paragraph, the casting factors and corresponding inspections must meet the following table :

- (i) Free from hazards in itself, in its method of operation, and in its effects on other parts of the rotorcraft ; and
 - (ii) Protected from fuel, oil, water, other detrimental substances, and mechanical damage.
 - (2) Electric power sources must function properly when connected in combination or independently.
 - (3) No failure or malfunction of any source may impair the ability of any remaining source to supply load circuits essential for safe operation.
 - (4) Each electric power source control must allow the independent operation of each source.
 - (c) *Generating system.* There must be at least one generator if the system supplies power to load circuits essential for safe operation. In addition—
 - (1) Each generator must be able to deliver its continuous rated power ;
 - (2) Generator voltage control equipment must be able to dependably regulate each generator output within rated limits ;
 - (3) Each generator must have a reverse current cutoff designed to disconnect the generator from the battery and from the other generators when enough reverse current exists to damage that generator ; and
 - (4) Each generator must have an overvoltage control designed and installed to prevent damage to the electrical system, or to equipment supplied by the electrical system, that could result if that generator were to develop an overvoltage condition.
 - (d) *Instruments.* There must be means to indicate to appropriate crewmembers the electric power system quantities essential for safe operation of the system. In addition—
 - (1) For direct current systems, an ammeter that can be switched into each generator feeder may be used ; and
 - (2) If there is only one generator, the ammeter may be in the battery feeder.
 - (e) *External power.* If provisions are made for connecting external power to the rotorcraft, and that external power can be electrically connected to equipment other than that used for engine starting, means must be provided to ensure that no external power supply having a reverse polarity, or a reverse phase sequence, can supply power to the rotorcraft's electrical system.]
- Amtd. 27-13, EFF. 9/1/77

FAR 27.1353 : Storage battery design and installation

- (a) Each storage battery must be designed and installed as prescribed in this section.
- (b) Safe cell temperatures and pressures must be maintained during any probable charging and discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge)—
 - (1) At maximum regulated voltage or power ;
 - (2) During a flight of maximum duration ; and
 - (3) Under the most adverse cooling condition likely to occur in service.
- (c) Compliance with paragraph (b) of this section must be shown by test unless experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.

(ii) Be installed and located so that the escape of fluids would not create a hazard.

(3) Each powerplant instrument that utilizes flammable fluids must be installed and located so that the escape of fluid would not create a hazard.

(b) *Fuel quantity indicator.* Each fuel quantity indicator must be installed to clearly indicate to the flight crew the quantity of fuel in each tank in flight. In addition—

(1) Each fuel quantity indicator must be calibrated to read "zero" during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under Sec. 27.959;

(2) When two or more tanks are closely interconnected by a gravity feed system and vented, and when it is impossible to feed from each tank separately, at least one fuel quantity indicator must be installed; and

(3) Each exposed sight gauge used as a fuel quantity indicator must be protected against damage.

(c) *Fuel flowmeter system.* If a fuel flowmeter system is installed, each metering component must have a means for bypassing the fuel supply if malfunction of that component severely restricts fuel flow.

(d) *Oil quantity indicator.* There must be means to indicate the quantity of oil in each tank—

(1) On the ground (including during the filling of each tank); and

(2) In flight, if there is an oil transfer system or reserve oil supply system.

(e) [Rotor drive system transmissions and gearboxes utilizing ferromagnetic materials must be equipped with chip detectors designed to indicate the presence of ferromagnetic particles resulting from damage or excessive wear. Chip detectors must—

(1) Be designed to provide a signal to the device required by Sec. 27.1305(v) and be provided with a means to allow crewmembers to check, in flight, the function of each detector electrical circuit and signal.]

(2) [Reserved.]

Amdt. 27-37, Eff. 10/18/99

66.3 Electrical Systems and Equipment

FAR 27.1351 : General

(a) *Electrical system capacity.* Electrical equipment must be adequate for its intended use. In addition—

(1) Electric power sources, their transmission cables, and their associated control and protective devices must be able to furnish the required power at the proper voltage to each load circuit essential for safe operation; and

(2) Compliance with subparagraph (1) of this paragraph must be shown by an electrical load analysis, or by electrical measurements that take into account the electrical loads applied to the electrical system, in probable combinations and for probable durations.

(b) *Function.* For each electrical system, the following apply :

(1) Each system, when installed, must be—

Casting factor	Inspection
2.0 or more	100 percent visual.
Less than 2.0 but more than 1.5.	100 percent visual, and magnetic particle or penetrant or equivalent non-destructive inspection methods.
1.25 through 1.50.	100 percent visual, magnetic particle or penetrant, and radiographic, or approved equivalent non-destructive inspection methods.

(2) The percentage of castings inspected by nonvisual methods may be reduced below that specified in paragraph (d)(1) of this section when an approved quality control procedure is established.

(3) For castings procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis—

(i) A casting factor of 1.0 may be used; and

(ii) The castings must be inspected as provided in paragraph (d)(1) of this section for casting factors of "1.25 through 1.50" and tested under paragraph (c)(2) of this section.

(e) [Non-structural castings. Castings used for non-structural purposes do not require evaluation, testing or close inspection.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.623 : Bearing factors.

(a) [Each part that has clearance (free fit), and that is subject to pounding or vibration, must have a bearing factor large enough to provide for the effects of normal relative motion.

(b) For control surface hinges and control system joints, compliance with the factors prescribed in Secs. 23.657 and 23.693, respectively, meets paragraph (a) of this section.]

Amdt. 23-7, Eff. 09/14/69

FAR 23.625 : Fitting factors.

For each fitting (a part or terminal used to join one structural member to another), the following apply :

(a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1.15 must be applied to each part of—

(1) The fitting;

(2) The means of attachment; and

(3) The bearing on the joined members.

(b) No fitting factor need be used for joint designs based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood).

(c) For each integral fitting, the part must be treated as a fitting up to the point at which the section properties become typical of the member.

(d) [For each seat, berth, safety belt, and harness, its attachment to the structure must be shown, by analysis, tests, or both, to be able to withstand the inertia forces prescribed in Sec. 23.561 multiplied by a fitting factor of 1.33.]

Amdt. 23-7, Eff. 09/14/69

FAR 23.627 : Fatigue strength.

The structure must be designed, as far as practicable, to avoid points of stress concentration where variable stresses above the fatigue limit are likely to occur in normal service.

FAR 23.629 : Flutter.

(a) [It must be shown by the methods of paragraph (b) and either paragraph (c) or (d) of this section, that the airplane is free from flutter, control reversal, and divergence for any condition of operation within the limit $V - n$ envelope and at all speeds up to the speed specified for the selected method. In addition—]

(1) Adequate tolerances must be established for quantities which affect flutter, including speed, damping, mass balance, and control system stiffness ; and

(2) The natural frequencies of main structural components must be determined by vibration tests or other approved methods.

(b) [Flight flutter tests must be made to show that the airplane is free from flutter, control reversal and divergence and to show that—]

(1) Proper and adequate attempts to induce flutter have been made within the speed range up to V_D ;

(2) The vibratory response of the structure during the test indicates freedom from flutter ;

(3) A proper margin of damping exists at V_D ; and

(4) There is no large and rapid reduction in damping as V_D is approached.

(c) [Any rational analysis used to predict freedom from flutter, control reversal and divergence must cover all speeds up to $1.2 V_D$.]

(d) Compliance with the rigidity and mass balance criteria (pages 4-12), in Airframe and Equipment Engineering Report No. 45 (as corrected) "Simplified Flutter Prevention Criteria" (published by the Federal Aviation Administration) may be accomplished to show that the airplane is free from flutter, control reversal, or divergence if—

(1) V_D/M_D for the airplane is less than 260 knots (EAS) and less than Mach 0.5,

(2) The wing and aileron flutter prevention criteria, as represented by the wing torsional stiffness and aileron balance criteria, are limited in use to airplanes without large mass concentrations (such as engines, floats, or fuel tanks in outer wing panels) along the wing span, and

(3) The airplane—

(i) [Does not have a T-tail or other unconventional tail configurations:]

(ii) Does not have unusual mass distributions or other unconventional design features that affect the applicability of the criteria, and

(iii) Has fixed-fin and fixed-stabilizer surfaces.

(b) A magnetic nonstabilized direction indicator may deviate more than 10 degrees due to the operation of electrically powered systems such as electrically heated windshields if either a magnetic stabilized direction indicator, which does not have a deviation in level flight greater than 10 degrees on any heading, or a gyroscopic direction indicator, is installed. Deviations of a magnetic nonstabilized direction indicator of more than 10 degrees must be placarded in accordance with Sec. 27.1547(e).]

Amdt. 27-13, Eff. 9/1/77

FAR 27.1329 : Automatic pilot system

(a) Each automatic pilot system must be designed so that the automatic pilot can—

(1) Be sufficiently overpowered by one pilot to allow control of the rotorcraft ; and

(2) Be readily and positively disengaged by each pilot to prevent it from interfering with control of the rotorcraft.

(b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.

(c) Each manually operated control for the system's operation must be readily accessible to the pilots.

(d) The system must be designed and adjusted so that, within the range of adjustment available to the pilot, it cannot produce hazardous loads on the rotorcraft or create hazardous deviations in the flight path under any flight condition appropriate to its use, either during normal operation or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(e) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation.

(f) [If the automatic pilot system can be coupled to airborne navigation equipment, means must be provided to indicate to the pilots the current mode of operation. Selector switch position is not acceptable as a means of indication.]

Amdt. 27-35, Eff. 9/8/98

FAR 27.1335 : [Flight director systems.]

[If a flight director system is installed, means must be provided to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.]

Amdt. 27-13, Eff. 9/1/77

FAR 27.1337 : Powerplant instruments

(a) *Instruments and instrument lines.*

(1) Each powerplant instrument line must meet the requirements of Secs. 27.961 and 27.993.

(2) Each line carrying flammable fluids under pressure must—

(i) Have restricting orifices or other safety devices at the source of pressure to prevent the escape of excessive fluid if the line fails ; and

FAR 27.1323 : Airspeed indicating system

- (a) [Each airspeed indicating instrument must be calibrated to indicate true airspeed (at sea level with a standard atmosphere) with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied.
- (b) The airspeed indicating system must be calibrated in flight at forward speeds of 20 knots and over.
- (c)] At each forward speed above 80 percent of the climbout speed, the airspeed indicator must indicate true airspeed, at sea level with a standard atmosphere, to within an allowable installation error of not more than the greater of—
- (1) ± 3 percent of the calibrated airspeed; or
 - (2) 5 knots.

Amdt. 27-13, Eff. 9/1/77

FAR 27.1325 : [Static pressure systems.]

- (a) [Each instrument with static air case connections must be vented so that the influence of rotorcraft speed, the opening and closing of windows, airflow variation, and moisture or other foreign matter does not seriously affect its accuracy.
- (b) Each static pressure port must be designed and located in such manner that the correlation between air pressure in the static pressure system and true ambient atmospheric static pressure is not altered when the rotorcraft encounters icing conditions. An anti-icing means or an alternate source of static pressure may be used in showing compliance with this requirement. If the reading of the altimeter, when on the alternate static pressure system, differs from the reading of the altimeter when on the primary static system by more than 50 feet, a correction card must be provided for the alternate static system.

- (c) Except as provided in paragraph (d) of this section, if the static pressure system incorporates both a primary and an alternate static pressure source, the means for selecting one or the other source must be designed so that—

- (1) When either source is selected, the other is blocked off; and
 - (2) Both sources cannot be blocked off simultaneously.
- (d) For unpressurized rotorcraft, paragraph (c)(1) of this section does not apply if it can be demonstrated that the static pressure system calibration, when either static pressure source is selected, is not changed by the other static pressure source being open or blocked.]

Amdt. 27-13, Eff. 9/1/77

FAR 27.1327 : Magnetic direction indicator

- (a) [Except as provided in paragraph (b) of this section—
- (1) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the rotorcraft's vibration or magnetic fields; and
 - (2) The compensated installation may not have a deviation, in level flight, greater than 10 degrees on any heading.

- (e) For turbopropeller-powered airplanes, the dynamic evaluation must include—

- (1) Whirl mode degree of freedom which takes into account the stability of the plane of rotation of the propeller and significant elastic, inertial, and aerodynamic forces, and
 - (2) Propeller, engine, engine mount, and airplane structure stiffness and damping variations appropriate to the particular configuration.
- (f) Freedom from flutter, control reversal and divergence up to V_D/M_D must be shown as follows :
- (1) For airplanes that meet the criteria of paragraphs (d)(1) through (3) of this section, after the failure, malfunction, or disconnection of any single element in any tab control system.
 - (2) For airplanes other than those described in paragraph (f)(1) of this section, after the failure, malfunction, or disconnection of any single element in the primary flight control system, any tab control system, or any flutter damper.
 - (g) [For airplanes showing compliance with the fail-safe criteria of Secs. 23.571 and 23.572, the airplane must be shown by analysis to be free from flutter up to V_D/M_D after fatigue failure, or obvious partial failure, of a principal structural element.
 - (h) For airplanes showing compliance with the damage tolerance criteria of Sec. 23.573, the airplane must be shown by analysis to be free from flutter up to V_D/M_D with the extent of damage for which residual strength is demonstrated.
 - (i) For modifications to the type design that could affect the flutter characteristics, compliance with paragraph (a) of this section must be shown, except that analysis based on previously approved data may be used alone to show freedom from flutter, control reversal and divergence, for all speeds up to the speed specified for the selected method.]

Amdt. 23-48, Eff. 03/11/96

31.1 Wings**FAR 23.641 : Proof of strength.**

The strength of stressed-skin wings must be proven by load tests or by combined structural analysis and load tests.

FAR 23.643 : [Deleted.]

[Deleted.]

Amdt. 23-7, Eff. 09/14/69

31.2 Control Surfaces**FAR 23.651 : Proof of strength.**

- (a) Limit load tests of control surfaces are required. These tests must include the horn or fitting to which the control system is attached.
- (b) In structural analyses, rigging loads due to wire bracing must be accounted for in a rational or conservative manner.

FAR 23.655 : Installation.

- (a) [Movable surfaces must be installed so that there is no interference between any surfaces, their bracing, or adjacent fixed structure, when one surface is held in its most critical clearance positions and the others are operated through their full movement.]
- (b) If an adjustable stabilizer is used, it must have stops that will limit its range of travel to that allowing safe flight and landing.

Amdt. 23-45, Eff. 09/07/93

FAR 23.657 : Hinges.

- (a) Control surface hinges, except ball and roller bearing hinges, must have a factor of safety of not less than 6.67 with respect to the ultimate bearing strength of the softest material used as a bearing.
- (b) For ball or roller bearing hinges, the approved rating of the bearing may not be exceeded.
- (c) [[Removed.]]

Amdt. 23-48, Eff. 03/11/96

FAR 23.659 : Mass balance.

The supporting structure and the attachment of concentrated mass balance weights used on control surfaces must be designed for—

- (a) 2½g normal to the plane of the control surface ;
- (b) 12g fore and aft; and
- (c) 12g parallel to the hinge line.

31.3 Control Systems**FAR 23.671 : General.**

- (a) Each control must operate easily, smoothly, and positively enough to allow proper performance of its functions.
- (b) Controls must be arranged and identified to provide for convenience in operation and to prevent the possibility of confusion and subsequent inadvertent operation.

FAR 23.672 : [Stability augmentation and automatic and power-operated systems.]

[If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this part, such systems must comply with Sec. 23.671 and the following :

- (a) A warning, which is clearly distinguishable to the pilot under expected flight conditions without requiring the pilot's attention, must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system that could result in an unsafe condition if the pilot was not aware of the failure. Warning systems must not activate the control system.

FAR 27.1309 : Equipment, systems, and installations

- (a) [The equipment, systems, and installations whose functioning is required by this subchapter must be designed and installed to ensure that they perform their intended functions under any foreseeable operating condition.
- (b) The equipment, systems, and installation of a multiengine rotorcraft must be designed to prevent hazards to the rotorcraft in the event of a probable malfunction or failure.
- (c) The equipment, systems, and installations of single-engine rotorcraft must be designed to minimize hazards to the rotorcraft in the event of a probable malfunction or failure.
- (d) In showing compliance with paragraph (a), (b), or (c) of this section, the effects of lightning strikes on the rotorcraft must be considered in accordance with Sec. 27.610.]

Amdt. 27-21, Eff. 12/6/84

66.2 Instruments : Installation**FAR 27.1321 : Arrangement and visibility**

- (a) Each flight, navigation, and powerplant instrument for use by any pilot must be easily visible to him.
- (b) For each multiengine rotorcraft, identical powerplant instruments must be located so as to prevent confusion as to which engine each instrument relates.
- (c) Instrument panel vibration may not damage, or impair the readability or accuracy of, any instrument.
- (d) [If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.]

Amdt. 27-13, Eff. 9/1/77

FAR 27.1322 : Warning, caution, and advisory lights

[If warning, caution, or advisory lights are installed in the cockpit, they must, unless otherwise approved by the Administrator, be—

- (a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action) ;
- (b) Amber, for caution lights (lights indicating the possible need for future corrective action) ;
- (c) Green, for safe operation lights ; and
- (d) Any other color, including white, for lights not described in paragraphs (a) through (c) of this section, provided the color differs sufficiently from the colors prescribed in paragraphs (a) through (c) of this section to avoid possible confusion.]

Amdt. 27-11, Eff. 2/1/77

- (3) The r.p.m. of each main rotor whose speed can vary appreciably with respect to that of another main rotor.

- (1) A low fuel warning device for each fuel tank which feeds an engine. This device must—
(1) Provide a warning to the flightcrew when approximately 10 minutes of usable fuel remains in the tank; and

- (2) Be independent of the normal fuel quantity indicating system.

- (m) Means to indicate to the flightcrew the failure of any fuel pump installed to show compliance with Sec. 27.955.

- (n) A gas temperature indicator for each turbine engine.

- (o) Means to enable the pilot to determine the torque of each turboshaft engine, if a torque limitation is established for that engine under Sec. 27.1521(e).

- (p) For each turbine engine, an indicator to indicate the functioning of the powerplant ice protection system.

- (q) An indicator for the fuel filter required by Sec. 27.997 to indicate the occurrence of contamination of the filter at the degree established by the applicant in compliance with Sec. 27.955.

- (r) For each turbine engine, a warning means for the oil strainer or filter required by Sec. 27.1019, if it has no bypass, to warn the pilot of the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with Sec. 27.1019(a)(2).

- (s) An indicator to indicate the proper functioning of any selectable or controllable heater used to prevent ice clogging of fuel system components.

- (t) For rotorcraft for which a 30-second/2-minute OEI power rating is requested, a means must be provided to alert the pilot when the engine is at the 30-second and the 2-minute OEI power levels, when the event begins, and when the time interval expires.

- (u) For each turbine engine utilizing 30-second/2-minute OEI power, a device or system must be provided for use by ground personnel which—

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

- (2) Permits retrieval of the recorded data;

- (3) Can be reset only by ground maintenance personnel; and

- (4) Has a means to verify proper operation of the system or device.

- (v) [Warning or caution devices to signal to the flight crew when ferromagnetic particles are detected by the chip detector required by Sec. 27.1337(e).]

Amdt. 27-37, Eff. 10/18/99

FAR 27.1307 : Miscellaneous equipment

The following is the required miscellaneous equipment :

- (a) An approved seat for each occupant.

- (b) An approved safety belt for each occupant.

- (c) A master switch arrangement.

- (d) An adequate source of electrical energy, where electrical energy is necessary for operation of the rotorcraft.

- (e) Electrical protective devices.

- (b) The design of the stability augmentation system or of any other automatic or power-operated system must permit initial counteraction of failures without requiring exceptional pilot skill or strength, by either the deactivation of the system or a failed portion thereof, or by overriding the failure by movement of the flight controls in the normal sense.

- (c) It must be shown that, after any single failure of the stability augmentation system or any other automatic or power-operated system—

- (1) The airplane is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations that is critical for the type of failure being considered;

- (2) The controllability and maneuverability requirements of this part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and airplane configuration) that is described in the Airplane Flight Manual (AFM); and

- (3) The trim, stability, and stall characteristics are not impaired below a level needed to permit continued safe flight and landing.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.673 : Primary flight controls.

Primary flight controls are those used by the pilot for the immediate control of pitch, roll, and yaw.

Amdt. 23-48, Eff. 03/11/96

FAR 23.675 : Stops.

- (a) [Each control system must have stops that positively limit the range of motion of each movable aerodynamic surface controlled by the system.

- (b) Each stop must be so located so that wear, slackness, or take-up adjustments will not adversely affect the control characteristics of the airplane because of a change in the range of surface travel.

- (c) Each stop must be able to withstand any loads corresponding to the design conditions for the control system.]

Amdt. 23-17, Eff. 02/01/77

FAR 23.677 : Trim systems.

- (a) [Proper precautions must be taken to prevent inadvertent, improper, or abrupt trim tab operation. There must be means near the trim control to indicate to the pilot the direction of trim control movement relative to airplane motion. In addition, there must be means to indicate to the pilot the position of the trim device with respect to both the range of adjustment and, in the case of lateral and directional trim, the neutral position. This means must be visible to the pilot and must be located and designed to prevent confusion. The pitch trim indicator must be clearly marked with a position or range within which it has been demonstrated that takeoff is safe for all center of gravity positions and each flap position approved for takeoff.]

(b) Trimming devices must be designed so that, when any one connecting or transmitting element in the primary flight control system fails, adequate control for safe flight and landing is available with—

(1) For single-engine airplanes, the longitudinal trimming devices ; or

(2) For multiengine airplanes, the longitudinal and directional trimming devices.

(c) Tab controls must be irreversible unless the tab is properly balanced and has no unsafe flutter characteristics. Irreversible tab systems must have adequate rigidity and reliability in the portion of the system from the tab to the attachment of the irreversible unit to the airplane structure.

(d) It must be demonstrated that the airplane is safely controllable and that a pilot can perform all maneuvers and operations necessary to effect a safe landing following any probable powered trim system runaway that reasonably might be expected in service, allowing for appropriate time delay after pilot recognition of the trim system runaway. The demonstration must be conducted at the critical airplane weights and center of gravity positions.

Amdt. 23-49, Eff. 03/11/96

FAR 23.679 : Control system locks.

[If there is a device to lock the control system on the ground or water :

(a) There must be a means to—

(1) Give unmistakable warning to the pilot when the lock is engaged ; or

(2) Automatically disengage the device when the pilot operates the primary flight controls in a normal manner.

(b) The device must be installed to limit the operation of the airplane so that, when the device is engaged, the pilot receives unmistakable warning at the start of takeoff.

(c) The device must have a means to preclude the possibility of it becoming inadvertently engaged in flight.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.681 : Limit load static tests.

(a) Compliance with the limit load requirements of this part must be shown by tests in which—

(1) The direction of the test loads produces the most severe loading in the control system ; and

(2) Each fitting, pulley, and bracket used in attaching the system to the main structure is included.

(b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

FAR 23.683 : Operation tests.

(a) It must be shown by operation tests that, when the controls are operated from the pilot compartment with the system loaded as prescribed in paragraph (b) of this section, the system is free from—

66.1 General

FAR 27.1301 : Function and installation

Each item of installed equipment must—

(a) Be of a kind and design appropriate to its intended function ;

(b) Be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors ;

(c) Be installed according to limitations specified for that equipment ; and

(d) Function properly when installed.

FAR 27.1303 : Flight and navigation instruments

The following are the required flight and navigation instruments :

(a) An airspeed indicator.

(b) An altimeter.

(c) A magnetic direction indicator.

FAR 27.1305 : Powerplant instruments

The following are the required powerplant instruments :

(a) A carburetor air temperature indicator, for each engine having a preheater that can provide a heat rise in excess of 60° F.

(b) A cylinder head temperature indicator, for each—

(1) Air cooled engine ;

(2) Rotorcraft with cooling shutters ; and

(3) Rotorcraft for which compliance with Sec. 27.1043 is shown in any condition other than the most critical flight condition with respect to cooling.

(c) A fuel pressure indicator, for each pump-fed engine.

(d) A fuel quantity indicator, for each fuel tank.

(e) A manifold pressure indicator, for each altitude engine.

(f) An oil temperature warning device to indicate when the temperature exceeds a safe value in each main rotor drive gearbox (including any gearboxes essential to rotor phasing) having an oil system independent of the engine oil system.

(g) An oil pressure warning device to indicate when the pressure falls below a safe value in each pressure-lubricated main rotor drive gearbox (including any gearboxes essential to rotor phasing) having an oil system independent of the engine oil system.

(h) An oil pressure indicator for each engine.

(i) An oil quantity indicator for each oil tank.

(j) An oil temperature indicator for each engine.

(k) At least one tachometer to indicate the r.p.m. of each engine and, as applicable—

(1) The r.p.m. of the single main rotor ;

(2) The common r.p.m. of any main rotors whose speeds cannot vary appreciably with respect to each other ; or

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- (1) Jamming;
 - (2) Excessive friction; and
 - (3) Excessive deflection.
- (b) The prescribed test loads are—
- (1) [For the entire system, loads corresponding to the limit airloads on the appropriate surface, or the limit pilot forces in Sec. 23.397(b), whichever are less; and]
 - (2) For secondary controls, loads not less than those corresponding to the maximum pilot effort established under Sec. 23.405.

Amdt. 23-7, Eff. 09/14/69

FAR 23.685 : Control system details.

- (a) [Each detail of each control system must be designed and installed to prevent jamming, chafing, and interference from cargo, passengers, loose objects, or the freezing of moisture.]
- (b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system.
- (c) There must be means to prevent the slapping of cables or tubes against other parts.
- (d) Each element of the flight control system must have design features, or must be distinctively and permanently marked, to minimize the possibility of incorrect assembly that could result in malfunctioning of the control system.

Amdt. 23-17, Eff. 02/01/77

FAR 23.687 : Spring devices.

The reliability of any spring device used in the control system must be established by tests simulating service conditions unless failure of the spring will not cause flutter or unsafe flight characteristics.

FAR 23.689 : Cable systems.

- (a) Each cable, cable fitting, turnbuckle, splice, and pulley used must meet approved specifications. In addition—
 - (1) No cable smaller than $\frac{1}{8}$ inch diameter may be used in primary control systems;
 - (2) Each cable system must be designed so that there will be no hazardous change in cable tension throughout the range of travel under operating conditions and temperature variations; and
 - (3) There must be means for visual inspection at each fairlead, pulley, terminal, and turnbuckle.
- (b) [Each kind and size of pulley must correspond to the cable with which it is used. Each pulley must have closely fitted guards to prevent the cables from being misplaced or fouled, even when slack. Each pulley must lie in the plane passing through the cable so that the cable does not rub against the pulley flange.]
- (c) Fairleads must be installed so that they do not cause a change in cable direction of more than three degrees.

- (d) Clevis pins subject to load or motion and retained only by cotter pins may not be used in the control system.
- (e) Turnbuckles must be attached to parts having angular motion in a manner that will positively prevent binding throughout the range of travel.
- (f) Tab control cables are not part of the primary control system and may be less than $\frac{1}{8}$ inch diameter in airplanes that are safely controllable with the tabs in the most adverse positions.

Amdt. 23-7, Eff. 9/14/69

FAR 23.691 : [Artificial stall barrier system.]

[If the function of an artificial stall barrier, for example, stick pusher, is used to show compliance with Sec. 23.201(c), the system must comply with the following :

- (a) With the system adjusted for operation, the plus and minus airspeeds at which downward pitching control will be provided must be established.
- (b) Considering the plus and minus airspeed tolerances established by paragraph (a) of this section, an airspeed must be selected for the activation of the downward pitching control that provides a safe margin above any airspeed at which any unsatisfactory stall characteristics occur.
- (c) In addition to the stall warning required by Sec. 23.207, a warning that is clearly distinguishable to the pilot under all expected flight conditions without requiring the pilot's attention, must be provided for faults that would prevent the system from providing the required pitching motion.
- (d) Each system must be designed so that the artificial stall barrier can be quickly and positively disengaged by the pilots to prevent unwanted downward pitching of the airplane by a quick release (emergency) control that meets the requirements of Sec. 23.1329(b).
- (e) A preflight check of the complete system must be established and the procedure for this check made available in the Airplane Flight Manual (AFM). Preflight checks that are critical to the safety of the airplane must be included in the limitations section of the AFM.
- (f) For those airplanes whose design includes an autopilot system :
 - (1) A quick release (emergency) control installed in accordance with Sec. 23.1329(b) may be used to meet the requirements of paragraph (d), of this section, and
 - (2) The pitch servo for that system may be used to provide the stall downward pitching motion.
- (g) In showing compliance with Sec. 23.1309, the system must be evaluated to determine the effect that any announced or unannounced failure may have on the continued safe flight and landing of the airplane or the ability of the crew to cope with any adverse conditions that may result from such failures. This evaluation must consider the hazards that would result from the airplane's flight characteristics if the system was not provided, and the hazard that may result from unwanted downward pitching motion, which could result from a failure at airspeeds above the selected stall speed.]

Amdt. 23-49, Eff. 03/11/96

Chapitre 66

Subpart F—Equipment

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FAR 27.1195 : [Fire detector systems.]

[Each turbine engine powered rotorcraft must have approved quick-acting fire detectors in numbers and locations ensuring prompt detection of fire in the engine compartment which cannot be readily observed in flight by the pilot in the cockpit.]
Amdt. 27-5, Eff. 4/23/71

FAR 23.693 : Joints.

Control system joints (in push-pull systems) that are subject to angular motion, except those in ball and roller bearing systems, must have a special factor of safety of not less than 3.33 with respect to the ultimate bearing strength of the softest material used as a bearing. This factor may be reduced to 2.0 for joints in cable control systems. For ball or roller bearings, the approved ratings may not be exceeded.

FAR 23.697 : Wing flap controls.

- (a) Each wing flap control must be designed so that, when the flap has been placed in any position upon which compliance with the performance requirements of this part is based, the flap will not move from that position unless the control is adjusted or is moved by the automatic operation of a flap load limiting device.
- (b) The rate of movement of the flaps in response to the operation of the pilot's control or automatic device must give satisfactory flight and performance characteristics under steady or changing conditions of airspeed, engine power, and attitude.
- (c) [If compliance with Sec. 23.145(b)(3) necessitates wing flap retraction to positions that are not fully retracted, the wing flap control lever settings corresponding to those positions must be positively located such that a definite change of direction of movement of the lever is necessary to select settings beyond those settings.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.699 : Wing flap position indicator.

There must be a wing flap position indicator for—

- (a) Flap installations with only the retracted and fully extended position, unless—
 - (1) A direct operating mechanism provides a sense of "feel" and position (such as when a mechanical linkage is employed); or
 - (2) The flap position is readily determined without seriously detracting from other piloting duties under any flight condition, day or night; and
- (b) Flap installation with intermediate flap positions if—
 - (1) Any flap position other than retracted or fully extended is used to show compliance with the performance requirements of this part; and
 - (2) The flap installation does not meet the requirements of paragraph (a)(1) of this section.

FAR 23.701 : Flap interconnection.

- (a) The main wing flaps and related movable surfaces as a system must—
 - (1) [Be synchronized by a mechanical interconnection between the movable flap surfaces that is independent of the flap drive system; or by an approved equivalent means; or
 - (2) Be designed so that the occurrence of any failure of the flap system that would result in an unsafe flight characteristic of the airplane is extremely improbable; or]

- (b) The airplane must be shown to have safe flight characteristics with any combination of extreme positions of individual movable surfaces (mechanically interconnected surfaces are to be considered as a single surface.)
- (c) If an interconnection is used in multiengine airplanes, it must be designed to account for the unsymmetrical loads resulting from flight with the engines on one side of the plane of symmetry inoperative and the remaining engines at takeoff power. For single-engine airplanes, and multiengine airplanes with no slipstream effects on the flaps, it may be assumed that 100 percent of the critical air load acts on one side and 70 percent on the other.

Amdt. 23-49, Eff. 03/11/96

FAR 23.703 : [Takeoff warning system.]

[For commuter category airplanes, unless it can be shown that a lift or longitudinal trim device that affects the takeoff performance of the aircraft would not give an unsafe takeoff configuration when selected out of an approved takeoff position, a takeoff warning system must be installed and meet the following requirements :

- (a) The system must provide to the pilots an aural warning that is automatically activated during the initial portion of the takeoff role if the airplane is in a configuration that would not allow a safe takeoff. The warning must continue until—
 - (1) The configuration is changed to allow safe takeoff, or
 - (2) Action is taken by the pilot to abandon the takeoff roll.
- (b) The means used to activate the system must function properly for all authorized takeoff power settings and procedures and throughout the ranges of takeoff weights, altitudes, and temperatures for which certification is requested.]

Amdt. 23-49, Eff. 03/11/96

31.4 Landing Gear

FAR 23.721 : [General.]

[For commuter category airplanes that have a passenger seating configuration, excluding pilot seats, of 10 or more, the following general requirements for the landing gear apply :

- (a) The main landing-gear system must be designed so that if it fails due to overloads during takeoff and landing (assuming the overloads to act in the upward and aft directions), the failure mode is not likely to cause the spillage of enough fuel from any part of the fuel system to constitute a fire hazard.
- (b) Each airplane must be designed so that, with the airplane under control, it can be landed on a paved runway with any one or more landing-gear legs not extended without sustaining a structural component failure that is likely to cause the spillage of enough fuel to constitute a fire hazard.
- (c) Compliance with the provisions of this section may be shown by analysis or tests, or both.]

Amdt. 23-34, Eff. 02/17/87

FAR 27.1191 : [Firewalls.]

- (a) [Each engine, including the combustor, turbine, and tailpipe sections of turbine engines must be isolated by a firewall, shroud, or equivalent means, from personnel compartments, structures, controls, rotor mechanisms, and other parts that are—
 - (1) Essential to a controlled landing ; and
 - (2) Not protected under Sec. 27.861.]
 - (b) Each auxiliary power unit and combustion heater, and any other combustion equipment to be used in flight, must be isolated from the rest of the rotorcraft by firewalls, shrouds, or equivalent means.
 - (c) In meeting paragraphs (a) and (b) of this section, account must be taken of the probable path of a fire as affected by the airflow in normal flight and in autorotation.
 - (d) Each firewall and shroud must be constructed so that no hazardous quantity of air, fluids, or flame can pass from any engine compartment to other parts of the rotorcraft.
 - (e) Each opening in the firewall or shroud must be sealed with close-fitting, fireproof grommets, bushings, or firewall fittings.
 - (f) Each firewall and shroud must be fireproof and protected against corrosion.
- Amdt. 27-2, Eff. 2/25/68

FAR 27.1193 : Cowling and engine compartment covering

- (a) Each cowling and engine compartment covering must be constructed and supported so that it can resist the vibration, inertia, and air loads to which it may be subjected in operation.
- (b) There must be means for rapid and complete drainage of each part of the cowling or engine compartment in the normal ground and flight attitudes.
- (c) No drain may discharge where it might cause a fire hazard.
- (d) Each cowling and engine compartment covering must be at least fire resistant.
- (e) Each part of the cowling or engine compartment covering subject to high temperatures due to its nearness to exhaust system parts or exhaust gas impingement must be fireproof.
- (f) [A means of retaining each openable or readily removable panel, cowling, or engine or rotor drive system covering must be provided to preclude hazardous damage to rotors or critical control components in the event of structural or mechanical failure of the normal retention means, unless such failure is extremely improbable.]

Amdt. 27-23, Eff. 10/3/88

FAR 27.1194 : [Other surfaces.]

- [All surfaces aft of, and near, powerplant compartments, other than tail surfaces not subject to heat, flames, or sparks emanating from a powerplant compartment, must be at least fire resistant.]
- Amdt. 27-2, Eff. 2/25/68

(b) Paragraph (a) does not apply to—

- (1) [Lines, fittings, and components which are already approved as part of a type certificated engine ; and]
- (2) Vent and drain lines, and their fittings, whose failure will not result in, or add to, a fire hazard.
- (c) Each flammable fluid drain and vent must discharge clear of the induction system air inlet.

Amdt. 27-20, Eff. 3/26/84

FAR 27.1185 : Flammable fluids

- (a) Each fuel tank must be isolated from the engines by a firewall or shroud.
- (b) Each tank or reservoir, other than a fuel tank, that is part of a system containing flammable fluids or gases must be isolated from the engine by a firewall or shroud, unless the design of the system, the materials used in the tank and its supports, the shutoff means, and the connections, lines and controls provide a degree of safety equal to that which would exist if the tank or reservoir were isolated from the engines.
- (c) There must be at least one-half inch of clear airspace between each tank and each firewall or shroud isolating that tank, unless equivalent means are used to prevent heat transfer from each engine compartment to the flammable fluid.
- (d) [Absorbent materials close to flammable fluid system components that might leak must be covered or treated to prevent the absorption of hazardous quantities of fluids.]

Amdt. 27-37, Eff. 10/18/99

FAR 27.1187 : Ventilation [and drainage.]

- [Each compartment containing any part of the powerplant installation must have provision for ventilation and drainage of flammable fluids. The drainage means must be—
- (a) Effective under conditions expected to prevail when drainage is needed, and
 - (b) Arranged so that no discharged fluid will cause an additional fire hazard.]

Amdt. 27-37, Eff. 10/18/99

FAR 27.1189 : Shutoff means

- (a) There must be means to shut off each line carrying flammable fluids into the engine compartment, except—
 - (1) Lines, fittings, and components forming an integral part of an engine;
 - (2) For oil systems for which all components of the system, including oil tanks, are fireproof or located in areas not subject to engine fire conditions; and
 - (3) For reciprocating engine installations only, engine oil system lines in installations using engines of less than 500 cu. in. displacement.
- (b) There must be means to guard against inadvertent operation of each shutoff, and to make it possible for the crew to reopen it in flight after it has been closed.
- (c) [Each shutoff valve and its control must be designed, located, and protected to function properly under any condition likely to result from an engine fire.]

Amdt. 27-23, Eff. 10/3/88

FAR 23.723 : Shock absorption tests.

(a) It must be shown that the limit load factors selected for design in accordance with Sec. 23.473 for takeoff and landing weights, respectively, will not be exceeded. This must be shown by energy absorption tests except that analysis based on tests conducted on a landing gear system with identical energy absorption characteristics may be used for increases in previously approved takeoff and landing weights.

(b) The landing gear may not fail, but may yield, in a test showing its [reserve] energy absorption capacity, simulating a descent velocity of 1.2 times the limit descent velocity, assuming wing lift equal to the weight of the airplane.

Amdt. 23-49, Eff. 03/11/96

FAR 23.725 : Limit drop tests.

(a) If compliance with Sec. 23.723(a) is shown by free drop tests, these tests must be made on the complete airplane, or on units consisting of wheel, tire, and shock absorber, in their proper relation, from free drop heights not less than those determined by the following formula :

$$h \text{ (inches)} = 3.6 \left(\frac{W}{S} \right)^{\frac{1}{2}}$$

However, the free drop height may not be less than 9.2 inches and need not be more than 18.7 inches.

(b) If the effect of wing lift is provided for in free drop tests, the landing gear must be dropped with an effective weight equal to—

$$[W_e = W \frac{h + (1-L)d}{h + d}]$$

where—

- W_e :the effective weight to be used in the drop test (lbs.) ;
 h :specified free drop height (inches) ;
 d :deflection under impact of the tire (at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop mass (inches) ;
 W : $W = W_M$ for main gear units (lbs.), equal to the static weight on that unit with the airplane in the level attitude (with the nose wheel clear in the case of the nose wheel type airplanes) ;
 W : $W = W_T$ for tail gear units (lbs.), equal to the static weight on the tail unit with the airplane in the tail-down attitude ;
 W : $W = W_N$ for nose wheel units (lbs.), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the airplane acts at the center of gravity and exerts a force of 1.0g downward and 0.33g forward ; and
 L :the ratio of the assumed wing lift to the airplane weight, but not more than 0.667

(c) The limit inertia load factor must be determined in a rational or conservative manner, during the drop test, using a landing gear unit attitude, and applied drag loads, that represent the landing conditions.

(d) The value of d used in the computation of W_e in paragraph (b) of this section may not exceed the value actually obtained in the drop test.

(e) The limit inertia load factor must be determined from the drop test in paragraph (b) of this section according to the following formula :

$$n = n_j \frac{W_e}{W} + L$$

where—

n_j : the load factor developed in the drop test (that is, the acceleration $\left(\frac{dv}{dt}\right)$ in g's recorded in the drop test) plus 1.0 ; and

W_e , W , and L are the same as in the drop test computation.

(f) The value of n determined in accordance with paragraph (e) may not be more than the limit inertia load factor used in the landing conditions in Sec. 23.473.

Amdt. 23-48, Eff. 03/11/96

FAR 23.726 : [Ground load dynamic tests.]

(a) [If compliance with the ground load requirements of Secs. 23.479 through 23.483 is shown dynamically by drop test, one drop test must be conducted that meets Sec. 23.725 except that the drop height must be—

(1) 2.25 times the drop height prescribed in Sec. 23.725(a) ; or

(2) Sufficient to develop 1.5 times the limit load factor.

(b) The critical landing condition for each of the design conditions specified in Secs. 23.479 through 23.483 must be used for proof of strength.]

Amdt. 23-7, Eff. 09/14/69

FAR 23.727 : Reserve energy absorption drop tests.

(a) If compliance with the reserve energy absorption requirement in Sec. 23.728(b) is shown by free drop tests, the drop height may not be less than 1.44 times that specified in Sec. 23.725.

(b) [If the effect of wing lift is provided for, the units must be dropped with an effective mass equal to $W_e = W \left(\frac{L}{K+L} \right)$, when the symbols and other details are the same as in Sec. 23.725.]

Amdt. 23-7, Eff. 09/14/69

FAR 23.729 : Landing gear extension and retraction system.

(a) *General.* For airplanes with retractable landing gear, the following apply :

FAR 27.1145 : Ignition switches

(a) There must be means to quickly shut off all ignition by the grouping of switches or by a master ignition control.

(b) [Each group of ignition switches, except ignition switches for turbine engines for which continuous ignition is not required, and each master ignition control must have a means to prevent its inadvertent operation.]

Amdt. 27-12, Eff. 5/2/77

FAR 27.1147 : Mixture controls

If there are mixture controls, each engine must have a separate control and the controls must be arranged to allow—

(a) Separate control of each engine ; and

(b) Simultaneous control of all engines.

FAR 27.1151 : [Rotor brake controls.]

(a) [It must be impossible to apply the rotor brake inadvertently in flight.

(b) There must be means to warn the crew if the rotor brake has not been completely released before takeoff.]

Amdt. 27-33, Eff. 8/8/96

FAR 27.1163 : Powerplant accessories

(a) Each engine-mounted accessory must—

(1) Be approved for mounting on the engine involved ;

(2) Use the provisions on the engine for mounting ; and

(3) Be sealed in such a way as to prevent contamination of the engine oil system and the accessory system.

(b) [Unless other means are provided, torque limiting means must be provided for accessory drives located on any component of the transmission and rotor drive system to prevent damage to these components from excessive accessory load.]

Amdt. 27-23, Eff. 10/3/88

65.10 Powerplant Fire Protection

FAR 27.1183 : [Lines, fittings, and components.]

(a) Except as provided in paragraph (b) of this section, each line, fitting, and other component carrying flammable fluid in any area subject to engine fire conditions must be fire resistant, except that 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. Components must be shielded or located so as to safeguard against the ignition of leaking flammable fluid. An integral oil sump of less than [25-quart] capacity on a reciprocating engine need not be fireproof nor be enclosed by a fireproof shield.

65.9 Powerplant Controls and Accessories

FAR 27.1141 : Powerplant controls : general

(a) Powerplant controls must be located and arranged under Sec. 27.777 and marked under Sec. 27.1555.

(b) Each flexible powerplant control must be approved.

(c) [Each control must be able to maintain any set position without—

(1) Constant attention ; or

(2) Tendency to creep due to control loads or vibration.

(d) [Controls of powerplant valves required for safety must have—

(1) For manual valves, positive stops or in the case of fuel valves suitable index provisions, in the open and closed position ; and

(2) For power-assisted valves, a means to indicate to the flight crew when the valve—

(i) Is in the fully open or fully closed position ; or

(ii) Is moving between the fully open and fully closed position.

[(e)] For turbine engine powered rotorcraft, no single failure or malfunction, or probable combination thereof, in any powerplant control system may cause the failure of any powerplant function necessary for safety.

Amdt. 27-33, Eff. 8/8/96

FAR 27.1143 : Engine controls

(a) There must be a separate power control for each engine.

(b) Power controls must be grouped and arranged to allow—

(1) Separate control of each engine ; and

(2) Simultaneous control of all engines.

(c) Each power control must provide a positive and immediately responsive means of controlling its engine.

(d) If a power control incorporates a fuel shutoff feature, the control must have a means to prevent the inadvertent movement of the control into the shutoff position. The means must—

(1) Have a positive lock or stop at the idle position ; and

(2) Require a separate and distinct operation to place the control in the shutoff position.

(e) [For rotorcraft to be certificated for a 30-second OEI power rating, a means must be provided to automatically activate and control the 30-second OEI power and prevent any engine from exceeding the installed engine limits associated with the 30-second OEI power rating approved for the rotorcraft.]

Amdt. 27-29, Eff. 10/17/94

(1) Each landing gear retracting mechanism and its supporting structure must be designed for maximum flight load factors with the gear retracted and must be designed for the combination of friction, inertia, brake torque, and air loads, occurring during retraction at any airspeed up to $1.6 V_{S1}$ with flaps retracted, and for any load factor up to those specified in Sec. 23.345 for the flaps-extended condition.

(2) The landing gear and retracting mechanism, including the wheel well doors, must withstand flight loads, including loads resulting from all yawing conditions specified in Sec. 23.351, with the landing gear extended at any speed up to at least $1.6 V_{S1}$ with the flaps retracted.

(b) *Landing gear lock.* There must be positive means (other than the use of hydraulic pressure) to keep the landing gear extended.

(c) *Emergency operation.* For a landplane having retractable landing gear that cannot be extended manually, there must be means to extend the landing gear in the event of either—

(1) Any reasonably probable failure in the normal landing gear operation system ; or

(2) Any reasonably probable failure in a power source that would prevent the operation of the normal landing gear operation system.

(d) *Operation test.* The proper functioning of the retracting mechanism must be shown by operation tests.

(e) *[Position indicator.* If a retractable landing gear is used, there must be a landing gear position indicator (as well as necessary switches to actuate the indicator) or other means to inform the pilot that each gear is secured in the extended (or retracted) position. If switches are used, they must be located and coupled to the landing gear mechanical system in a manner that prevents an erroneous indication of either "down and locked" if each gear is not in the fully extended position, or "up and locked" if each landing gear is not in the fully retracted position.]

(f) *Landing gear warning.* For landplanes, the following aural or equally effective landing gear warning devices must be provided :

(1) A device that functions continuously when one or more throttles are closed beyond the power settings normally used for landing approach if the landing gear is not fully extended and locked. A throttle stop may not be used in place of an aural device. If there is a manual shutoff for the warning device prescribed in this paragraph, the warning system must be designed so that when the warning has been suspended after one or more throttles are closed, subsequent retardation of any throttle to, or beyond, the position for normal landing approach will activate the warning device.

(2) A device that functions continuously when the wing flaps are extended beyond the maximum approach flap position, using a normal landing procedure, if the landing gear is not fully extended and locked. There may not be a manual shutoff for this warning device. The flap position sensing unit may be installed at any suitable location. The system for this device may use any part of the system (including the aural warning device) for the device required in paragraph (f)(1) of this section.

- (g) [Equipment located in the landing gear bay. If the landing gear bay is used as the location for equipment other than the landing gear, that equipment must be designed and installed to minimize damage from items such as a tire burst, or rocks, water, and slush that may enter the landing gear bay.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.731 : Wheels.

- (a) [The maximum static load rating of each wheel may not be less than the corresponding static ground reaction—
- (1) Design maximum weight ; and
- (2) Critical center of gravity.
- (b) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the applicable ground load requirements of this part.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.733 : Tires.

- (a) [Each landing gear wheel must have a tire whose approved tire ratings (static and dynamic) are not exceeded—
- (1) By a load on each main wheel tire (to be compared to the static rating approved for such tires) equal to the corresponding static ground reaction under the design maximum weight and critical center of gravity ; and
- (2) By a load on nose wheel tires (to be compared with the dynamic rating approved for such tires) equal to the reaction obtained at the nose wheel, assuming the mass of the airplane to be concentrated at the most critical center of gravity and exerting a force of 1.0W downward and 0.31 W forward (where W is the design maximum weight), with the reactions distributed to the nose and main wheels by the principles of statics, and with the drag reaction at the ground applied only at wheels with brakes.]
- (b) If specially constructed tires are used, the wheels must be plainly and conspicuously marked to that effect. The markings must include the make, size, number of plies, and identification marking of the proper tire.
- (c) Each tire installed on a retractable landing gear system must, at the maximum size of the tire type expected in service, have a clearance to surrounding structure and systems that is adequate to prevent contact between the tire and any part of the structure or systems.

Amdt. 23-45, Eff. 09/07/93

FAR 23.735 : Brakes.

- (a) [Brakes must be provided. The landing brake kinetic energy capacity rating of each main wheel brake assembly must not be less than the kinetic energy absorption requirements determined under either of the following methods :]
- (1) The brake kinetic energy absorption requirements must be based on a conservative rational analysis of the sequence of events expected during landing at the design landing weight.

- grams per cubic meter in the form of drops having a mean effective diameter of not less than 20 microns, followed by momentary operation at takeoff power or thrust. During the 30 minutes of idle operation, the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator.

- (c) *Supercharged reciprocating engines.* For each engine having superchargers to pressurize the air before it enters the carburetor, the heat rise in the air caused by that supercharging at any altitude may be utilized in determining compliance with paragraph (a) of this section if the heat rise utilized is that which will be available, automatically, for the applicable altitude and operating condition because of supercharging.

Amdt. 27-23, Eff. 10/3/88

65.8 Exhaust System

FAR 27.1121 : General

For each exhaust system—

- (a) There must be means for thermal expansion of manifolds and pipes ;
- (b) There must be means to prevent local hot spots ;
- (c) Exhaust gases must discharge clear of the engine air intake, fuel system components, and drains ;
- (d) [Each exhaust system part with a surface hot enough to ignite flammable fluids or vapors must be located or shielded so that leakage from any system carrying flammable fluids or vapors will not result in a fire caused by impingement of the fluids or vapors on any part of the exhaust system including shields for the exhaust system ;]
- (e) Exhaust gases may not impair pilot vision at night due to glare ;
- (f) If significant traps exist, each turbine engine exhaust system must have drains discharging clear of the rotorcraft, in any normal ground and flight attitudes, to prevent fuel accumulation after the failure of an attempted engine start ;
- (g) [Each exhaust heat exchanger must incorporate means to prevent blockage of the exhaust port after any internal heat exchanger failure.]

Amdt. 27-12, Eff. 5/2/77

FAR 27.1123 : [Exhaust piping.]

- (a) [Exhaust piping must be heat and corrosion resistant, and must have provisions to prevent failure due to expansion by operating temperatures.
- (b) Exhaust piping must be supported to withstand any vibration and inertia loads to which it would be subjected in operations.
- (c) Exhaust piping connected to components between which relative motion could exist must have provisions for flexibility.]

Amdt. 27-11, Eff. 2/1/77

- (b) Each cold air induction system opening must be outside the cowl if backfire flames can emerge.
- (c) If fuel can accumulate in any air induction system, that system must have drains that discharge fuel—
- (1) Clear of the rotorcraft; and
 - (2) Out of the path of exhaust flames.
- (d) [For turbine engine powered rotorcraft—
- (1) There must be means to prevent hazardous quantities of fuel leakage or overflow from drains, vents, or other components of flammable fluid systems from entering the engine intake system; and
 - (2) The air inlet ducts must be located or protected so as to minimize the ingestion of foreign matter during takeoff, landing, and taxiing.]

Amdt. 27-23, Eff. 10/3/88

FAR 27.1093 : Induction system icing protection

- (a) *Reciprocating engines.* Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of 30 degrees F., and with the engines at 75 percent of maximum continuous power—
- (1) Each rotorcraft with sea level engines using conventional venturi carburetors has a preheater that can provide a heat rise of 90 degrees F.;
 - (2) Each rotorcraft with sea level engines using carburetors tending to prevent icing has a sheltered alternate source of air, and that the preheat supplied to the alternate air intake is not less than that provided by the engine cooling air downstream of the cylinders;
 - (3) Each rotorcraft with altitude engines using conventional venturi carburetors has a preheater capable of providing a heat rise of 120 degrees F.; and
 - (4) Each rotorcraft with altitude engines using carburetors tending to prevent icing has a preheater that can provide a heat rise of—
 - (i) 100 degrees F.; or
 - (ii) If a fluid deicing system is used, at least 40 degrees F.

(b) *Turbine engines.*

- (1) [It must be shown that each turbine engine and its air inlet system can operate throughout the flight power range of the engine (including idling)—
 - (i) Without accumulating ice on engine or inlet system components that would adversely affect engine operation or cause a serious loss of power under the icing conditions specified in Appendix C of Part 29 of this chapter; and
 - (ii) In snow, both falling and blowing, without adverse effect on engine operation, within the limitations established for the rotorcraft.]
- (2) Each turbine engine must idle for 30 minutes on the ground, with the air bleed available for engine icing protection at its critical condition, without adverse effect, in an atmosphere that is at a temperature between 15° and 30° F (between -9° and -1° C) and has a liquid water content not less than 0.3

- (2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula :

$$KE = 0.0443 \frac{W V^2}{N}$$

where—

KE :Kinetic energy per wheel (ft.-lb.);

W :Design landing weight (lb.);

V :Airplane speed in knots. *V* must be not less than *V_S*, the poweroff stalling speed of the airplane at sea level, at the design landing weight, and in the landing configuration; and

N :Number of main wheels with brakes.

- (b) Brakes must be able to prevent the wheels from rolling on a paved runway with takeoff power on the critical engine, but need not prevent movement of the airplane with wheels locked.
- (c) [During the landing distance determination required by Sec. 23.75, the pressure on the wheel braking system must not exceed the pressure specified by the brake manufacturer.
- (d) If antiskid devices are installed, the devices and associated systems must be designed so that no single probable malfunction or failure will result in a hazardous loss of braking ability or directional control of the airplane.
- (e) In addition, for commuter category airplanes, the rejected takeoff brake kinetic energy capacity rating of each main wheel brake assembly must not be less than the kinetic energy absorption requirements determined under either of the following methods—
- (1) The brake kinetic energy absorption requirements must be based on a conservative rational analysis of the sequence of events expected during a rejected takeoff at the design takeoff weight.
 - (2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula—

$$KE = 0.0443 \frac{W V^2}{N}$$

where—

KE :Kinetic energy per wheel (ft.-lbs.);

W :Design takeoff weight (lbs.);

V :Ground speed, in knots, associated with the maximum value of *V₁* selected in accordance with Sec. 23.51(c)(1);

N :Number of main wheels with brakes.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.737 : Skis.

[The maximum limit load rating of each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements of this part.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.745 : [Nose/Tail wheel steering.]

- (a) [If nose/tail wheel steering is installed, it must be demonstrated that its use does not require exceptional pilot skill during takeoff and landing, in crosswinds, or in the event of an engine failure; or its use must be limited to low speed maneuvering.
 - (b) Movement of the pilot's steering control must not interfere with the retraction or extension of the landing gear.]
- Amdt. 23-49, EF. 03/11/96

31.5 Floats and Hulls**FAR 23.751 : Main float buoyancy.**

- (a) Each main float must have—
 - (1) [A buoyancy of 80 percent in excess of the buoyancy required by that float to support its portion of the maximum weight of the seaplane or amphibian in fresh water; and
 - (2) Enough watertight compartments to provide reasonable assurance that the seaplane or amphibian will stay afloat without capsizing if any two compartments of the main floats are flooded.]
 - (b) Each main float must contain at least four watertight compartments approximately equal in volume.
- Amdt. 23-45, EF. 09/07/93

FAR 23.753 : Main float design.

[Each seaplane main float must meet the requirements of Sec. 23.521.]
Amdt. 23-45, EF. 09/07/93

FAR 23.755 : Hulls.

- (a) The hull of a hull seaplane or amphibian of 1,500 pounds or more maximum weight must have watertight compartments designed and arranged so that the hull, auxiliary floats, and tires (if used), will keep the airplane afloat without capsizing in fresh water when—
 - (1) For airplanes of 5,000 pounds or more maximum weight, any two adjacent compartments are flooded; and
 - (2) For airplanes of 1,500 pounds up to, but not including, 5,000 pounds maximum weight, any single compartment is flooded.
- (b) [Watertight doors in bulkheads may be used for communication between compartments.]

Amdt. 23-48, EF. 03/11/96

FAR 23.757 : Auxiliary floats.

Auxiliary floats must be arranged so that, when completely submerged in fresh water, they provide a righting moment of at least 1.5 times the upsetting moment caused by the seaplane or amphibian being tilted.

- (c) *Correction factor* (except cylinder barrels). Unless a more rational correction applies, temperatures of engine fluids and power-plant components (except cylinder barrels) for which temperature limits are established, must be corrected by adding to them the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum component or fluid temperature recorded during the cooling test.
- (d) *Correction factor for cylinder barrel temperatures*. Cylinder barrel temperatures must be corrected by adding to them 0.7 times the difference between the [maximum ambient atmospheric temperature] and the temperature of the ambient air at the time of the first occurrence of the maximum cylinder barrel temperature recorded during the cooling test.

Amdt. 27-14, EF. 3/1/78

FAR 27.1045 : Cooling test procedures

- (a) *General*. For each stage of flight, the cooling tests must be conducted with the rotorcraft—
 - (1) In the configuration most critical for cooling; and
 - (2) Under the conditions most critical for cooling.
- (b) *Temperature stabilization*. For the purpose of the cooling tests, a temperature is "stabilized" when its rate of change is less than two degrees F. per minute. The following component and engine fluid temperature stabilization rules apply :
 - (1) For each rotorcraft, and for each stage of flight—
 - (i) The temperatures must be stabilized under the conditions from which entry is made into the stage of flight being investigated; or
 - (ii) If the entry condition normally does not allow temperatures to stabilize, operation through the fuel entry condition must be conducted before entry into the stage of flight being investigated in order to allow the temperatures to attain their natural levels at the time of entry.
 - (2) For each helicopter during the takeoff stage of flight, the climb at takeoff power must be preceded by a period of hover during which the temperatures are stabilized.
- (c) *Duration of test*. For each stage of flight the tests must be continued until—
 - (1) [The temperatures stabilize or 5 minutes after the occurrence of the highest temperature recorded, as appropriate to the test condition.]
 - (2) That stage of flight is completed; or
 - (3) An operating limitation is reached.

Amdt. 27-23, EF. 10/3/88

65.7 Induction System**FAR 27.1091 : Air induction**

- (a) The air induction system for each engine must supply the air required by that engine under the operating conditions and maneuvers for which certification is requested.

(d) For each lubricant tank or sump outlet supplying lubrication to rotor drive systems and rotor drive system components, a screen must be provided to prevent entrance into the lubrication system of any object that might obstruct the flow of lubricant from the outlet to the filter required by paragraph (c) of this section. The requirements of paragraph (c) do not apply to screens installed at lubricant tank or sump outlets.

(e) Splash-type lubrication systems for rotor drive system gearboxes must comply with Secs. 27.1021 and 27.1337(d).

Amdt. 27-37, Eff. 10/18/99

65.6 Cooling

FAR 27.1041 : General

(a) [Each powerplant cooling system must be able to maintain the temperatures of powerplant components within the limits established for these components under critical surface (ground or water) and flight operating conditions for which certification is required and after normal shutdown. Powerplant components to be considered include but may not be limited to engines, rotor drive system components, auxiliary power units, and the cooling or lubricating fluids used with these components.]

(b) Compliance with paragraph (a) of this section must be shown in tests conducted under the conditions prescribed in that paragraph.

Amdt. 27-23, Eff. 10/3/88

FAR 27.1043 : Cooling tests

(a) [General. For the tests prescribed in Sec. 27.1041(b), the following apply :

(1) If the tests are conducted under conditions deviating from the maximum ambient atmospheric temperature specified in paragraph (b) of this section, the recorded powerplant temperatures must be corrected under paragraphs (c) and (d) of this section unless a more rational correction method is applicable.

(2) No corrected temperature determined under subparagraph (1) of this paragraph may exceed established limits.

(3) For reciprocating engines, the fuel used during the cooling tests must be of the minimum grade approved for the engines, and the mixture settings must be those normally used in the flight stages for which the cooling tests are conducted.

(4) The test procedures must be as prescribed in Sec. 27.1045.

(b) [Maximum ambient atmospheric temperature. A maximum ambient atmospheric temperature corresponding to sea level conditions of at least 100 degrees F must be established. The assumed temperature lapse rate is 3.6 degrees F per thousand feet of altitude above sea level until a temperature of -69.7 degrees F is reached, above which altitude the temperature is considered constant at -69.7 degrees F. However, for winterization installations, the applicant may select a maximum ambient atmospheric temperature corresponding to sea level conditions of less than 100 degrees F.]

31.6 Personnel and Cargo Accommodations

FAR 23.771 : Pilot compartment.

For each pilot compartment—

(a) The compartment and its equipment must allow each pilot to perform his duties without unreasonable concentration or fatigue ;

(b) [Where the flight crew are separated from the passengers by a partition, an opening or openable window or door must be provided to facilitate communication between flight crew and the passengers ; and

(c) The aerodynamic controls listed in Sec. 23.779, excluding cables and control rods, must be located with respect to the propellers so that no part of the pilot or the controls lies in the region between the plane of rotation of any inboard propeller and the surface generated by a line passing through the center of the propeller hub making an angle of 5° forward or aft of the plane of rotation of the propeller.]

Amdt. 23-14, Eff. 12/20/73

FAR 23.773 : Pilot compartment view.

(a) [Each pilot compartment must be—

(1) Arranged with sufficiently extensive, clear and undistorted view to enable the pilot to safely taxi, takeoff, approach, land, and perform any maneuvers within the operating limitations of the airplane.

(2) Free from glare and reflections that could interfere with the pilot's vision. Compliance must be shown in all operations for which certification is requested ; and

(3) Designed so that each pilot is protected from the elements so that moderate rain conditions do not unduly impair the pilot's view of the flight path in normal flight and while landing.

(b) Each pilot compartment must have a means to either remove or prevent the formation of fog or frost on an area of the internal portion of the windshield and side windows sufficiently large to provide the view specified in paragraph (a)(1) of this section. Compliance must be shown under all expected external and internal ambient operating conditions, unless it can be shown that the windshield and side windows can be easily cleared by the pilot without interruption of normal pilot duties.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.775 : Windshields and windows.

(a) [The internal panels of windshields and windows must be constructed of a nonsplintering material, such as nonsplintering safety glass.]

(b) The design of windshields, windows, and canopies in pressurized airplanes must be based on factors peculiar to high altitude operation, including—

(1) The effects of continuous and cyclic pressurization loadings ;

(2) The inherent characteristics of the material used ; and

(3) The effects of temperatures and temperature gradients.

- (c) [On pressurized airplanes, if certification for operation up to and including 25,000 feet is requested, an enclosure canopy including a representative part of the installation must be subjected to special tests to account for the combined effects of continuous and cyclic pressurization loadings and flight loads, or compliance with the fail-safe requirements of paragraph (d) of this section must be shown.
- (d) If certification for operation above 25,000 feet is requested, the windshields, window panels, and canopies must be strong enough to withstand the maximum cabin pressure differential loads combined with critical aerodynamic pressure and temperature effects, after failure of any load-carrying element of the windshield, window panel, or canopy.
- (e) The windshield and side windows forward of the pilot's back when the pilot is seated in the normal flight position must have a minimum transmittance value of not less than 70 percent.]
- (f) Unless operation in known or forecast icing conditions is prohibited by operating limitations, a means must be provided to prevent or to clear accumulations of ice from the windshield so that the pilot has adequate view for taxi, takeoff, approach, landing, and to perform any maneuvers within the operating limitations of the airplane.
- (g) In the event of any probable single failure, a transparency heating system must be incapable of raising the temperature of any windshield or window to a point where there would be—
 - (1) Structural failure that adversely affects the integrity of the cabin; or
 - (2) A danger of fire.
- (h) [In addition, for commuter category airplanes, the following applies :
 - (1) Windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the impact of a two-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to the airplane's maximum approach flap speed.
 - (2) The windshield panes in front of the pilots must be arranged so that, assuming the loss of vision through any one panel, one or more panels remain available for use by a pilot seated at a pilot station to permit continued safe flight and landing.]

Amdt. 23-49, EFF. 03/11/96

FAR 23.777 : Cockpit controls.

- (a) Each cockpit control must be located and (except where its function is obvious) identified to provide convenient operation and to prevent confusion and inadvertent operation.
- (b) The controls must be located and arranged so that the pilot, when seated, has full and unrestricted movement of each control without interference from either his clothing or the cockpit structure.
- (c) Powerplant controls must be located—
 - (1) For multiengine airplanes, on the pedestal or overhead at or near the center of the cockpit ;

- (3) [The oil strainer or filter, unless it is installed at an oil tank outlet, must incorporate a means to indicate contamination before it reaches the capacity established in accordance with paragraph (a)(2) of this section.]
- (4) The bypass of a strainer or filter must be constructed and installed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.
- (5) An oil strainer or filter that has no bypass, except one that is installed at an oil tank outlet, must have a means to connect it to the warning system required in Sec. 27.1305(r).
- (b) Each oil strainer or filter in a powerplant installation using reciprocating engines must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.

Amdt. 27-23, EFF. 10/3/88

FAR 27.1021 : Oil system drains

[A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must—

- (a) Be accessible; and
- (b) Have manual or automatic means for positive locking in the closed position.]

Amdt. 27-20, EFF. 3/26/84

FAR 27.1027 : Transmissions and gearboxes : General

- (a) [The lubrication system for components of the rotor drive system that require continuous lubrication must be sufficiently independent of the lubrication systems of the engine(s) to ensure lubrication during autorotation.]
- (b) Pressure lubrication systems for transmissions and gearboxes must comply with the engine oil system requirements of Secs. 27.1013 (except paragraph (d)), 27.1015, 27.1017, 27.1021, and 27.1337(d).
- (c) Each pressure lubrication system must have an oil strainer or filter through which all of the lubricant flows and must—
 - (1) Be designed to remove from the lubricant any contaminant which may damage transmission and drive system components or impede the flow of lubricant to a hazardous degree ;
 - (2) Be equipped with a means to indicate collection of contaminants on the filter or strainer at or before opening of the bypass required by paragraph (c)(3) of this section; and
 - (3) Be equipped with a bypass constructed and installed so that—
 - (i) The lubricant will flow at the normal rate through the rest of the system with the strainer or filter completely blocked ; and
 - (ii) The release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flowpath.

FAR 27.1013 : Oil tanks

Each oil tank must be designed and installed so that—

- (a) It can withstand, without failure, each vibration, inertia, fluid, and structural load expected in operation;
- (b) [(Reserved).]
- (c) Where used with a reciprocating engine, it has an expansion space of not less than the greater of 10 percent of the tank capacity or 0.5 gallon, and where used with a turbine engine, it has an expansion space of not less than 10 percent of the tank capacity;
- (d) It is impossible to fill the tank expansion space inadvertently with the rotorcraft in the normal ground attitude;
- (e) Adequate venting is provided; and
- (f) There are means in the filler opening to prevent oil overflow from entering the oil tank compartment.

Amdt. 27-9, Eff. 10/31/74

FAR 27.1015 : [Oil tank tests.]

[Each oil tank must be designed and installed so that it can withstand, without leakage, an internal pressure of 5 p.s.i., except that each pressurized oil tank used with a turbine engine must be designed and installed so that it can withstand, without leakage, an internal pressure of 5 p.s.i., plus the maximum operating pressure of the tank.]

Amdt. 27-9, Eff. 10-31-74

FAR 27.1017 : Oil lines and fittings

- (a) Each oil line must be supported to prevent excessive vibration.
- (b) Each oil line connected to components of the rotorcraft between which relative motion could exist must have provisions for flexibility.
- (c) Flexible hose must be approved.
- (d) Each oil line must have an inside diameter of not less than the inside diameter of the engine inlet or outlet. No line may have splices between connections.

FAR 27.1019 : Oil strainer or filter

- (a) Each turbine engine installation must incorporate an oil strainer or filter through which all of the engine oil flows and which meets the following requirements :
 - (1) Each oil strainer or filter that has a bypass must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter completely blocked.
 - (2) The oil strainer or filter must have the capacity (with respect to operating limitations established for the engine) to ensure that engine oil system functioning is not impaired when the oil is contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine under Part 33 of this Chapter.

- (2) For [single and] tandem seated single-engine airplanes, on the left side console or instrument panel ;
- (3) For other single-engine airplanes at or near the center of the cockpit, on the pedestal, instrument panel, or overhead; and
- (4) For airplanes with side-by-side pilot seats and with two sets of powerplant controls, on left and right consoles.
- (d) The control location order from left to right must be power (thrust) lever, propeller (rpm control), and mixture control (condition lever and fuel cut-off for turbine-powered airplanes). Power (thrust) levers must be at least one inch higher or longer to make them more prominent than propeller (rpm control) or mixture controls. Carburetor heat or alternate air control must be to the left of the throttle or at least eight inches from the mixture control when located other than on a pedestal. Carburetor heat or alternate air control, when located on a pedestal must be aft or below the power (thrust) lever. Supercharger controls must be located below or aft of the propeller controls. Airplanes with tandem seating or single-place airplanes may utilize control locations on the left side of the cabin compartment; however, location order from left to right must be power (thrust) lever, propeller (rpm control) and mixture control.
- (e) Identical powerplant controls for each engine must be located to prevent confusion as to the engines they control.
 - (1) Conventional multiengine powerplant controls must be located so that the left control(s) operates the left engine(s) and the right control(s) operates the right engine(s).
 - (2) On twin-engine airplanes with front and rear engine locations (tandem), the left powerplant controls must operate the front engine and the right powerplant controls must operate the rear engine.
- (f) Wing flap and auxiliary lift device controls must be located—
 - (1) Centrally, or to the right of the pedestal or powerplant throttle control centerline; and
 - (2) Far enough away from the landing gear control to avoid confusion.
- (g) The landing gear control must be located to the left of the throttle centerline or pedestal centerline.
- (h) Each fuel feed selector control must comply with Sec. 23.995 and be located and arranged so that the pilot can see and reach it without moving any seat or primary flight control when his seat is at any position in which it can be placed.
 - (1) For a mechanical fuel selector :
 - (i) The indication of the selected fuel valve position must be by means of a pointer and must provide positive identification and feel (detent, etc.) of the selected position.
 - (ii) The position indicator pointer must be located at the part of the handle that is the maximum dimension of the handle measured from the center of rotation.
- (2) For electrical or electronic fuel selector :
 - (i) Digital controls or electrical switches must be properly labelled.

- (ii) Means must be provided to indicate to the flight crew the tank or function selected. Selector switch position is not acceptable as a means of indication. The "off" or "closed" position must be indicated in red.
- (3) If the fuel valve selector handle or electrical or digital selection is also a fuel shut-off selector, the off position marking must be colored red. If a separate emergency shut-off means is provided, it also must be colored red.

Amdt. 23-51, Eff. 03/11/96

FAR 23.779 : Motion and effect of cockpit controls.

Cockpit controls must be designed so that they operate in accordance with the following movement and actuation :

(a) Aerodynamic controls :

(1) <i>Primary Controls</i>	<i>Motion and effect</i>
Aileron	Right (clockwise) for right wing down
Elevator	Rearward for nose up.
Rudder	Right pedal forward for nose right.
(2) <i>Secondary Controls</i>	
Flaps (or auxiliary lift devices)	Forward or up for flaps up or auxiliary device stowed ; rearward or down for flaps down or auxiliary device deployed.
Trim tabs (or equivalent)	Switch motion or mechanical rotation or control to produce similar rotation of the airplane about an axis parallel to the axis control. Axis of roll trim control may be displaced to accommodate comfortable actuation by the pilot. For single-engine airplanes, direction of pilot's hand movement must be in the same sense as airplane response for rudder trim if only a portion of a rotational element is accessible.

(b) Powerplant and auxiliary controls :

(1) <i>Powerplant Controls</i>	<i>Motion and effect</i>
Power (thrust lever)	Forward to increase forward thrust and rearward to increase rearward thrust.
Propellers	Forward to increase rpm.
Mixture	Forward or upward for rich.
Fuel	Forward for open.
Carburetor, air heat or alternate air	Forward or upward for cold.
Supercharger	Forward or upward for low blower.
Turbo-superchargers	Forward, upward, or clockwise to increase pressure.
Rotary controls	Clockwise from off to full on
(2) <i>Auxiliary Controls</i>	
Fuel tank selector	Right for right tanks, left for left tanks
Landing gear	Down to extend
Speed brakes	Aft to extend

Amdt. 23-51, Eff. 03/11/96

- (a) Be accessible for draining and cleaning and must incorporate a screen or element which is easily removable;
- (b) Have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes ;
- (c) Be mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter itself, unless adequate strength margins under all loading conditions are provided in the lines and connections ; and
- (d) [Provide a means to remove from the fuel any contaminant which would jeopardize the flow of fuel through rotorcraft or engine fuel system components required for proper rotorcraft fuel system or engine fuel system operation.]

Amdt. 27-23, Eff. 10/3/88

FAR 27.999 : Fuel system drains

- (a) [There must be at least one accessible drain at the lowest point in each fuel system to completely drain the system with the rotorcraft in any ground attitude to be expected in service.]
- (b) Each drain required by paragraph (a) of this section must—
- (1) Discharge clear of all parts of the rotorcraft ;
 - (2) [Have manual or automatic means to assure positive closure in the off position ; and]
 - (3) Have a drain valve—
 - (i) That is readily accessible and which can be easily opened and closed ; and
 - (ii) That is either located or protected to prevent fuel spillage in the event of a landing with landing gear retracted.

Amdt. 27-23, Eff. 10/3/88

65.5 Oil System

FAR 27.1011 : [Engines] general

- (a) Each engine must have an independent oil system that can supply it with an appropriate quantity of oil at a temperature not above that safe for continuous operation.
- (b) The usable oil capacity of each system may not be less than the product of the endurance of the rotorcraft under critical operating conditions and the maximum oil consumption of the engine under the same conditions, plus a suitable margin to ensure adequate circulation and cooling. Instead of a rational analysis of endurance and consumption, a usable oil capacity of one gallon for each 40 gallons of usable fuel may be used.
- (c) The oil cooling provisions for each engine must be able to maintain the oil inlet temperature to that engine at or below the maximum established value. This must be shown by flight tests.

Amdt. 27-23, Eff. 10/3/88

- (b) The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line.
- (c) The diameter of each strainer must be at least that of the fuel tank outlet.
- (d) Each finger strainer must be accessible for inspection and cleaning.]

Amdt. 27-11, Eff. 2/1/77

65.4 Fuel System Components

FAR 27.991 : Fuel pumps

[Compliance with Sec. 27.955 may not be jeopardized by failure of—

- (a) Any one pump except pumps that are approved and installed as parts of a type certificated engine ; or
- (b) Any component required for pump operation except, for engine driven pumps, the engine served by that pump.]

Amdt. 27-23, Eff. 10/3/88

FAR 27.993 : Fuel system lines and fittings

- (a) Each fuel line must be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure and accelerated flight conditions.
- (b) Each fuel line connected to components of the rotorcraft between which relative motion could exist must have provisions for flexibility.
- (c) Flexible hose must be approved.
- (d) [Each flexible connection in fuel lines that may be under pressure or subjected to axial loading must use flexible hose assemblies.
- (e) No flexible hose that might be adversely affected by high temperatures may be used where excessive temperatures will exist during operation or after engine shutdown.]

Amdt. 27-2, Eff. 2/25/68

FAR 27.995 : Fuel valves

- (a) There must be a positive, quick-acting valve to shut off fuel to each engine individually.
- (b) The control for this valve must be within easy reach of appropriate crewmembers.
- (c) Where there is more than one source of fuel supply there must be means for independent feeding from each source.
- (d) No shutoff valve may be on the engine side of any firewall.

FAR 27.997 : Fuel strainer or filter

[There must be a fuel strainer or filter between the fuel tank outlet and the inlet of the first fuel system component which is susceptible to fuel contamination, including but not limited to the fuel metering device or an engine positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must—]

FAR 23.781 : Cockpit control knob shape.

- (a) [Flap and landing gear] control knobs must conform to the general shapes (but not necessarily the exact sizes or specific proportions) in the following figure (Figure 31.1, p. 329) :

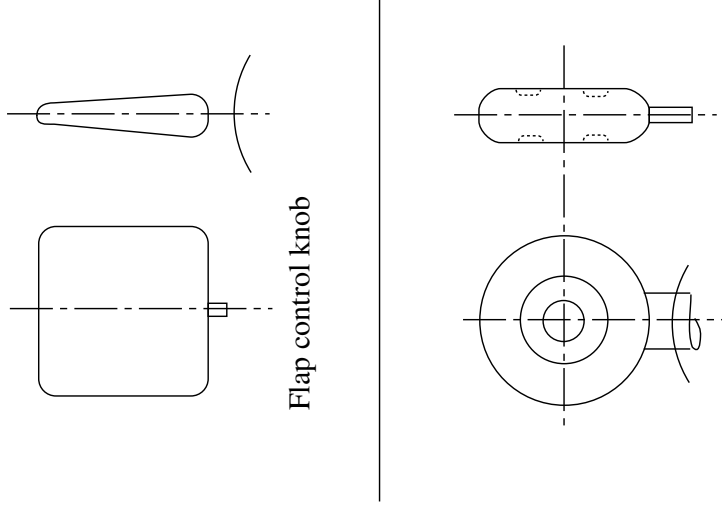


FIG. 31.1 — Control Knob

- (b) [Powerplant control knobs must conform to the general shapes (but not necessarily the exact sizes of specific proportions) in the following figure (Figure 31.2, p. 330) ;]

Amdt. 23-33, Eff. 08/11/86

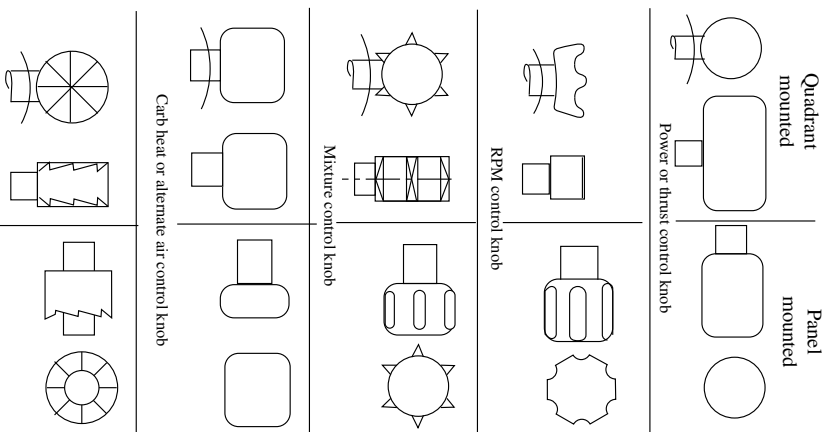


FIG. 31.2 – Control Knob

FAR 27.971 : Fuel tank sump

(a) [Each fuel tank must have a drainable sump with an effective capacity in any ground attitude to be expected in service of 0.25 percent of the tank capacity or one sixteenth gallon, whichever is greater, unless—

(1) The fuel system has a sediment bowl or chamber that is accessible for preflight drainage and has a minimum capacity of 1 ounce for every 20 gallons of fuel tank capacity; and

(2) Each fuel tank drain is located so that in any ground attitude to be expected in service, water will drain from all parts of the tank to the sediment bowl or chamber.

(b) Each sump, sediment bowl, and sediment chamber drain required by the section must comply with the drain provisions of Sec. 27.999(b).]

Amdt. 27-23, EFF. 10/3/88

FAR 27.973 : Fuel tank filler connection

(a) [Each fuel tank filler connection must prevent the entrance of fuel into any part of the rotorcraft other than the tank itself during normal operations and must be crash resistant during a survivable impact in accordance with Sec. 27.952(c). In addition—

(1) Each filler must be marked as prescribed in Sec. 27.1557(c)(1);

(2) Each recessed filler connection that can retain any appreciable quantity of fuel must have a drain that discharges clear of the entire rotorcraft; and

(3) Each filler cap must provide a fuel-tight seal under the fluid pressure expected in normal operation and in a survivable impact.

(b) Each filler cap or filler cap cover must warn when the cap is not fully locked or seated on the filler connection.]

Amdt. 27-30, EFF. 11/2/94

FAR 27.975 : Fuel tank vents

(a) Each fuel tank must be vented from the top part of the expansion space so that venting is effective under all normal flight conditions. Each vent must minimize the probability of stoppage by dirt or ice.

(b) [The venting system must be designed to minimize spillage of fuel through the vents to an ignition source in the event of a rollover during landing, ground operation, or a survivable impact.]

Amdt. 27-35, EFF. 9/8/98

FAR 27.977 : Fuel tank outlet

(a) [There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must—

(1) For reciprocating engine powered rotorcraft, have 8 to 16 meshes per inch; and

(2) For turbine engine powered rotorcraft, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

(iii) If more than one frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, the most critical of these frequencies must be the test frequency.

(4) Under paragraphs (d)(3)(ii) and (iii) of this section, the time of test must be adjusted to accomplish the same number of vibration cycles as would be accomplished in 25 hours at the frequency specified in paragraph (d)(3)(i) of this section.

(5) During the test, the tank assembly must be rocked at the rate of 16 to 20 complete cycles per minute through an angle of 15 degrees on both sides of the horizontal (30 degrees total), about the most critical axis, for 25 hours. If motion about more than one axis is likely to be critical, the tank must be rocked about each critical axis for 12 1/2 hours.]

Amdt. 27-12, Eff. 5/2/77

FAR 27.967 : [Fuel tank installation.]

(a) [Each fuel tank must be supported so that tank loads are not concentrated on unsupported tank surfaces. In addition—

- (1) There must be pads, if necessary, to prevent chafing between each tank and its supports;
- (2) The padding must be nonabsorbent or treated to prevent the absorption of fuel;
- (3) If flexible tank liners are used, they must be supported so that it is not necessary for them to withstand fluid loads; and
- (4) Each interior surface of tank compartments must be smooth and free of projections that could cause wear of the liner unless—
 - (i) There are means for protection of the liner at those points; or
 - (ii) The construction of the liner itself provides such protection.

(b) Any spaces adjacent to tank surfaces must be adequately ventilated to avoid accumulation of fuel or fumes in those spaces due to minor leakage. If the tank is in a sealed compartment, ventilation may be limited to drain holes that prevent clogging and excessive pressure resulting from altitude changes. If flexible tank liners are installed, the venting arrangement for the spaces between the liner and its container must maintain the proper relationship to tank vent pressures for any expected flight condition.

(c) The location of each tank must meet the requirements of Sec. 27.1185(a) and (c).

(d) No rotorcraft skin immediately adjacent to a major air outlet from the engine compartment may act as the wall of the integral tank.]

Amdt. 27-30, Eff. 11/2/94

FAR 27.969 : Fuel tank expansion space

[Each fuel tank or each group of fuel tanks with interconnected vent systems must have an expansion space of not less than 2 percent of the tank capacity. It must be impossible to fill the fuel tank expansion space inadvertently with the rotorcraft in the normal ground attitude.]

Amdt. 27-23, Eff. 10/3/88

FAR 23.783 : Doors.

(a) Each closed cabin with passenger accommodations must have at least one adequate and easily accessible external door.

(b) [Passenger doors must not be located with respect to any propeller disk or any other potential hazard so as to endanger persons using the door.]

(c) Each external passenger or crew door must comply with the following requirements :

- (1) There must be a means to lock and safeguard the door against inadvertent opening during flight by persons, by cargo, or as a result of mechanical failure.
- (2) The door must be openable from the inside and the outside when the internal locking mechanism is in the locked position.

(3) There must be a means of opening which is simple and obvious and is arranged and marked inside and outside so that the door can be readily located, unlocked, and opened, even in darkness.

(4) The door must meet the marking requirements of Sec. 23.811 of this part.

(5) The door must be reasonably free from jamming as a result of fuselage deformation in an emergency landing.

(6) Auxiliary locking devices that are actuated externally to the airplane may be used but such devices must be overridden by the normal internal opening means.

(d) In addition, each external passenger or crew door, for a commuter category airplane, must comply with the following requirements :

(1) Each door must be openable from both the inside and outside, even though persons may be crowded against the door on the inside of the airplane.

(2) If inward opening doors are used, there must be a means to prevent occupants from crowding against the door to the extent that would interfere with opening the door.

(3) Auxiliary locking devices may be used.

(e) Each external door on a commuter category airplane, each external door forward of any engine or propeller on a normal, utility, or acrobatic category airplane, and each door of the pressure vessel on a pressurized airplane must comply with the following requirements :

(1) There must be a means to lock and safeguard each external door, including cargo and service type doors, against inadvertent opening in flight, by persons, by cargo, or as a result of mechanical failure or failure of a single structural element, either during or after closure.

(2) There must be a provision for direct visual inspection of the locking mechanism to determine if the external door, for which the initial opening movement is not inward, is fully closed and locked. The provisions must be discernible, under operating lighting conditions, by a crewmember using a flashlight or an equivalent lighting source.

(3) There must be a visual warning means to signal a flight crewmember if the external door is not fully closed and locked. The means must be designed so that any failure, or combination of failures, that would result in an erroneous closed and locked indication is improbable for doors for which the initial opening movement is not inward.

(f) In addition, for commuter category airplanes, the following requirements apply :

- (1) Each passenger entry door must qualify as a floor level emergency exit. This exit must have a rectangular opening of not less than 24 inches wide by 48 inches high, with corner radii not greater than one-third the width of the exit.
- (2) If an integral stair is installed at a passenger entry door, the stair must be designed so that, when subjected to the inertia loads resulting from the ultimate static load factors in Sec. 23.561(b)(2) and following the collapse of one or more legs of the landing gear, it will not reduce the effectiveness of emergency egress through the passenger entry door.

(g) [If lavatory doors are installed, they must be designed to preclude an occupant from becoming trapped inside the lavatory. If a locking mechanism is installed, it must be capable of being unlocked from outside of the lavatory.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.785 : Seats, berths, litter, safety belts, and shoulder harnesses.

[There must be a seat or berth for each occupant that meets the following:]

(a) Each seat/restraint system and the supporting structure must be designed to support occupants weighing at least 215 pounds when subjected to the maximum load factors corresponding to the specified flight and ground load conditions, as defined in the approved operating envelope of the airplane. In addition, these loads must be multiplied by a factor of 1.33 in determining the strength of all fittings and the attachment of—

- (1) Each seat to the structure; and
- (2) Each safety belt and shoulder harness to the seat or structure.

(b) [Each forward-facing or aft-facing seat/restraint system in normal, utility, or acrobatic category airplanes must consist of a seat, a safety belt, and a shoulder harness, with a metal-to-metal latching device, that are designed to provide the occupant protection provisions required in Sec. 23.562. Other seat orientations must provide the same level of occupant protection as a forward-facing or aft-facing seat with a safety belt and a shoulder harness, and must provide the protection provisions of Sec. 23.562.

(c) For commuter category airplanes, each seat and the supporting structure must be designed for occupants weighing at least 170 pounds when subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561(b)(2) of this part. Each occupant must be protected from serious head injury when subjected to the inertia loads resulting from these load factors by a safety belt and shoulder harness, with a metal-to-metal latching device, for the front seats; and a safety belt, or a safety belt and shoulder harness, with a metal-to-metal latching device, for each seat other than the front seats.]

(d) Each restraint system must have a single-point release for occupant evacuation.

(e) The restraint system for each crewmember must allow the crewmember, when seated with the safety belt and shoulder harness fastened, to perform all functions necessary for flight operations.

(f) Each pilot seat must be designed for the reactions resulting from the application of pilot forces to the primary flight controls as prescribed in Sec. 23.395 of this part.

(g) Each flexible fuel tank bladder or liner must be approved or shown to be suitable for the particular application and must be puncture resistant. Puncture resistance must be shown by meeting the TSO-C80 paragraph 16.0 requirements using a minimum puncture force of 370 pounds.

(h) Each integral fuel tank must have provisions for inspection and repair of its interior.]

Amdt. 27-30, Eff. 11/2/94

FAR 27.965 : [Fuel tank tests.]

(a) [Each fuel tank must be able to withstand the applicable pressure tests in this section without failure or leakage. If practicable, test pressures may be applied in a manner simulating the pressure distribution in service.

(b) Each conventional metal tank, nonmetallic tank with walls that are not supported by rotorcraft structure, and integral tank must be subjected to a pressure of 3.5 p.s.i. unless the pressure developed during maximum limit acceleration or emergency deceleration with a full tank exceeds this value, in which case a hydrostatic head, or equivalent test, must be applied to duplicate the acceleration loads as far as possible. However, the pressure need not exceed 3.5 p.s.i. on surfaces not exposed to the acceleration loading.

(c) Each nonmetallic tank with walls supported by the rotorcraft structure must be subjected to the following tests :

(1) A pressure test of at least 2.0 p.s.i. This test may be conducted on the tank alone in conjunction with the test specified in paragraph (c)(2) of this section.

(2) A pressure test, with the tank mounted in the rotorcraft structure, equal to the load developed by the reaction of the contents, with the tank full, during maximum limit acceleration or emergency deceleration. However, the pressure need not exceed 2.0 p.s.i. on surfaces not exposed to the acceleration loading.

(d) Each tank with large unsupported or unstiffened flat areas, or with other features whose failure or deformation could cause leakage, must be subjected to the following test or its equivalent :

(1) Each complete tank assembly and its support must be vibration tested while mounted to simulate the actual installation.

(2) The tank assembly must be vibrated for 25 hours while two-thirds full of any suitable fluid. The amplitude of vibration may not be less than one thirty-second of an inch, unless otherwise substantiated.

(3) The test frequency of vibration must be as follows :

(i) If no frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, the test frequency of vibration, in number of cycles per minute must, unless a frequency based on a more rational calculation is used, be the number obtained by averaging the maximum and minimum power-on engine speeds (r.p.m.) for reciprocating engine powered rotorcraft or 2,000 c.p.m. for turbine engine powered rotorcraft.

(ii) If only one frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, that frequency of vibration must be the test frequency.

- (c) *Multiple fuel tanks.* If an engine can be supplied with fuel from more than one tank, the fuel system must, in addition to having appropriate manual switching capability, be designed to prevent interruption of fuel flow to that engine, without attention by the flightcrew, when any tank supplying fuel to that engine is depleted of usable fuel during normal operation, and any other tank that normally supplies fuel to the engine alone contains usable fuel.]

Amdt. 27-23, Eff. 10/3/88

FAR 27.959 : Unusable fuel supply

The unusable fuel supply for each tank must be established as not less than the quantity at which the first evidence of malfunction occurs under the most adverse fuel feed condition occurring under any intended operations and flight maneuvers involving that tank.

FAR 27.961 : Fuel system hot weather operation

[Each suction lift fuel system and other fuel systems with features conducive to vapor formation must be shown by test to operate satisfactorily (within certification limits) when using fuel at a temperature of 110° F under critical operating conditions including, if applicable, the engine operating conditions defined by Sec. 27.927 (b)(1) and (b)(2).]

Amdt. 27-23, Eff. 10/3/88

FAR 27.963 : Fuel tanks : general

- (a) Each fuel tank must be able to withstand, without failure, the vibration, inertia, fluid, and structural loads to which it may be subjected in operation.
- (b) Each fuel tank of 10 gallons or greater capacity must have internal baffles, or must have external support to resist surging.
- (c) Each fuel tank must be separated from the engine compartment by a firewall. At least one-half inch of clear airspace must be provided between the tank and the firewall.
- (d) Spaces adjacent to the surfaces of fuel tanks must be ventilated so that fumes cannot accumulate in the tank compartment in case of leakage. If two or more tanks have interconnected outlets, they must be considered as one tank, and the airspaces in those tanks must be interconnected to prevent the flow of fuel from one tank to another as a result of a difference in pressure between those airspaces.
- (e) The maximum exposed surface temperature of any component in the fuel tank must be less, by a safe margin as determined by the Administrator, than the lowest expected autoignition temperature of the fuel or fuel vapor in the tank. Compliance with this requirement must be shown under all operating conditions and under all failure or malfunction conditions of all components inside the tank.
- (f) [Each fuel tank installed in personnel compartments must be isolated by fume-proof and fuel-proof enclosures that are drained and vented to the exterior of the aircraft. The design and construction of the enclosures must provide necessary protection for the tank, must be crash resistant during a survivable impact in accordance with Sec. 27.952, and must be adequate to withstand loads and abrasions to be expected in personnel compartments.]

- (g) There must be a means to secure each safety belt and shoulder harness, when not in use, to prevent interference with the operation of the airplane and with rapid occupant egress in an emergency.

- (h) Unless otherwise placarded, each seat in a utility and acrobatic category airplane must be designed to accommodate an occupant wearing a parachute.

- (i) The cabin area surrounding each seat, including the structure, interior walls, instrument panel, control wheel, pedals, and seats within striking distance of the occupant's head or torso (with the restraint system fastened) must be free of potentially injurious objects, sharp edges, protuberances, and hard surfaces. If energy absorbing designs or devices are used to meet this requirement, they must protect the occupant from serious injury when the occupant is subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561 (b)(2) of this part, or they must comply with the occupant protection provisions of Sec. 23.562 of this part, as required in paragraphs (b) and (c) of this section.

- (j) Each seat track must be fitted with stops to prevent the seat from sliding off the track.

- (k) Each seat/restraint system may use design features, such as crushing or separation of certain components, to reduce occupant loads when showing compliance with the requirements of Sec. 23.562 of this part ; otherwise, the system must remain intact.

- (l) For the purposes of this section, a front seat is a seat located at a flight crewmember station or any seat located alongside such a seat.

- (m) Each berth, or provisions for a litter, installed parallel to the longitudinal axis of the airplane, must be designed so that the forward part has a padded end-board, canvas diaphragm, or equivalent means that can withstand the load reactions from a 215 pound occupant when subjected to the inertia loads resulting from the ultimate static load factors of Sec. 23.561 (b)(2) of this part. In addition—

(1) Each berth or litter must have an occupant restraint system and may not have corners or other parts likely to cause serious injury to a person occupying it during emergency landing conditions ; and

(2) Occupant restraint system attachments for the berth or litter must withstand the inertia loads resulting from the ultimate static load factors of Sec. 23.561 (b)(2) of this part.

- (n) Proof of compliance with the static strength requirements of this section for seats and berths approved as part of the type design and for seat and berth installations may be shown by—

(1) Structural analysis, if the structure conforms to conventional airplane types for which existing methods of analysis are known to be reliable ;

(2) A combination of structural analysis and static load tests to limit load ; or

(3) Static load tests to ultimate loads.

Amdt. 23-49, 03/11/96

FAR 23.787 : Baggage and cargo compartments.

- (a) [Each baggage and cargo compartment must :

- (1) Be designed for its placarded maximum weight of contents and for the critical load distributions at the appropriate maximum load factors corresponding to the flight and ground load conditions of this part.
- (2) Have means to prevent the contents of any compartment from becoming a hazard by shifting, and to protect any controls, wiring, lines, equipment or accessories whose damage or failure would affect safe operations.
- (3) Have a means to protect occupants from injury by the contents of any compartment, located aft of the occupants and separated by structure, when the ultimate forward inertial load factor is 9g and assuming the maximum allowed baggage or cargo weight for the compartment.
- (b) Designs that provide for baggage or cargo to be carried in the same compartment as passengers must have a means to protect the occupants from injury when the baggage or cargo is subjected to the inertial loads resulting from the ultimate static load factors of Sec. 23.561(b)(3), assuming the maximum allowed baggage or cargo weight for the compartment.
- (c) For airplanes that are used only for the carriage of cargo, the flightcrew emergency exits must meet the requirements of Sec. 23.807 under any cargo loading conditions.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.791 : [Passenger information signs]

[For those airplanes in which the flightcrew members cannot observe the other occupants' seats or where the flightcrew members' compartment is separated from the passenger compartment, there must be at least one illuminated sign (using either letters or symbols) notifying all passengers when seat belts should be fastened. Signs that notify when seat belts should be fastened must :

- (a) When illuminated, be legible to each person seated in the passenger compartment under all probable lighting conditions ; and
- (b) Be installed so that a flightcrew member can, when seated at the flightcrew member's station, turn the illumination on and off.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.803 : Emergency evacuation.

- (a) [For commuter category airplanes, an evacuation demonstration must be conducted utilizing the maximum number of occupants for which certification is desired. The demonstration must be conducted under simulated night conditions using only the emergency exits on the most critical side of the airplane. The participants must be representative of average airline passengers with no prior practice or rehearsal for the demonstration. Evacuation must be completed within 90 seconds.
- (b) In addition, when certification to the emergency exit provisions of Sec. 23.807(d)(4) is requested, only the emergency lighting system required by Sec. 23.812 may be used to provide cabin interior illumination during the evacuation demonstration required in paragraph (a) of this section.]

Amdt. 23-46, Eff. 06/16/94

- (3) Filler caps designed to minimize the probability of incorrect installation or inflight loss.
- (4) A fuel system in which those parts of the system from each tank outlet to any engine are independent of each part of each system supplying fuel to other engines.

FAR 27.954 : [Fuel system lightning protection].

[The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by—

- (a) Direct lightning strikes to areas having a high probability of stroke attachment ;
- (b) Swept lightning strokes to areas where swept strokes are highly probable ; or
- (c) Corona and streamer at fuel vent outlets.]

Amdt. 27-23, Eff. 10/3/88

FAR 27.955 : Fuel flow

- (a) [*General.* The fuel system for each engine must be shown to provide the engine with at least 100 percent of the fuel required under each operating and maneuvering condition to be approved for the rotorcraft including, as applicable, the fuel required to operate the engine(s) under the test conditions required by Sec. 27.927. Unless equivalent methods are used, compliance must be shown by test during which the following provisions are met except that combinations of conditions which are shown to be improbable need not be considered.

- (1) The fuel pressure, corrected for critical accelerations, must be within the limits specified by the engine type certificate data sheet.
- (2) The fuel level in the tank may not exceed that established as unusable fuel supply for the tank under Sec. 27.959, plus the minimum additional fuel necessary to conduct the test.
- (3) The fuel head between the tank outlet and the engine inlet must be critical with respect to rotorcraft flight attitudes.
- (4) The critical fuel pump (for pump-fed systems) is installed to produce (by actual or simulated failure) the critical restriction to fuel flow to be expected from pump failure.
- (5) Critical values of engine rotation speed, electrical power, or other sources of fuel pump motive power must be applied.
- (6) Critical values of fuel properties which adversely affect fuel flow must be applied.
- (7) The fuel filter required by Sec. 27.997 must be blocked to the degree necessary to simulate the accumulation of fuel contamination required to activate the indicator required by Sec. 27.1305(q).
- (b) *Fuel transfer systems.* If normal operation of the fuel system requires fuel to be transferred to an engine feed tank, the transfer must occur automatically via a system which has been shown to maintain the fuel level in the engine feed tank within acceptable limits during flight or surface operation of the rotorcraft.

- (3) Alternate, equivalent means to the use of breakaway couplings must not create a survivable impact-induced load on the fuel line to which it is installed greater than 25 to 50 percent of the ultimate load (strength) of the weakest component in the line and must comply with the fatigue requirements of Sec. 27.571 without leaking.

(d) *Fragible or deformable structural attachments.* Unless hazardous relative motion of fuel tanks and fuel system components to local rotorcraft structure is demonstrated to be extremely improbable in an otherwise survivable impact, fragile or locally deformable attachments of fuel tanks and fuel system components to local rotorcraft structure must be used. The attachment of fuel tanks and fuel system components to local rotorcraft structure, whether fragile or locally deformable, must be designed such that its separation or relative local deformation will occur without rupture or local tear-out of the fuel tank or fuel system components that will cause fuel leakage. The ultimate strength of fragile or deformable attachments must be as follows :

- (1) The load required to separate a fragile attachment from its support structure, or deform a locally deformable attachment relative to its support structure, must be between 25 and 50 percent of the minimum ultimate load (ultimate strength) of the weakest component in the attached system. In no case may the load be less than 300 pounds.

(2) A fragile or locally deformable attachment must separate or locally deform as intended whenever its ultimate load (as defined in paragraph (d)(1) of this section) is applied in the modes most likely to occur.

(3) All fragile or locally deformable attachments must comply with the fatigue requirements of Sec. 27.571.

(e) *Separation of fuel and ignition sources.* To provide maximum crash resistance, fuel must be located as far as practicable from all occupiable areas and from all potential ignition sources.

(f) *Other basic mechanical design criteria.* Fuel tanks, fuel lines, electrical wires, and electrical devices must be designed, constructed, and installed, as far as practicable, to be crash resistant.

(g) *Rigid or Semirigid fuel tanks.* Rigid or semirigid fuel tank or bladder walls must be impact and tear resistant.]

Amdt. 27-30, Eff. 11/2/94

FAR 27.953 : Fuel system independence

(a) Each fuel system for multiengine rotorcraft must allow fuel to be supplied to each engine through a system independent of those parts of each system supplying fuel to other engines. However, separate fuel tanks need not be provided for each engine.

(b) If a single fuel tank is used on a multiengine rotorcraft, the following must be provided :

- (1) Independent tank outlets for each engine, each incorporating a shutoff valve at the tank. This shutoff valve may also serve as the firewall shutoff valve required by Sec. 27.995 if the line between the valve and the engine compartment does not contain a hazardous amount of fuel that can drain into the engine compartment.

(2) At least two vents arranged to minimize the probability of both vents becoming obstructed simultaneously.

FAR 23.805 : [Flightcrew emergency exits.]

[For airplanes where the proximity of the passenger emergency exits to the flightcrew area does not offer a convenient and readily accessible means of evacuation for the flightcrew, the following apply :

- (a) There must be either one emergency exit on each side of the airplane, or a top hatch emergency exit, in the flightcrew area ;
- (b) Each emergency exit must be located to allow rapid evacuation of the crew and have a size and shape of at least a 19- by 20-inch unobstructed rectangular opening ; and
- (c) For each emergency exit that is not less than six feet from the ground, an assisting means must be provided. The assisting means may be a rope or any other means demonstrated to be suitable for the purpose. If the assisting means is a rope, or an approved device equivalent to a rope, it must be—

- (1) Attached to the fuselage structure at or above the top of the emergency exit opening or, for a device at a pilot's emergency exit window, at another approved location if the stowed device, or its attachment, would reduce the pilot's view ; and

(2) Able (with its attachment) to withstand a 400-pound static load.]

Amdt. 23-46, Eff. 06/16/94

FAR 23.807 : Emergency exits.

(a) *Number and location.* Emergency exits must be located to allow escape without crowding in any probable crash attitude. The airplane must have at least the following emergency exits :

- (1) For all airplanes with a seating capacity of two or more, excluding airplanes with canopies, at least one emergency exit on the opposite side of the cabin from the main door specified in Sec. 23.783 of this part.

(2) [Reserved.]

- (3) If the pilot compartment is separated from the cabin by a door that is likely to block the pilot's escape in a minor crash, there must be an exit in the pilot's compartment. The number of exits required by paragraph (a)(1) of this section must then be separately determined for the passenger compartment, using the seating capacity of that compartment.

(4) [Emergency exits must not be located with respect to any propeller disk or any other potential hazard so as to endanger persons using that exit.

(b) *Type and operation.* Emergency exits must be movable windows, panels, canopies, or external doors, openable from both inside and outside the airplane, that provide a clear and unobstructed opening large enough to admit a 19-by-26-inch ellipse. Auxiliary locking devices used to secure the airplane must be designed to be overridden by the normal internal opening means. The inside handles of emergency exits that open outward must be adequately protected against inadvertent operation. In addition, each emergency exit must—]

- (1) Be readily accessible, requiring no exceptional agility to be used in emergencies ;
- (2) Have a method of opening that is simple and obvious ;
- (3) Be arranged and marked for easy location and operation, even in darkness ;

- (4) Have reasonable provisions against jamming by fuselage deformation; and
- (5) [In the case of aerobatic category airplanes, allow each occupant to abandon the airplane at any speed between and V_D ; and
- (6) In the case of utility category airplanes certificated for spinning, allow each occupant to abandon the airplane at the highest speed likely to be achieved in the maneuver for which the airplane is certificated]
- (c) *Tests.* The proper functioning of each emergency exit must be shown by tests.
- (d) *Doors and exits.* In addition, for commuter category airplanes, the following requirements apply :
 - (1) In addition to the passenger-entry door—
 - (i) For an airplane with a total passenger seating capacity of 15 or fewer, an emergency exit, as defined in paragraph (b) of this section, is required on each side of the cabin ; and
 - (ii) For an airplane with a total passenger seating capacity of 16 through 19, three emergency exits, as defined in paragraph (b) of this section, are required with one on the same side as the passenger entry door and two on the side opposite the door.
 - (2) A means must be provided to lock each emergency exit and to safeguard against its opening in flight, either inadvertently by persons or as a result of mechanical failure. In addition, a means for direct visual inspection of the locking mechanism must be provided to determine that each emergency exit for which the initial opening movement is outward is fully locked.
 - (3) Each required emergency exit, except floor level exits, must be located over the wing or, if not less than six feet from the ground, must be provided with an acceptable means to assist the occupants to descend to the ground. Emergency exits must be distributed as uniformly as practical, taking into account passenger seating configuration.
 - (4) Unless the applicant has complied with paragraph (d)(1) of this section, there must be an emergency exit on the side of the cabin opposite the passenger entry door, provided that—
 - (i) For an airplane having a passenger seating configuration of nine or fewer, the emergency exit has a rectangular opening measuring not less than 19 inches by 26 inches high with corner radii not greater than one-third the width of the exit, located over the wing, with a step up inside the airplane of not more than 29 inches and a step down outside the airplane of not more than 36 inches;
 - (ii) For an airplane having a passenger seating configuration of 10 to 19 passengers, the emergency exit has a rectangular opening measuring not less than 20 inches wide by 36 inches high, with corner radii not greater than one-third the width of the exit, and with a step up inside the airplane of not more than 20 inches. If the exit is located over the wing, the step down outside the airplane may not exceed 27 inches; and
 - (iii) The airplane complies with the additional requirements of Secs. 23.561(b)(2)(iv), 23.803(b), 23.811(c), 23.812, 23.813(b), and 23.815.
- (e) For multiengine airplanes, ditching emergency exits must be provided in accordance with the following requirements, unless the emergency exits required by paragraph (a) or (d) of this section already comply with them :

- (1) For fuel tanks in the cabin :
 - (i) Upward-4g.
 - (ii) Forward-10g.
 - (iii) Sideward-8g.
 - (iv) Downward-20g.
- (2) For fuel tanks located above or behind the crew or passenger compartment that, if loosened, could injure an occupant in an emergency landing :
 - (i) Upward-1.5g.
 - (ii) Forward-8g.
 - (iii) Sideward-2g.
 - (iv) Downward-4g.
- (3) For fuel tanks in other areas :
 - (i) Upward-1.5g.
 - (ii) Forward-4g.
 - (iii) Sideward-2g.
 - (iv) Downward-4g.
- (c) *Fuel line self-sealing breakaway couplings.* Self-sealing breakaway couplings must be installed unless hazardous relative motion of fuel system components to each other or to local rotorcraft structure is demonstrated to be extremely improbable or unless other means are provided. The couplings or equivalent devices must be installed at all fuel tank-to-fuel line connections, tank-to-tank interconnects, and at other points in the fuel system where local structural deformation could lead to the release of fuel.
 - (1) The design and construction of self-sealing breakaway couplings must incorporate the following design features :
 - (i) The load necessary to separate a breakaway coupling must be between 25 to 50 percent of the minimum ultimate failure load (ultimate strength) of the weakest component in the fluid-carrying line. The separation load must in no case be less than 300 pounds, regardless of the size of the fluid line.
 - (ii) A breakaway coupling must separate whenever its ultimate load (as defined in paragraph (c)(1)(i) of this section) is applied in the failure modes most likely to occur.
 - (iii) All breakaway couplings must incorporate design provisions to visually ascertain that the coupling is locked together (leak-free) and is open during normal installation and service.
 - (iv) All breakaway couplings must incorporate design provisions to prevent uncoupling or unintended closing due to operational shocks, vibrations, or accelerations.
 - (v) No breakaway coupling design may allow the release of fuel once the coupling has performed its intended function.
 - (2) All individual breakaway couplings, coupling fuel feed systems, or equivalent means must be designed, tested, installed, and maintained so that inadvertent fuel shutoff in flight is improbable in accordance with Sec. 27.955(a) and must comply with the fatigue evaluation requirements of Sec. 27.571 without leaking.

- (c) [For governor-controlled engines, it must be shown that there exists no hazardous torsional instability of the drive system associated with critical combinations of power, rotational speed, and control displacement.]

Amdt. 27-11, Eff. 2/1/77

65.3 Fuel System

FAR 27.951 : General

- (a) Each fuel system must be constructed and arranged to ensure a flow of fuel at a rate and pressure established for proper engine functioning under any likely operating condition, including the maneuvers for which certification is requested.
- (b) Each fuel system must be arranged so that—
- (1) No fuel pump can draw fuel from more than one tank at a time ; or
 - (2) There are means to prevent introducing air into the system.

- (c) [Each fuel system for a turbine engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80° F and having 0.75cc of free water per gallon added and cooled to the most critical condition for icing likely to be encountered in operation.]

Amdt. 27-9, Eff. 10/31/74

FAR 27.952 : [Fuel system crash resistance.]

[Unless other means acceptable to the Administrator are employed to minimize the hazard of fuel fires to occupants following an otherwise survivable impact (crash landing), the fuel systems must incorporate the design features of this section. These systems must be shown to be capable of sustaining the static and dynamic deceleration loads of this section, considered as ultimate loads acting alone, measured at the system component's center of gravity, without structural damage to system components, fuel tanks, or their attachments that would leak fuel to an ignition source.

- (a) *Drop test requirements.* Each tank, or the most critical tank, must be drop-tested as follows :

- (1) The drop height must be at least 50 feet.
- (2) The drop impact surface must be nondeforming.
- (3) The tank must be filled with water to 80 percent of the normal full capacity.
- (4) The tank must be enclosed in a surrounding structure representative of the installation unless it can be established that the surrounding structure is free of projections or other design features likely to contribute to rupture of the tank.
- (5) The tank must drop freely and impact in a horizontal position $\pm 10^\circ$.
- (6) After the drop test, there must be no leakage.

- (b) *Fuel tank load factors.* Except for fuel tanks located so that tank rupture with fuel release to either significant ignition sources, such as engines, heaters, and auxiliary power units, or occupants is extremely remote, each fuel tank must be designed and installed to retain its contents under the following ultimate inertial load factors, acting alone.

- (1) One exit above the waterline on each side of the airplane having the dimensions specified in paragraph (b) or (d) of this section, as applicable ; and
- (2) If side exits cannot be above the waterline, there must be a readily accessible overhead hatch emergency exit that has a rectangular opening measuring not less than 20 inches wide by 36 inches long, with corner radii not greater than one-third the width of the exit.

Amdt. 23-49, Eff. 03/11/96

FAR 23.811 : Emergency exit marking.

- (a) Each emergency exit and external door in the passenger compartment must be externally marked and readily identifiable from outside the airplane by—
- (1) A conspicuous visual identification scheme ; and
 - (2) A permanent decal or placard on or adjacent to the emergency exit which shows the means of opening the emergency exit, including any special instructions, if applicable.

- (b) In addition, for commuter category airplanes, these exits and doors must be internally marked with the word "exit" by a sign which has white letters 1 inch high on a red background 2 inches high, be self-illuminated or independently, internally-electrically illuminated, and have a minimum brightness of at least 160 microlamberts. The color may be reversed if the passenger compartment illumination is essentially the same.

- (c) [In addition, when certification to the emergency exit provisions of Sec. 23.807(d)(4) is requested, the following apply :

- (1) Each emergency exit, its means of access, and its means of opening, must be conspicuously marked ;
- (2) The identity and location of each emergency exit must be recognizable from a distance equal to the width of the cabin ;
- (3) Means must be provided to assist occupants in locating the emergency exits in conditions of dense smoke ;
- (4) The location of the operating handle and instructions for opening each emergency exit from inside the airplane must be shown by marking that is readable from a distance of 30 inches ;
- (5) Each passenger entry door operating handle must—
 - (i) Be self-illuminated with an initial brightness of at least 160 microlamberts ; or
 - (ii) Be conspicuously located and well illuminated by the emergency lighting even in conditions of occupant crowding at the door ;
- (6) Each passenger entry door with a locking mechanism that is released by rotary motion of the handle must be marked—
 - (i) With a red arrow, with a shaft of at least three-fourths of an inch wide and a head twice the width of the shaft, extending along at least 70 degrees of arc at a radius approximately equal to three-fourths of the handle length ;
 - (ii) So that the center line of the exit handle is within $\pm$ one inch of the projected point of the arrow when the handle has reached full travel and has released the locking mechanism ; and

- (iii) With the word "open" in red letters, one inch high, placed horizontally near the head of the arrow; and
 - (7) In addition to the requirements of paragraph (a) of this section, the external marking of each emergency exit must—
 - (i) Include a 2-inch colorband outlining the exit; and
 - (ii) Have a color contrast that is readily distinguishable from the surrounding fuselage surface. The contrast must be such that if the reflectance of the darker color is 15 percent or less, the reflectance of the lighter color must be at least 45 percent. "Reflectance" is the ratio of the luminous flux reflected by a body to the luminous flux it receives. When the reflectance of the darker color is greater than 15 percent, at least a 30 percent difference between its reflectance and the reflectance of the lighter color must be provided.]
- Amtd. 23-46, Eff. 06/16/94

FAR 23.812 : [Emergency lighting.]

[When certification to the emergency exit provisions of Sec. 23.807(d)(4) is requested, the following apply :

- (a) An emergency lighting system, independent of the main cabin lighting system, must be installed. However, the source of general cabin illumination may be common to both the emergency and main lighting systems if the power supply to the emergency lighting system is independent of the power supply to the main lighting system.
- (b) There must be a crew warning light that illuminates in the cockpit when power is on in the airplane and the emergency lighting control device is not armed.
- (c) The emergency lights must be operable manually from the flightcrew station and be provided with automatic activation. The cockpit control device must have "on", "off", and "armed" positions so that, when armed in the cockpit, the lights will operate by automatic activation.
- (d) There must be a means to safeguard against inadvertent operation of the cockpit control device from the "armed" or "on" positions.
- (e) The cockpit control device must have provisions to allow the emergency lighting system to be armed or activated at any time that it may be needed.
- (f) When armed, the emergency lighting system must activate and remain lighted when—
 - (1) The normal electrical power of the airplane is lost; or
 - (2) The airplane is subjected to an impact that results in a deceleration in excess of 2g and a velocity change in excess of 3.5 feet-per-second, acting along the longitudinal axis of the airplane; or
 - (3) Any other emergency condition exists where automatic activation of the emergency lighting is necessary to aid with occupant evacuation.
- (g) The emergency lighting system must be capable of being turned off and reset by the flightcrew after automatic activation.
- (h) The emergency lighting system must provide internal lighting, including—
 - (1) Illuminated emergency exit marking and locating signs, including those required in Sec. 23.811(b) ;

- (1) Under conditions associated with all engines operating, make 200 applications, for 10 seconds each, of torque that is at least equal to the lesser of—
 - (i) The maximum torque used in meeting Sec. 27.923 plus 10 percent ; or
 - (ii) The maximum attainable torque output of the engines, assuming that torque limiting devices, if any, function properly.

(2) For multiengine rotorcraft under conditions associated with each engine, in turn, becoming inoperative, apply to the remaining transmission torque inputs the maximum torque attainable under probable operating conditions, assuming that torque limiting devices, if any, function properly. Each transmission input must be tested at this maximum torque for at least 15 minutes.

(3) [The tests prescribed in this paragraph must be conducted on the rotorcraft at the maximum rotational speed intended for the power condition of the test and the torque must be absorbed by the rotors to be installed, except that other ground or flight test facilities with other appropriate methods of torque absorption may be used if the conditions of support and vibration closely simulate the conditions that would exist during a test on the rotorcraft.]

- (c) It must be shown by tests that the rotor drive system is capable of operating under autorotative conditions for 15 minutes after the loss of pressure in the rotor drive primary oil system.

Amtd. 27-23, Eff. 10/3/88

FAR 27.931 : Shafting critical speed

- (a) The critical speeds of any shafting must be determined by demonstration, except that analytical methods may be used if reliable methods of analysis are available for the particular design.
- (b) If any critical speed lies within, or close to, the operating ranges for idling, power on, and autorotative conditions, the stresses occurring at that speed must be within safe limits. This must be shown by tests.
- (c) If analytical methods are used and show that no critical speed lies within the permissible operating ranges, the margins between the calculated critical speeds and the limits of the allowable operating ranges must be adequate to allow for possible variations between the computed and actual values.

FAR 27.935 : Shafting joints

Each universal joint, slip joint, and other shafting joints whose lubrication is necessary for operation must have provision for lubrication.

FAR 27.939 : Turbine engine operating characteristics

- (a) Turbine engine operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flameout) are present, to a hazardous degree, during normal and emergency operation within the range of operating limitations of the rotorcraft and of the engine.
- (b) The turbine engine air inlet system may not, as a result of airflow distortion during normal operation, cause vibration harmful to the engine.

application of higher or asymmetric torque and speed prescribed by the test.

- (iii) This test may be conducted on a representative bench test facility when engine limitations either preclude repeated use of this power or would result in premature engine removal during the test. The loads, the vibration frequency, and the methods of application to be affected rotor drive system components must be representative of rotorcraft conditions. Test components must be those used to show compliance with the remainder of this section.]

- (f) The parts of the test prescribed in paragraphs (c) and (d) of this section must be conducted in intervals of not less than 30 minutes and may be accomplished either on the ground or in flight. The part of the test prescribed in paragraph (e) of this section must be conducted in intervals of not less than five minutes.

- (g) At intervals of not more than five hours during the tests prescribed in paragraphs (c), (d), and (e) of this section, the engine must be stopped rapidly enough to allow the engine and rotor drive to be automatically disengaged from the rotors.

- (h) Under the operating conditions specified in paragraph (c) of this section, 500 complete cycles of lateral control, 500 complete cycles of longitudinal control of the main rotors, and 500 complete cycles of control of each auxiliary rotor must be accomplished. A "complete cycle" involves movement of the controls from the neutral position, through both extreme positions, and back to the neutral position, except that control movements need not produce loads or flapping motions exceeding the maximum loads or motions encountered in flight. The cycling may be accomplished during the testing prescribed in paragraph (c) of this section.

- (i) At least 200 start-up clutch engagements must be accomplished—

- (1) So that the shaft on the driven side of the clutch is accelerated; and
- (2) Using a speed and method selected by the applicant.

- (j) For multiengine helicopters for which the use of 30-minute OEI power is requested, five runs must be made at 30-minute OEI torque and the maximum speed for use with 30-minute OEI torque, in which each engine, in sequence, is made inoperative and the remaining engine(s) is run for a 30-minute period.

- (k) For multiengine rotorcraft for which the use of continuous OEI power is requested, five runs must be made at continuous OEI torque and the maximum speed for use with continuous OEI torque, in which each engine, in sequence, is made inoperative and the remaining engine(s) is run for a 1-hour period.

Amdt. 27-29, Eff. 10/17/94

FAR 27.927 : Additional tests

- (a) Any additional dynamic, endurance, and operational tests, and vibratory investigations necessary to determine that the rotor drive mechanism is safe, must be performed.

- (b) If turbine engine torque output to the transmission can exceed the highest engine or transmission torque rating limit, and that output is not directly controlled by the pilot under normal operating conditions (such as where the primary engine power control is accomplished through the flight control), the following test must be made :

- (2) Sources of general illumination in the cabin that provide an average illumination of not less than 0.05 foot-candle and an illumination at any point of not less than 0.01 foot-candle when measured along the center line of the main passenger aisle(s) and at the seat armrest height; and
- (3) Floor proximity emergency escape path marking that provides emergency evacuation guidance for the airplane occupants when all sources of illumination more than 4 feet above the cabin aisle floor are totally obscured.

- (i) The energy supply to each emergency lighting unit must provide the required level of illumination for at least 10 minutes at the critical ambient conditions after activation of the emergency lighting system.

- (j) If rechargeable batteries are used as the energy supply for the emergency lighting system, they may be recharged from the main electrical power system of the airplane provided the charging circuit is designed to preclude inadvertent battery discharge into the charging circuit faults. If the emergency lighting system does not include a charging circuit, battery condition monitors are required.

- (k) Components of the emergency lighting system, including batteries, wiring, relays, lamps, and switches, must be capable of normal operation after being subjected to the inertia forces resulting from the ultimate load factors prescribed in Sec. 23.561(b)(2).

- (l) The emergency lighting system must be designed so that after any single transverse vertical separation of the fuselage during a crash landing :

- (1) At least 75 percent of all electrically illuminated emergency lights required by this section remain operative; and
- (2) Each electrically illuminated exit sign required by Sec. 23.811(b) and (c) remains operative, except those that are directly damaged by the fuselage separation.]

Amdt. 23-46, Eff. 06/16/94

FAR 23.813 : Emergency exit access.

- (a) [For commuter category airplanes, access to window-type emergency exits may not be obstructed by seats or seat backs.

- (b) In addition, when certification to the emergency exit provisions of Sec. 23.807(d)(4) is requested, the following emergency exit access must be provided :

- (1) The passageway leading from the aisle to the passenger entry door must be unobstructed and at least 20 inches wide.

- (2) There must be enough space next to the passenger entry door to allow assistance in evacuation of passengers without reducing the unobstructed width of the passageway below 20 inches.

- (3) If it is necessary to pass through a passageway between passenger compartments to reach a required emergency exit from any seat in the passenger cabin, the passageway must be unobstructed; however, curtains may be used if they allow free entry through the passageway.

- (4) No door may be installed in any partition between passenger compartments unless that door has a means to latch it in the open position. The latching means must be able to withstand the loads imposed upon it by the door when the door is subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561(b)(2).

- (5) If it is necessary to pass through a doorway separating the passenger cabin from other areas to reach a required emergency exit from any passenger seat, the door must have a means to latch it in the open position. The latching means must be able to withstand the loads imposed upon it by the door when the door is subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561(b)(2).]

Amdt. 23-46, EFF. 06/16/94

FAR 23.815 : Width of aisle.

- (a) [Except as provided in paragraph (b) of this section, for commuter category airplanes, the width of the main passenger aisle at any point between seats must equal or exceed the values in the following table :

Number of Passenger Seats	Minimum main passenger aisle width	
	Less than 25 inches from floor	25 inches and more from floor
10 through 19	9 inches	15 inches

- (b) When certification to the emergency exit provisions of Sec. 23.807(d)(4) is requested, the main passenger aisle width at any point between the seats must equal or exceed the following values :

Number of Passenger Seats	Minimum main passenger aisle width (inches)	
	Less than 25 inches from floor	25 inches and more from floor
10 or fewer	12	15
11 through 19	12	20

¹ : A narrower width not less than 9 inches may be approved when substantiated by tests found necessary by the Administrator.]

Amdt. 23-46, EFF. 06/16/94

FAR 23.831 : Ventilation.

- (a) Each passenger and crew compartment must be suitably ventilated. Carbon monoxide concentration may not exceed one part in 20,000 parts of air.
- (b) [For pressurized airplanes,] the ventilating air in the flightcrew and passenger compartments must be free of harmful or hazardous concentrations of gases and vapors in normal operations and in the event of reasonably probable failures or malfunctioning of the ventilating, heating, pressurization, or other systems and equipment. If accumulation of hazardous quantities of smoke in the cockpit area is reasonably probable, smoke evacuation must be readily accomplished starting with full pressurization and without depressurizing beyond safe limits.

Amdt. 23-42, EFF. 02/04/91

31.7 Pressurization

FAR 23.841 : Pressurized cabins.

- (a) If certification for operation over [25,000 feet]is requested, the airplane must be able to maintain a cabin pressure altitude of not more than 15,000 feet in event of any probable failure or malfunction in the pressurization system.

FAR 27.923 : Rotor drive system and control mechanism tests

- (a) Each part tested as prescribed in this section must be in a serviceable condition at the end of the tests. No intervening disassembly which might affect test results may be conducted.
- (b) Each rotor drive system and control mechanism must be tested for not less than 100 hours. The test must be conducted on the rotorcraft, and the torque must be absorbed by the rotors to be installed, except that other ground or flight test facilities with other appropriate methods of torque absorption may be used if the conditions of support and vibration closely simulate the conditions that would exist during a test on the rotorcraft.
- (c) A 60-hour part of the test prescribed in paragraph (b) of this section must be run at not less than maximum continuous torque and the maximum speed for use with maximum continuous torque. In this test, the main rotor controls must be set in the position that will give maximum longitudinal cyclic pitch change to simulate forward flight. The auxiliary rotor controls must be in the position for normal operation under the conditions of the test.
- (d) A 30-hour or, for rotorcraft for which the use of either 30-minute OEI power or continuous OEI power is requested, a 25-hour part of the test prescribed in paragraph (b) of this section must be run at not less than 75 percent of maximum continuous torque and the minimum speed for use with 75 percent of maximum continuous torque. The main and auxiliary rotor controls must be in the position for normal operation under the conditions of the test.
- (e) [A 10-hour part of the test prescribed in paragraph (b) of this section must be run at not less than takeoff torque and the maximum speed for use with takeoff torque. The main and auxiliary rotor controls must be in the normal position for vertical ascent.
- (1) For multiengine rotorcraft for which the use of 2 1/2 minute OEI power is requested, 12 runs during the 10-hour test must be conducted as follows :
- (i) Each run must consist of at least one period of 2 1/2 minutes with takeoff torque and the maximum speed for use with takeoff torque on all engines.
- (ii) Each run must consist of at least one period for each engine in sequence, during which that engine simulates a power failure and the remaining engines are run at 2 1/2-minute OEI torque and the maximum speed for use with 2 1/2-minute OEI torque for 2 1/2-minutes.
- (2) For multiengine, turbine-powered rotorcraft for which the use of 30-second and 2-minute OEI power is requested, 10 runs must be conducted as follows :
- (i) Immediately following a takeoff run of at least 5 minutes, each power source must simulate a failure, in turn, and apply the maximum torque and the maximum speed for use with 30-second OEI power to the remaining affected drive system power inputs for not less than 30 seconds, followed by application of the maximum torque and the maximum speed for use with 2-minute OEI power for not less than 2 minutes. At least one run sequence must be conducted from a simulated "flight idle" condition. When conducted on a bench test, the test sequence must be conducted following stabilization at takeoff power.
- (ii) For the purpose of this paragraph, an affected power input includes all parts of the rotor drive system which can be adversely affected by the

- (2) An overspeed limiting device.
- (B) For fans driven by the rotor drive system, the maximum rotor drive system rotational speed to be expected in service, including transients.
- (2) Unless a fatigue evaluation under Sec. 27.571 is conducted, it must be shown that cooling fan blades are not operating at resonant conditions within the operating limits of the rotorcraft.]
- (c) *Turbine engine installation.* For turbine engine installations, the powerplant systems associated with engine control devices, systems, and instrumentation must be designed to give reasonable assurance that those engine operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service.
- Amdt. 27-23, Eff. 10/3/88
- FAR 27.907 : Engine vibration**
- (a) Each engine must be installed to prevent the harmful vibration of any part of the engine or rotorcraft.
- (b) The addition of the rotor and the rotor drive system to the engine may not subject the principal rotating parts of the engine to excessive vibration stresses. This must be shown by a vibration investigation.
- (c) No part of the rotor drive system may be subjected to excessive vibration stresses.

65.2 Rotor Drive System

FAR 27.917 : Design

- (a) Each rotor drive system must incorporate a unit for each engine to automatically disengage that engine from the main and auxiliary rotors if that engine fails.
- (b) Each rotor drive system must be arranged so that each rotor necessary for control in autorotation will continue to be driven by the main rotors after disengagement of the engine from the main and auxiliary rotors.
- (c) If a torque limiting device is used in the rotor drive system, it must be located so as to allow continued control of the rotorcraft when the device is operating.
- (d) [The rotor drive system includes any part necessary to transmit power from the engines to the rotor hubs. This includes gear boxes, shafting, universal joints, couplings, rotor brake assemblies, clutches, supporting bearings for shafting, any attendant accessory pads or drives, and any cooling fans that are a part of, attached to, or mounted on the rotor drive system.]

Amdt. 27-11, Eff. 2/1/77

FAR 27.921 : Rotor brake

If there is a means to control the rotation of the rotor drive system independently of the engine, any limitations on the use of that means must be specified, and the control for that means must be guarded to prevent inadvertent operation.

- (b) Pressurized cabins must have at least the following valves, controls, and indicators, for controlling cabin pressure :
- (1) Two pressure relief valves to automatically limit the positive pressure differential to a predetermined value at the maximum rate of flow delivered by the pressure source. The combined capacity of the relief valves must be large enough so that the failure of any one valve would not cause an appreciable rise in the pressure differential. The pressure differential is positive when the internal pressure is greater than the external.
- (2) Two reverse pressure differential relief valves (or their equivalent) to automatically prevent a negative pressure differential that would damage the structure. However, one valve is enough if it is of a design that reasonably precludes its malfunctioning.
- (3) A means by which the pressure differential can be rapidly equalized.
- (4) An automatic or manual regulator for controlling the intake or exhaust airflow, or both, for maintaining the required internal pressures and airflow rates.
- (5) Instruments to indicate to the pilot the pressure differential, the cabin pressure altitude, and the rate of change of cabin pressure altitude.
- (6) Warning indication at the pilot station to indicate when the safe or preset pressure differential is exceeded and when a cabin pressure altitude of 10,000 feet is exceeded.
- (7) A warning placard for the pilot if the structure is not designed for pressure differentials up to the maximum relief valve setting in combination with landing loads.
- (8) A means to stop rotation of the compressor or to divert airflow from the cabin if continued rotation of an engine-driven cabin compressor or continued flow of any compressor bleed air will create a hazard if a malfunction occurs.
- Amdt. 23-49, Eff. 03/11/96
- FAR 23.843 : Pressurization tests.**
- (a) *Strength test.* The complete pressurized cabin, including doors, windows, canopy, and valves, must be tested as a pressure vessel for the pressure differential specified in Sec. 23.365(d).
- (b) *Functional tests.* The following functional tests must be performed :
- (1) Tests of the functioning and capacity of the positive and negative pressure differential valves, and of the emergency release valve, to simulate the effects of closed regulator valves.
- (2) Tests of the pressurization system to show proper functioning under each possible condition of pressure, temperature, and moisture, up to the maximum altitude for which certification is requested.
- (3) Flight tests, to show the performance of the pressure supply, pressure and flow regulators, indicators, and warning signals, in steady and stepped climbs and descents at rates corresponding to the maximum attainable within the operating limitations of the airplane, up to the maximum altitude for which certification is requested.
- (4) Tests of each door and emergency exit, to show that they operate properly after being subjected to the flight tests prescribed in subparagraph (3) of this paragraph.

31.8 Fire Protection

FAR 23.851 : Fire extinguishers.

- (a) [There must be at least one hand fire extinguisher for use in the pilot compartment that is located within easy access of the pilot while seated.
- (b) There must be at least one hand fire extinguisher located conveniently in the passenger compartment—
 - (1) Of each airplane accommodating more than 6 passengers; and
 - (2) Of each commuter category airplane.
- (c) For hand fire extinguishers, the following apply :
 - (1) The type and quantity of each extinguishing agent used must be appropriate to the kinds of fire likely to occur where that agent is to be used.
 - (2) Each extinguisher for use in a personnel compartment must be designed to minimize the hazard of toxic gas concentrations.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.853 : [Passenger and crew compartment interiors.]

For each compartment to be used by the crew or passengers—

- (a) The materials must be at least flame-resistant ;
- (b) [Reserved.]
- (c) If smoking is to be prohibited, there must be a placard so stating, and if smoking is to be allowed—
 - (1) There must be an adequate number of self-contained, removable ashtrays; and
 - (2) Where the crew compartment is separated from the passenger compartment, there must be at least one illustrated sign (using either letters or symbols) notifying all passengers when smoking is prohibited. Signs which notify when smoking is prohibited must—
 - (i) When illuminated, be legible to each passenger seated in the passenger cabin under all probable lighting conditions ; and
 - (ii) Be so constructed that the crew can turn the illumination on and off.
- (d) In addition, for commuter category airplanes the following requirements apply :
 - (1) Each disposal receptacle for towels, paper, or waste must be fully enclosed and constructed of at least fire resistant materials and must contain fires likely to occur in it under normal use. The ability of the disposal receptacle to contain those fires under all probable conditions of wear, misalignment, and ventilation expected in service must be demonstrated by test. A placard containing the legible words "No Cigarette Disposal" must be located on or near each disposal receptacle door.
 - (2) Lavatories must have "No Smoking" or "No Smoking in Lavatory" placards located conspicuously on each side of the entry door and self-contained, removable ashtrays located conspicuously on or near the entry side of each lavatory door, except that one ashtray may serve more than one lavatory door if it can be seen from the cabin side of each lavatory door served. The placards must have red letters at least $\frac{1}{2}$ inch high on a white background at least 1 inch high (a "No Smoking" symbol may be included on the placard).

65.1 General

FAR 27.901 : Installation

- (a) For the purpose of this part, the powerplant installation includes each part of the rotorcraft (other than the main and auxiliary rotor structures) that—
 - (1) Is necessary for propulsion;
 - (2) Affects the control of the major propulsive units; or
 - (3) Affects the safety of the major propulsive units between normal inspections or overhauls.
- (b) For each powerplant installation—
 - (1) [Each component of the installation must be constructed, arranged, and installed to ensure its continued safe operation between normal inspections or overhauls for the range of temperature and altitude for which approval is requested.]
 - (2) Accessibility must be provided to allow any inspection and maintenance necessary for continued airworthiness;
 - (3) Electrical interconnections must be provided to prevent differences of potential between major components of the installation and the rest of the rotorcraft;
 - (4) Axial and radial expansion of turbine engines may not affect the safety of the installation; and
 - (5) [Design precautions must be taken to minimize the possibility of incorrect assembly of components and equipment essential to safe operation of the rotorcraft, except where operation with the incorrect assembly can be shown to be extremely improbable.]
- (c) The installation must comply with—
 - (1) The installation instructions provided under Sec. 33.5 of this chapter ; and
 - (2) The applicable provisions of this subpart.

Amdt. 27-23, Eff. 10/3/88

FAR 27.903 : Engines

- (a) *Engine type certification.* [Each engine must have an approved type certificate. Reciprocating engines for use in helicopters must be qualified in accordance with Sec. 33.49(d) of this chapter or be otherwise approved for the intended usage.
- (b) *Engine or drive system cooling fan blade protection.*
 - (1) If an engine or rotor drive system cooling fan is installed, there must be means to protect the rotorcraft and allow a safe landing if a fan blade fails. This must be shown by showing that—
 - (i) The fan blades are contained in case of failure;
 - (ii) Each fan is located so that a failure will not jeopardize safety; or
 - (iii) Each fan blade can withstand an ultimate load of 1.5 times the centrifugal force resulting from operation limited by the following :
 - (A) For fans driven directly by the engine—
 - (1) The terminal engine r.p.m. under uncontrolled conditions ; or

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(3) Materials (including finishes or decorative surfaces applied to the materials) used in each compartment occupied by the crew or passengers must meet the following test criteria as applicable :

- (i) Interior ceiling panels, interior wall panels, partitions, galley structure, large cabinet walls, structural flooring, and materials used in the construction of stowage compartments (other than underseat stowage compartments and compartments for stowing small items such as magazines and maps) must be self-extinguishing when tested vertically in accordance with the applicable portions of appendix F of this Part or by other equivalent methods. The average burn length may not exceed 6 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling.
- (ii) Floor covering, textiles (including draperies and upholstery), seat cushions, padding, decorative and non-decorative coated fabrics, leather, trays and galley furnishings, electrical conduit, thermal and acoustical insulation and insulation covering, air ducting, joint and edge covering, cargo compartment liners, insulation brakes, cargo covers and transparentes, molded and thermoformed parts, air ducting joints, and trim strips (decorative and chafing), that are constructed of materials not covered in paragraph (d)(3)(iv) of this section must be self extinguishing when tested vertically in accordance with the applicable portions of Appendix F of this Part or other approved equivalent methods. The average burn length may not exceed 8 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 5 seconds after falling.
- (iii) Motion picture film must be safety film meeting the Standard Specifications for Safety Photographic Film PH1.25 (available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018) or an FAA approved equivalent. If the film travels through ducts, the ducts must meet the requirements of paragraph (d)(3)(ii) of this section.
- (iv) Acrylic windows and signs, parts constructed in whole or in part of elastomeric materials, edge-lighted instrument assemblies consisting of two or more instruments in a common housing, seatbelts, shoulder harnesses, and cargo and baggage tiedown equipment, including containers, bins, pallets, etc., used in passenger or crew compartments, may not have an average burn rate greater than 2.5 inches per minute when tested horizontally in accordance with the applicable portions of appendix F of this part or by other approved equivalent methods.
- (v) Except for electrical wire cable insulation, and for small parts (such as knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys, and small electrical parts) that the Administrator finds would not contribute significantly to the propagation of a fire, materials in items not specified in (d)(3)(i), (ii), (iii), or (iv) of this section may not have a burn rate greater than 4.0 inches per minute when tested horizontally in accordance with the applicable portions of appendix F of this part or by other approved equivalent methods.

- (e) Lines, tanks, or equipment containing fuel, oil, or other flammable fluids may not be installed in such compartments unless adequately shielded, isolated, or otherwise protected so that any leakage or failure of such an item would not create a hazard.
- (f) Airplane materials located on the cabin side of the firewall must be self-extinguishing or be located at such a distance from the firewall, or otherwise protected, so that ignition will not occur if the firewall is subjected to a flame temperature of not less than 2,000° F for 15 minutes. For self-extinguishing materials (except electrical wire and cable insulation and small parts that the Administrator finds would not contribute significantly to the propagation of a fire), a vertical self-extinguishing test must be conducted in accordance with appendix F of this part or an equivalent method approved by the Administrator. The average burn length of the material may not exceed 6 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the material test specimen may not continue to flame for more than an average of 3 seconds after falling.

Amdt. 23-49, Eff. 03/11/96

FAR 23.855 : [Cargo and baggage compartment fire protection.]

- (a) [Sources of heat within each cargo and baggage compartment that are capable of igniting the compartment contents must be shielded and insulated to prevent such ignition.
- (b) Each cargo and baggage compartment must be constructed of materials that meet the appropriate provisions of Sec. 23.853(d)(3).
- (c) In addition, for commuter category airplanes, each cargo and baggage compartment must :
- (1) Be located where the presence of a fire would be easily discovered by the pilots when seated at their duty station, or it must be equipped with a smoke or fire detector system to give a warning at the pilots' station, and provide sufficient access to enable a pilot to effectively reach any part of the compartment with the contents of a hand held fire extinguisher, or
- (2) Be equipped with a smoke or fire detector system to give a warning at the pilots' station and have ceiling and sidewall liners and floor panels constructed of materials that have been subjected to and meet the 45 degree angle test of appendix F of this part. The flame may not penetrate (pass through) the material during application of the flame or subsequent to its removal. The average flame time after removal of the flame source may not exceed 15 seconds, and the average glow time may not exceed 10 seconds. The compartment must be constructed to provide fire protection that is not less than that required of its individual panels; or
- (3) Be constructed and sealed to contain any fire within the compartment.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.859 : Combustion heater fire protection.

- (a) [Combustion heater fire regions. The following combustion heater fire regions must be protected from fire in accordance with the applicable provisions of Secs. 23.1182 through 23.1191 and 23.1203 :

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64.9 Miscellaneous

FAR 27.871 : Levelling marks

There must be reference marks for leveling the rotorcraft on the ground.

FAR 27.873 : Ballast provisions

Ballast provisions must be designed and constructed to prevent inadvertent shifting of ballast in flight.

- (1) The region surrounding the heater, if this region contains any flammable fluid system components (excluding the heater fuel system) that could—
 - (i) Be damaged by heater malfunctioning ; or
 - (ii) Allow flammable fluids or vapors to reach the heater in case of leakage.
- (2) The region surrounding the heater, if the heater fuel system has fittings that, if they leaked, would allow fuel vapor to enter this region.
- (3) The part of the ventilating air passage that surrounds the combustion chamber.
- (b) *Ventilating air ducts.* Each ventilating air duct passage through any fire region must be fireproof. In addition—
 - (1) Unless isolation is provided by fireproof valves or by equally effective means, the ventilating air duct downstream of each heater must be fireproof for a distance great enough to ensure that any fire originating in the heater can be contained in the duct ; and
 - (2) Each part of any ventilating duct passing through any region having a flammable fluid system must be constructed or isolated from that system so that the malfunctioning of any component of that system cannot introduce flammable fluids or vapors into the ventilating airstream.
- (c) *Combustion air ducts.* Each combustion air duct must be fireproof for a distance great enough to prevent damage from backfiring or reverse flame propagation. In addition—
 - (1) No combustion air duct may have a common opening with the ventilating airstream unless flames from backfires or reverse burning cannot enter the ventilating airstream under any operating condition, including reverse flow or malfunctioning of the heater or its associated components ; and
 - (2) No combustion air duct may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.
- (d) *Heater controls : general.* Provision must be made to prevent the hazardous accumulation of water or ice on or in any heater control component, control system tubing, or safety control.
- (e) *Heater safety controls.*
 - (1) Each combustion heater must have the following safety controls :
 - (i) Means independent of the components for the normal continuous control of air temperature, airflow, and fuel flow must be provided to automatically shut off the ignition and fuel supply to that heater at a point remote from that heater when any of the following occurs :
 - (A) The heat exchanger temperature exceeds safe limits.
 - (B) The ventilating air temperature exceeds safe limits.
 - (C) The combustion airflow becomes inadequate for safe operation.
 - (D) The ventilating airflow becomes inadequate for safe operation.
 - (ii) Means to warn the crew when any heater whose heat output is essential for safe operation has been shut off by the automatic means prescribed in subparagraph (i) of this paragraph.
 - (2) The means for complying with subparagraph (1)(i) of this paragraph for any individual heater must—

- (i) Be independent of components serving any other heater whose heat output is essential for safe operations; and
 - (ii) Keep the heater off until restarted by the crew.
- (f) *Air intakes.* Each combustion and ventilating air intake must be located so that no flammable fluids or vapors can enter the heater system under any operating condition—
 - (1) During normal operation; or
 - (2) As a result of the malfunctioning of any other component.
- (g) *Heater exhaust.* Heater exhaust systems must meet the provisions of Secs. 23.1121 and 23.1123. In addition, there must be provisions in the design of the heater exhaust system to safely expel the products of combustion to prevent the occurrence of—
 - (1) Fuel leakage from the exhaust to surrounding compartments;
 - (2) Exhaust gas impingement on surrounding equipment or structure;
 - (3) Ignition of flammable fluids by the exhaust, if the exhaust is in a compartment containing flammable fluid lines; and
 - (4) Restrictions in the exhaust system to relieve backfires that, if so restricted, could cause heater failure.
- (h) *Heater fuel systems.* Each heater fuel system must meet each powerplant fuel system requirement affecting safe heater operation. Each heater fuel system component within the ventilating airstream must be protected by shrouds so that no leakage from those components can enter the ventilating airstream.
- (i) *Drains.* There must be means to safely drain fuel that might accumulate within the combustion chamber or the heater exchanger. In addition—
 - (1) Each part of any drain that operates at high temperatures must be protected in the same manner as heater exhausts; and
 - (2) Each drain must be protected from hazardous ice accumulation under any operating condition.]

Amdt. 23-27, Eff. 11/18/80

FAR 23.863 : Flammable fluid fire protection.

- (a) In each area where flammable fluids or vapors might escape by leakage of a fluid system, there must be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazard if ignition does occur.
- (b) Compliance with paragraph (a) of this section must be shown by analysis or tests, and the following factors must be considered :
 - (1) Possible sources and paths of fluid leakage, and means of detecting leakage.
 - (2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials.
 - (3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices.
 - (4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents.

- (3) Both the primary and backup quick release subsystems must—
 - (i) Be reliable, durable, and function properly with all external loads up to and including the maximum external limit load for which authorization is requested.
 - (ii) Be protected against electromagnetic interference (EMI) from external and internal sources and against lightning to prevent inadvertent load release.
 - (A) The minimum level of protection required for jettisonable rotorcraft-load combinations used for nonhuman external cargo is a radio frequency field strength of 20 volts per meter.
 - (B) The minimum level of protection required for jettisonable rotorcraft-load combinations used for human external cargo is a radio frequency field strength of 200 volts per meter.
 - (iii) Be protected against any failure that could be induced by a failure mode of any other electrical or mechanical rotorcraft system.
- (c) For rotorcraft-load combinations to be used for human external cargo applications, the rotorcraft must—
 - (1) For jettisonable external loads, have a quick-release system that meets the requirements of paragraph (b) of this section and that—
 - (i) Provides a dual actuation device for the primary quick release subsystem, and
 - (ii) Provides a separate dual actuation device for the backup quick release subsystem;
 - (2) Have a reliable, approved personnel carrying device system that has the structural capability and personnel safety features essential for external occupant safety;
 - (3) Have placards and markings at all appropriate locations that clearly state the essential system operating instructions and, for the personnel carrying device system, the ingress and egress instructions;
 - (4) Have equipment to allow direct intercommunication among required crewmembers and external occupants; and
 - (5) Have the appropriate limitations and procedures incorporated in the flight manual for conducting human external cargo operations.
- (d) The critically configured jettisonable external loads must be shown by a combination of analysis, ground tests, and flight tests to be both transportable and releasable throughout the approved operational envelope without hazard to the rotorcraft during normal flight conditions. In addition, these external loads must be shown to be releasable without hazard to the rotorcraft during emergency flight conditions.
- (e) A placard or marking must be installed next to the external load attaching means clearly stating any operational limitations and the maximum authorized external load as demonstrated under Sec. 27.25 and this section.
- (f) The fatigue evaluation of Sec. 27.571 of this part does not apply to rotorcraft-load combinations to be used for nonhuman external cargo except for the failure of critical structural elements that would result in a hazard to the rotorcraft. For rotorcraft-load combinations to be used for human external cargo, the fatigue evaluation of Sec. 27.571 of this part applies to the entire quick release and personnel carrying device structural systems and their attachments.]

Amdt. 27-36, Eff. 10/5/99

- (4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents.

- (5) Ability of rotorcraft components that are critical to safety of flight to withstand fire and heat.

- (c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g. equipment shutdown or actuation of a fire extinguisher) quick acting means must be provided to alert the crew.

- (d) Each area where flammable fluids or vapors might escape by leakage of a fluid system must be identified and defined.]

Amdt. 27-16, Eff. 12/1/78

64.8 External Loads

FAR 27.865 : External Loads

- (a) [It must be shown by analysis, test, or both, that the rotorcraft external load attaching means for rotorcraft-load combinations to be used for nonhuman external cargo applications can withstand a limit static load equal to 2.5, or some lower load factor approved under Secs. 27.337 through 27.341, multiplied by the maximum external load for which authorization is requested. It must be shown by analysis, test, or both that the rotorcraft external load attaching means and corresponding personnel carrying device system for rotorcraft-load combinations to be used for human external cargo applications can withstand a limit static load equal to 3.5 or some lower load factor, not less than 2.5, approved under Secs. 27.337 through 27.341, multiplied by the maximum external load for which authorization is requested. The load for any rotorcraft-load combination class, for any external cargo type, must be applied in the vertical direction. For jettisonable external loads of any applicable external cargo type, the load must also be applied in any direction making the maximum angle with the vertical that can be achieved in service but not less than 30 deg.. However, the 30 deg. angle may be reduced to a lesser angle if—

- (1) An operating limitation is established limiting external load operations to such angles for which compliance with this paragraph has been shown ; or
- (2) It is shown that the lesser angle cannot be exceeded in service.

- (b) [The external load attaching means, for jettisonable rotorcraft- load combinations, must include a quick-release system to enable the pilot to release the external load quickly during flight. The quick- release system must consist of a primary quick release subsystem and a backup quick release subsystem that are isolated from one another. The quick-release system, and the means by which it is controlled, must comply with the following :

- (1) A control for the primary quick release subsystem must be installed either on one of the pilot's primary controls or in an equivalently accessible location and must be designed and located so that it may be operated by either the pilot or a crewmember without hazardonously limiting the ability to control the rotorcraft during an emergency situation.
- (2) A control for the backup quick release subsystem, readily accessible to either the pilot or another crewmember, must be provided.

- (5) Ability of airplane components that are critical to safety of flight to withstand fire and heat.

- (c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g. equipment shutdown or actuation of a fire extinguisher), [quick] acting means must be provided to alert the crew.

- (d) Each area where flammable fluids or vapors might escape by leakage of a fluid system must be identified and defined.

Amdt. 23-34, Eff. 2/17/87

FAR 23.865 : Fire protection of flight controls, engine mounts, and other flight structure.

[Flight controls, engine mounts, and other flight structure located in designated fire zones, or in adjacent areas that would be subjected to the effects of fire in the designated fire zones, must be constructed of fireproof material or be shielded so that they are capable of withstanding the effects of a fire. Engine vibration isolators must incorporate suitable features to ensure that the engine is retained if the non-fireproof portions of the isolators deteriorate from the effects of a fire.]

Amdt. 23-48, Eff. 03/11/96

31.9 Electrical Bonding and Lightning Protection

FAR 23.867 : [Electrical bonding and protection against lightning and static electricity.]

- (a) The airplane must be protected against catastrophic effects from lightning.

- (b) For metallic components, compliance with paragraph (a) of this section may be shown by—

- (1) Bonding the components properly to the airframe ; or

- (2) Designing the components so that a strike will not endanger the airplane.

- (c) For non-metallic components, compliance with paragraph (a) of this section may be shown by—

- (1) Designing the components to minimize the effect of a strike ; or

- (2) Incorporating acceptable means of diverting the resulting electrical current so as not to endanger the airplane.

Amdt. 23-49, Eff. 03/11/96

31.10 Miscellaneous

FAR 23.871 : [Leveling means.]

[There must be means for determining when the airplane is in a level position on the ground.]

Amdt. 23-7, Eff. 09/14/69

- (3) There must be means to warn the crew when any heater, the heat output of which is essential for safe operation, has been shut off by the automatic means prescribed in paragraph (g)(1) of this section.
 - (h) *Air intakes.* Each combustion and ventilating air intake must be located so that no flammable fluids or vapors can enter the heater system—
 - (1) During normal operation ; or
 - (2) As a result of the malfunction of any other component.
 - (i) *Heater exhaust.* Each heater exhaust system must meet the requirements of Secs. 27.1121 and 27.1123.
 - (1) Each exhaust shroud must be sealed so that no flammable fluids or hazardous quantities of vapors can reach the exhaust system through joints.
 - (2) No exhaust system may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.
 - (j) *Heater fuel systems.* Each heater fuel system must meet the powerplant fuel system requirements affecting safe heater operation. Each heater fuel system component in the ventilating airstream must be protected by shrouds so that no leakage from those components can enter the ventilating airstream.
 - (k) *Drains.* There must be means for safe drainage of any fuel that might accumulate in the combustion chamber or the heat exchanger.
 - (1) Each part of any drain that operates at high temperatures must be protected in the same manner as heater exhausts.
 - (2) Each drain must be protected against hazardous ice accumulation under any operating condition.]
- Amdt. 27-23, Eff. 10/3/88
- FAR 27.861 : Fire protection of structure, controls, and other parts**
- [Each part of the structure, controls, rotor mechanism, and other parts essential to a controlled landing that would be affected by powerplant fires must be fireproof or protected so they can perform their essential functions for at least 5 minutes under any foreseeable powerplant fire conditions.]
- Amdt. 27-26, Eff. 4/5/90
- FAR 27.863 : [Flammable fluid fire protection.]**
- (a) [In each area where flammable fluids or vapors might escape by leakage of a fluid system, there must be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazards if ignition does occur.
 - (b) Compliance with paragraph (a) of this section must be shown by analysis or tests, and the following factors must be considered :
 - (1) Possible sources and paths of fluid leakage, and means of detecting leakage.
 - (2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials.
 - (3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices.

- (3) Complete drainage of each part of each zone to minimize the hazards resulting from failure or malfunction of any component containing flammable fluids. The drainage means must be—
- (i) Effective under conditions expected to prevail when drainage is needed; and
 - (ii) Arranged so that no discharged fluid will cause an additional fire hazard.
- (4) Ventilation, arranged so that no discharged vapors will cause an additional fire hazard.
- (d) *Ventilating air ducts.* Each ventilating air duct passing through any heater region must be fireproof
- (1) Unless isolation is provided by fireproof valves or by equally effective means, the ventilating air duct downstream of each heater must be fireproof for a distance great enough to ensure that any fire originating in the heater can be contained in the duct.
 - (2) Each part of any ventilating duct passing through any region having a flammable fluid system must be so constructed or isolated from that system that the malfunctioning of any component of that system cannot introduce flammable fluids or vapors into the ventilating airstream.
- (e) *Combustion air ducts.* Each combustion air duct must be fireproof for a distance great enough to prevent damage from backfiring or reverse flame propagation.
- (1) No combustion air duct may connect with the ventilating airstream unless flames from backfires or reverse burning cannot enter the ventilating airstream under any operating condition, including reverse flow or malfunction of the heater or its associated components.
 - (2) No combustion air duct may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.
- (f) *Heater control : General.* There must be means to prevent the hazardous accumulation of water or ice on or in any heater control component, control system tubing, or safety control.
- (g) *Heater safety controls.* For each combustion heater, safety control means must be provided as follows :
- (1) Means independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow must be provided for each heater to automatically shut off the ignition and fuel supply of that heater at a point remote from that heater when any of the following occurs :
 - (i) The heat exchanger temperature exceeds safe limits.
 - (ii) The ventilating air temperature exceeds safe limits.
 - (iii) The combustion airflow becomes inadequate for safe operation.
 - (iv) The ventilating airflow becomes inadequate for safe operation.
 - (2) The means of complying with paragraph (g)(1) of this section for any individual heater must—
 - (i) Be independent of components serving any other heater, the heat output of which is essential for safe operation; and
 - (ii) Keep the heater off until restarted by the crew.

Chapitre 32

Subpart E : Powerplant

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- (a) The materials must be at least [flame]-resistant;
 - (b) [Reserved.]
 - (c) If smoking is to be prohibited, there must be a placard so stating, and if smoking is to be allowed—
 - (1) There must be an adequate number of self-contained, removable ashtrays; and
 - (2) Where the crew compartment is separated from the passenger compartment, there must be at least one illuminated sign (using either letters or symbols) notifying all passengers when smoking is prohibited. Signs which notify when smoking is prohibited must—
 - (i) When illuminated, be legible to each passenger seated in the passenger cabin under all probable lighting conditions; and
 - (ii) Be so constructed that the crew can turn the illumination on and off.
- Amdt. 27-37, Eff. 10/18/99

FAR 27.855 : Cargo and baggage compartments

- (a) Each cargo and baggage compartment must be constructed of, or lined with, materials that are at least—
 - (1) Flame resistant, in the case of compartments that are readily accessible to a crewmember in flight; and
 - (2) Fire resistant, in the case of other compartments.
- (b) No compartment may contain any controls, wiring, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that—
 - (1) They cannot be damaged by the movement of cargo in the compartment; and
 - (2) Their breakage or failure will not create a fire hazard.

FAR 27.859 : Heating systems

- (a) *General.* For each heating system that involves the passage of cabin air over, or close to, the exhaust manifold, there must be means to prevent carbon monoxide from entering any cabin or pilot compartment.
- (b) *Heat exchangers.* Each heat exchanger must be—
 - (1) Of suitable materials;
 - (2) Adequately cooled under all conditions; and
 - (3) Easily disassembled for inspection.
- (c) [*Combustion heater fire protection.* Except for heaters which incorporate designs to prevent hazards in the event of fuel leakage in the heater fuel system, fire within the ventilating air passage, or any other heater malfunction, each heater zone must incorporate the fire protection features of the applicable requirements of Secs. 27.1183, 27.1185, 27.1189, 27.1191, and be provided with—
 - (1) Approved, quick-acting fire detectors in numbers and locations ensuring prompt detection of fire in the heater region.
 - (2) Fire extinguisher systems that provide at least one adequate discharge to all areas of the heater region.

FAR 27.807 : Emergency exits**(a)** [Number and Location.

- (1) There must be at least one emergency exit on each side of the cabin readily accessible to each passenger. One of these exits must be usable in any probable attitude that may result from a crash;
- (2) Doors intended for normal use may also serve as emergency exits, provided that they meet the requirements of this section; and
- (3) If emergency flotation devices are installed, there must be an emergency exit accessible to each passenger on each side of the cabin that is shown by test, demonstration, or analysis to ;
 - (i) Be above the waterline; and
 - (ii) Open without interference from flotation devices, whether stowed or deployed.

(b) Type and operation. Each emergency exit prescribed by paragraph (a) of this section must—

- (1) Consist of a movable window or panel, or additional external door, providing an unobstructed opening that will admit a 19-by 26-inch ellipse;
 - (2) Have simple and obvious methods of opening, from the inside and from the outside, which do not require exceptional effort;
 - (3) Be arranged and marked so as to be readily located and opened even in darkness; and
 - (4) Be reasonably protected from jamming by fuselage deformation.
- (c) Tests. The proper functioning of each emergency exit must be shown by test.
- (d) Ditching emergency exits for passengers. If certification with ditching provisions is requested, the markings required by paragraph (b)(3) of this section must be designed to remain visible if the rotorcraft is capsized and the cabin is submerged.]

Amdt. 27-37, Eff. 10/18/99

FAR 27.831 : Ventilation

- (a) The ventilating system for the pilot and passenger compartments must be designed to prevent the presence of excessive quantities of fuel fumes and carbon monoxide.
- (b) The concentration of carbon monoxide may not exceed one part in 20,000 parts of air during forward flight or hovering in still air. If the concentration exceeds this value under other conditions, there must be suitable operating restrictions.

FAR 27.833 : [Heaters.]

[Each combustion heater must be approved.]

Amdt. 27-23, Eff. 10/3/88

64.7 Fire Protection**FAR 27.853 : Compartment interiors**

For each compartment to be used by the crew or passengers—

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32.1 General

FAR 23.901 : Installation.

- (a) For the purpose of this part, the airplane powerplant installation includes each component that—
 - (1) Is necessary for propulsion; and
 - (2) Affects the safety of the major propulsive units.
- (b) Each powerplant installation must be constructed and arranged to—
 - (1) Ensure safe operation to the maximum altitude for which approval is requested.
 - (2) Be accessible for necessary inspections and maintenance.
- (c) Engine cowls and nacelles must be easily removable or openable by the pilot to provide adequate access to and exposure of the engine compartment for preflight checks.
- (d) Each turbine engine installation must be constructed and arranged to—
 - (1) Result in carcass vibration characteristics that do not exceed those established during the type certification of the engine.
 - (2) Ensure that the capability of the installed engine to withstand the ingestion of rain, hail, ice, and birds into the engine inlet is not less than the capability established for the engine itself under Sec. 23.903(a)(2).]
- (e) The installation must comply with—
 - (1) The instructions provided under the engine type certificate and the propeller type certificate.
 - (2) The applicable provisions of this subpart.
- (f) Each auxiliary power unit installation must meet the applicable portions of this part. Amdt. 23-53, Eff. 04/30/98

FAR 23.903 : Engines.

- (a) *Engine type certificate.*
 - (1) Each engine must have a type certificate and must meet the applicable requirements of Part 34 of this chapter.
 - (2) [Each turbine engine and its installation must comply with one of the following:
 - (i) Sections 33.76, 33.77 and 33.78 of this chapter in effect on December 13, 2000.
 - (ii) Sections 33.77 and 33.78 of this chapter in effect on April 30, 1998, or as subsequently amended before December 13, 2000; or
 - (iii) Section 33.77 of this chapter in effect on October 31, 1974, or as subsequently amended before April 30, 1998, unless that engine's foreign object ingestion service history has resulted in an unsafe condition; or
 - (iv) Be shown to have a foreign object ingestion service history in similar installation locations which has not resulted in any unsafe condition.]
- Note : Sec. 33.77 of this chapter in effect on October 31, 1974, was published in 14 CFR parts 1 to 59, Revised as of January 1, 1975. See 39 FR 35467, October 1, 1974.

- (1) Be positioned so that if the contents break loose they are unlikely to cause injury to the occupants or restrict any of the escape facilities provided for use after an emergency landing; or
 - (2) Have sufficient strength to withstand the conditions specified in Sec. 27.561 including the means of restraint, and their attachments, required for the maximum authorized weight of cargo and baggage at the critical loading distribution.]
 - (d) If cargo compartment lamps are installed, each lamp must be installed so as to prevent contact between lamp bulb and cargo.
- Amdt. 27-27, Eff. 10/22/90

FAR 27.801 : [Ditching.]

- (a) [If certification with ditching provisions is requested, the rotorcraft must meet the requirements of this section and Secs. 27.807(d), 27.1411 and 27.1415.
 - (b) Each practicable design measure, compatible with the general characteristics of the rotorcraft, must be taken to minimize the probability that in an emergency landing on water, the behavior of the rotorcraft would cause immediate injury to the occupants or would make it impossible for them to escape.
 - (c) The probable behavior of the rotorcraft in a water landing must be investigated by model tests or by comparison with rotorcraft of similar configuration for which the ditching characteristics are known. Scoops, flaps, projections, and any other factor likely to affect the hydrodynamic characteristics of the rotorcraft must be considered.
 - (d) It must be shown that, under reasonably probable water conditions, the flotation time and trim of the rotorcraft will allow the occupants to leave the rotorcraft and enter the life rafts required by Sec. 27.1415. If compliance with this provision is shown by buoyancy and trim computations, appropriate allowances must be made for probable structural damage and leakage. If the rotorcraft has fuel tanks (with fuel jettisoning provisions) that can reasonably be expected to withstand a ditching without leakage, the jettisonable volume of fuel may be considered as buoyancy volume.
 - (e) Unless the effects of the collapse of external doors and windows are accounted for in the investigation of the probable behavior of the rotorcraft in a water landing (as prescribed in paragraphs (c) and (d) of this section), the external doors and windows must be designed to withstand the probable maximum local pressures.]
- Amdt. 27-11, Eff. 2/1/77
- FAR 27.805 : [Flight crew emergency exits.]**
- (a) [For rotorcraft with passenger emergency exits that are not convenient to the flight crew, there must be flight crew emergency exits, on both sides of the rotorcraft or as a top hatch in the flight crew area.
 - (b) Each flight crew emergency exit must be of sufficient size and must be located so as to allow rapid evacuation of the flight crew. This must be shown by test.
 - (c) Each flight crew emergency exit must not be obstructed by water or flotation devices after an emergency landing on water. This must be shown by test, demonstration, or analysis.]
- Amdt. 27-37, Eff. 10/18/99

- (ii) Each safety belt or harness to the seat or structure.
- (g) When the safety belt and shoulder harness are combined, the rated strength of the safety belt and shoulder harness may not be less than that corresponding to the inertial forces specified in Sec. 27.561(b), considering the occupant weight of at least 170 pounds, considering the dimensional characteristics of the restraint system installation, and using a distribution of at least a 60-percent load to the safety belt and at least 40-percent load to the shoulder harness. If the safety belt is capable of being used without the shoulder harness, the inertial forces specified must be met by the safety belt alone.
- (h) When a headrest is used, the headrest and its supporting structure must be designed to resist the inertia forces specified in Sec. 27.561, with a 1.33 fitting factor and a head weight of at least 13 pounds.
- (i) Each seating device system includes the device such as the seat, the cushions, the occupant restraint system, and attachment devices.
- (j) Each seating device system may use design features such as crushing or separation of certain parts of the seats to reduce occupant loads for the emergency landing dynamic conditions of Sec. 27.562; otherwise, the system must remain intact and must not interfere with rapid evacuation of the rotorcraft.
- (k) For purposes of this section, a litter is defined as a device designed to carry a nonambulatory person, primarily in a recumbent position, into and on the rotorcraft. Each berth or litter must be designed to withstand the load reaction of an occupant weight of at least 170 pounds when the occupant is subjected to the forward inertial factors specified in Sec. 27.561(b). A berth or litter installed within 15° or less of the longitudinal axis of the rotorcraft must be provided with a padded end-board, cloth diaphragm, or equivalent means that can withstand the forward load reaction. A berth or litter oriented greater than 15° with the longitudinal axis of the rotorcraft must be equipped with appropriate restraints, such as straps or safety belts, to withstand the forward load reaction. In addition—
- (1) The berth or litter must have a restraint system and must not have corners or other protuberances likely to cause serious injury to a person occupying it during emergency landing conditions; and
- (2) The berth or litter attachment and the occupant restraint system attachments to the structure must be designed to withstand the critical loads resulting from flight and ground load conditions and from the conditions prescribed in Sec. 27.561(b). [The fitting factor required by Sec. 27.625(d) shall be applied.]

Amtdt. 27-35, Eff. 9/8/98

FAR 27.787 : Cargo and baggage compartments

- (a) Each cargo and baggage compartment must be designed for its placarded maximum weight of contents and for the critical load distributions at the appropriate maximum load factors corresponding to the specified flight and ground load conditions, except the emergency landing conditions of Sec. 27.561.
- (b) There must be means to prevent the contents of any compartment from becoming a hazard by shifting under the loads specified in paragraph (a) of this section.
- (c) [Under the emergency landing conditions of Sec. 27.561, cargo and baggage compartments must—

(b) *Turbine engine installations.* For turbine engine installations—

- (1) Design precautions must be taken to minimize the hazards to the airplane in the event of an engine rotor failure or of a fire originating inside the engine which burns through the engine case.
- (2) The powerplant systems associated with engine control devices, systems, and instrumentation must be designed to give reasonable assurance that those operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service.
- (c) *Engine isolation.* The powerplants must be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any engine, or the failure or malfunction (including destruction by fire in the engine compartment) of any system that can affect an engine (other than a fuel tank if only one fuel tank is installed), will not—
- (1) Prevent the continued safe operation of the remaining engines; or
- (2) Require immediate action by any crewmember for continued safe operation of the remaining engines.
- (d) *Starting and stopping (piston engine).*
- (1) The design of the installation must be such that risk of fire or mechanical damage to the engine or airplane, as a result of starting the engine in any conditions in which starting is to be permitted, is reduced to a minimum. Any techniques and associated limitations for engine starting must be established and included in the Airplane Flight Manual, approved manual material, or applicable operating placards. Means must be provided for—
- (i) Restarting any engine of a multiengine airplane in flight, and
- (ii) Stopping any engine in flight, after engine failure, if continued engine rotation would cause a hazard to the airplane.
- (2) In addition, for commuter category airplanes, the following apply :
- (i) Each component of the stopping system on the engine side of the firewall that might be exposed to fire must be at least fire resistant.
- (ii) If hydraulic propeller feathering systems are used for this purpose, the feathering lines must be at least fire resistant under the operating conditions that may be expected to exist during feathering.
- (e) *Starting and stopping (turbine engine).* Turbine engine installations must comply with the following :
- (1) The design of the installation must be such that risk of fire or mechanical damage to the engine or the airplane, as a result of starting the engine in any conditions in which starting is to be permitted, is reduced to a minimum. Any techniques and associated limitations must be established and included in the Airplane Flight Manual, approved manual material, or applicable operating placards.
- (2) There must be means for stopping combustion within any engine and for stopping the rotation of any engine if continued rotation would cause a hazard to the airplane. Each component of the engine stopping system located in any fire zone must be fire resistant. If hydraulic propeller feathering systems are used for stopping the engine, the hydraulic feathering lines or hoses must be fire resistant.

- (3) It must be possible to restart an engine in flight. Any techniques and associated limitations must be established and included in the Airplane Flight Manual, approved manual material, or applicable operating placards.
- (4) It must be demonstrated in flight that when restarting engines following a false start, all fuel or vapor is discharged in such a way that it does not constitute a fire hazard.

(f) *Restart envelope.* An altitude and airspeed envelope must be established for the airplane for inflight engine restarting and each installed engine must have a restart capability within that envelope.

(g) *Restart capability.* For turbine engine powered airplanes, if the minimum windmilling speed of the engines, following the inflight shutdown of all engines, is insufficient to provide the necessary electrical power for engine ignition, a power source independent of the engine-driven electrical power generating system must be provided to permit inflight engine ignition for restarting.

Amdt. 23-54, EFF. 12/13/2000

FAR 23.904 : [Automatic power reserve system.]

[If installed, an automatic power reserve (APR) system that automatically advances the power or thrust on the operating engine(s), when any engine fails during takeoff, must comply with appendix H of this part.]

Amdt. 23-43, EFF. 05/10/93

FAR 23.905 : Propellers.

- (a) Each propeller must have a type certificate.
- (b) Engine power and propeller shaft rotational speed may not exceed the limits for which the propeller is certificated.
- (c) Each featherable propeller must have a means to unfeather it in flight.
- (d) Each component of the propeller blade pitch control system must meet the requirements of Sec. 35.42 of this chapter.
- (e) [All areas of the airplane forward of the pusher propeller that are likely to accumulate and shed ice into the propeller disc during any operating condition must be suitably protected to prevent ice formation, or it must be shown that any ice shed into the propeller disc will not create a hazardous condition.
- (f) Each pusher propeller must be marked so that the disc is conspicuous under normal daylight ground conditions.
- (g) If the engine exhaust gases are discharged into the pusher propeller disc, it must be shown by tests, or analysis supported by tests, that the propeller is capable of continuous safe operation.
- (h) All engine cowlings, access doors, and other removable items must be designed to ensure that they will not separate from the airplane and contact the pusher propeller.]

Amdt. 23-43, EFF. 05/10/93

- (c) Normal landing gear controls must operate downward to extend the landing gear.]

Amdt. 27-21, EFF. 12/6/84

FAR 27.783 : Doors

(a) Each closed cabin must have at least one adequate and easily accessible external door.

(b) [Each external door must be located where persons using it will not be endangered by the rotors, propellers, engine intakes, and exhausts when appropriate operating procedures are used. If opening procedures are required, they must be marked inside, on or adjacent to the door opening device.]

Amdt. 27-26, EFF. 4/5/90

FAR 27.785 : Seats, berths, [litters,] safety belts, and harnesses

(a) Each seat, safety belt, harness, and adjacent part of the rotorcraft at each station designated for occupancy during takeoff and landing must be free of potentially injurious objects, sharp edges, protuberances, and hard surfaces and must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the static inertial load factors specified in Sec. 27.561(b) and dynamic conditions specified in Sec. 27.562.

(b) Each occupant must be protected from serious head injury by a safety belt plus a shoulder harness that will prevent the head from contacting any injurious object except as provided for in Sec. 27.562 (c)(5). A shoulder harness (upper torso restraint), in combination with the safety belt, constitutes a torso restraint system as described in TSO-C114.

(c) Each occupant's seat must have a combined safety belt and shoulder harness with a single-point release. Each pilot's combined safety belt and shoulder harness must allow each pilot when seated with safety belt and shoulder harness fastened to perform all functions necessary for flight operations. There must be a means to secure belt and harnesses when not in use, to prevent interference with the operation of the rotorcraft and with rapid egress in an emergency.

(d) If seat backs do not have a firm handhold, there must be hand grips or rails along each aisle to enable the occupants to steady themselves while using the aisle in moderately rough air.

(e) Each projecting object that could injure persons seated or moving about in the rotorcraft in normal flight must be padded.

(f) Each seat and its supporting structure must be designed for an occupant weight of at least 170 pounds, considering the maximum load factors, inertial forces, and reactions between the occupant, seat, and safety belt or harness corresponding with the applicable flight and ground-load conditions, including the emergency landing conditions of Sec. 27.561(b). In addition—

- (1) Each pilot seat must be designed for the reactions resulting from the application of the pilot forces prescribed in Sec. 27.397; and
- (2) The inertial forces prescribed in Sec. 27.561(b) must be multiplied by a factor of 1.33 in determining the strength of the attachment of—
 - (i) Each seat to the structure; and

64.6 Personnel and Cargo Accommodations

FAR 27.771 : Pilot compartment

For each pilot compartment—

- (a) The compartment and its equipment must allow each pilot to perform his duties without unreasonable concentration or fatigue ;
- (b) If there is provision for a second pilot, the rotorcraft must be controllable with equal safety from either pilot seat ; and
- (c) The vibration and noise characteristics of cockpit appurtenances may not interfere with safe operation.

FAR 27.773 : Pilot compartment view

- (a) Each pilot compartment must be free from glare and reflections that could interfere with the pilot's view, and designed so that—
 - (1) Each pilot's view is sufficiently extensive, clear, and undistorted for safe operation ; and
 - (2) Each pilot is protected from the elements so that moderate rain conditions do not unduly impair his view of the flight path in normal flight and while landing.
- (b) If certification for night operation is requested, compliance with paragraph (a) of this section must be shown in night flight tests.

FAR 27.775 : Windshields and windows

[Windshields and windows must be made of material that will not break into danger-ous fragments.]
Amdt. 27-27, Eff. 10/22/90

FAR 27.777 : Cockpit controls

Cockpit controls must be—

- (a) Located to provide convenient operation and to prevent confusion and inadvertent operation ; and
- (b) Located and arranged with respect to the pilots' seats so that there is full and unres- tricted movement of each control without interference from the cockpit structure or the pilot's clothing when pilots from 5'2" to 6'0" in height are seated.

FAR 27.779 : [Motion and effect of cockpit controls.]

[Cockpit controls must be designed so that they operate in accordance with the fol- lowing movements and actuation :

- (a) Flight controls, including the collective pitch control, must operate with a sense of motion which corresponds to the effect on the rotorcraft.
- (b) Twist-grip engine power controls must be designed so that, for lefthand operation, the motion of the pilot's hand is clockwise to increase power when the hand is viewed from the edge containing the index finger. Other engine power controls, excluding the collective control, must operate with a forward motion to increase power.

FAR 23.907 : Propeller vibration.

- (a) Each propeller [other than a conventional fixed-pitch wooden propeller] must be shown to have vibration stresses, in normal operating conditions, that do not exceed values that have been shown by the propeller manufacturer to be safe for continuous operation. This must be shown by—

- (1) Measurement of stresses through direct testing of the propeller ;
 - (2) Comparison with similar installations for which these measurements have been made ; or
 - (3) Any other acceptable test method or service experience that proves the safety of the installation.
- (b) Proof of safe vibration characteristics for any type of propeller, except for conven- tional, fixed-pitch, wood propellers must be shown where necessary.

Amdt. 23-51, Eff. 03/11/96

FAR 23.909 : [Turbocharger systems.]

- (a) Each [turbocharger must be approved under the engine type certificate or it must be shown that the turbocharger system, while in its normal engine installation and operating in the engine environment—]
 - (1) Can withstand, without defect, an endurance test of 150 hours that meets the applicable requirements of Sec. 33.49 of this subchapter ; and
 - (2) Will have no adverse effect upon the engine.
- (b) Control system malfunctions, vibrations, and abnormal speeds and temperatures expected in service may not damage the [turbocharger] compressor or turbine.
- (c) Each [turbocharger] case must be able to contain fragments of a compressor or turbine that fails at the highest speed that is obtainable with normal speed control devices inoperative.
- (d) [Each intercooler installation, where provided, must comply with the following—]
 - (1) The mounting provisions of the intercooler must be designed to withstand the loads imposed on the system ;
 - (2) It must be shown that, under the installed vibration environment, the intercoo- ler will not fail in a manner allowing portions of the intercooler to be ingested by the engine ; and
 - (3) Airflow through the intercooler must not discharge directly on any airplane component (e.g., windshield) unless such discharge is shown to cause no hazard to the airplane under all operating conditions.
- (e) Engine power, cooling characteristics, operating limits, and procedures affected by the turbocharger system installations must be evaluated. Turbocharger operating procedures and limitations must be included in the Airplane Flight Manual in accordance with Sec. 23.1581 of this part.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.925 : Propeller clearance.

[Unless smaller clearances are substantiated, propeller clearances with the airplane at maximum weight, with the most adverse center of gravity, and with the propeller in the most adverse pitch position, may not be less than the following :]

(a) *Ground clearance.* There must be a clearance of at least seven inches (for each airplane with nose wheel landing gear) or nine inches (for each airplane with tail wheel landing gear) between each propeller and the ground with the landing gear statically deflected and in the level, normal takeoff, or taxiing attitude, whichever is most critical. In addition, for each airplane with conventional landing gear struts using fluid or mechanical means for absorbing landing shocks, there must be positive clearance between the propeller and the ground in the level takeoff attitude with the critical tire completely deflated and the corresponding landing gear strut bottomed. Positive clearance for airplanes using leaf spring struts is shown with a deflection corresponding to 1.5g.

(b) *Aft-mounted propellers.* In addition to the clearances specified in paragraph (a) of this section, an airplane with an aft mounted propeller must be designed such that the propeller will not contact the runway surface when the airplane is in the maximum pitch attitude attainable during normal takeoffs and landings.

(c) *Water clearance.* There must be a clearance of at least 18 inches between each propeller and the water, unless compliance with Sec. 23.239 can be shown with a lesser clearance.

(d) *Structural clearance.* There must be—

(1) At least one inch radial clearance between the blade tips and the airplane structure, plus any additional radial clearance necessary to prevent harmful vibration ;

(2) At least one-half inch longitudinal clearance between the propeller blades or cuts and stationary parts of the airplane ; and

(3) Positive clearance between other rotating parts of the propeller or spinner and stationary parts of the airplane.

Amdt. 23-51, Eff. 3/11/96

FAR 23.929 : Engine installation ice protection.

[Propellers (except wooden propellers) and other components of complete engine installations must be protected against the accumulation of ice as necessary to enable satisfactory functioning without appreciable loss of thrust when operated in the icing conditions for which certification is requested.]

Amdt. 23-51, Eff. 03/11/96

FAR 23.933 : Reversing systems.

(a) For turbojet and turbofan reversing systems—

(1) [Each system intended for ground operation only must be designed so that, during any reversal in flight, the engine will produce no more than flight idle thrust. In addition, it must be shown by analysis or test, or both, that—

(i) Each operable reverser can be restored to the forward thrust position ; or

FAR 27.735 : Brakes

[For rotorcraft with wheel-type landing gear, a braking device must be installed that is—]

(a) Controllable by the pilot ;

(b) Usable during power-off landings ; and

(c) Adequate to—
(1) Counteract any normal unbalanced torque when starting or stopping the rotor ; and

(2) Hold the rotorcraft parked on a 10° slope on a dry, smooth pavement.

Amdt. 27-21, Eff. 12/6/84

FAR 27.737 : Skis

The maximum limit load rating of each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements of this part.

64.5 Floats and Hulls**FAR 27.751 : Main float buoyancy**

(a) For main floats, the buoyancy necessary to support the maximum weight of the rotorcraft in fresh water must be exceeded by—

(1) 50 percent, for single floats ; and

(2) 60 percent, for multiple floats.

(b) [Each main float must have enough water-tight compartments so that, with any single main float compartment flooded, the main floats will provide a margin of positive stability great enough to minimize the probability of capsizing.]

Amdt. 27-2, Eff. 2/25/68

FAR 27.753 : Main float design

(a) *Bag floats.* Each bag float must be designed to withstand—

(1) The maximum pressure differential that might be developed at the maximum altitude for which certification with that float is requested ; and

(2) The vertical loads prescribed in Sec. 27.521(a), distributed along the length of the bag over three-quarters of its projected area.

(b) *Rigid floats.* Each rigid float must be able to withstand the vertical, horizontal, and side loads prescribed in Sec. 27.521. These loads may be distributed along the length of the float.

FAR 27.755 : Hulls

For each rotorcraft, with a hull and auxiliary floats, that is to be approved for both taking off from and landing on water, the hull and auxiliary floats must have enough watertight compartments so that, with any single compartment flooded, the buoyancy of the hull and auxiliary floats (and wheel tires if used) provides a margin of positive stability great enough to minimize the probability of capsizing.

- (2) The combined friction, inertia, and air loads occurring during retraction and extension at any airspeed up to the design maximum landing gear operating speed; and
- (3) The flight loads, including those in yawed flight, occurring with the gear extended at any airspeed up to the design maximum landing gear extended speed.
- (b) *Landing gear lock.* A positive means must be provided to keep the gear extended.
- (c) *Emergency operation.* When other than manual power is used to operate the gear, emergency means must be provided for extending the gear in the event of—
 - (1) Any reasonably probable failure in the normal retraction system; or
 - (2) The failure of any single source of hydraulic, electric, or equivalent energy.
- (d) *Operation tests.* The proper functioning of the retracting mechanism must be shown by operation tests.
- (e) *Position indicator.* There must be a means to indicate to the pilot when the gear is secured in the extreme positions.
- (f) *Control.* The location and operation of the retraction control must meet the requirements of Secs. 27.777 and 27.779.
- (g) *Landing gear warning.* An aural or equally effective landing gear warning device must be provided that functions continuously when the rotorcraft is in a normal landing mode and the landing gear is not fully extended and locked. A manual shutoff capability must be provided for the warning device and the warning system must automatically reset when the rotorcraft is no longer in the landing mode.]

Amdt. 27-21, Eff. 12/6/84

FAR 27.731 : Wheels

- (a) Each landing gear wheel must be approved.
- (b) The maximum static load rating of each wheel may not be less than the corresponding static ground reaction with—
 - (1) Maximum weight; and
 - (2) Critical center of gravity.
- (c) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the applicable ground load requirements of this part.

FAR 27.733 : Tires

- (a) Each landing gear wheel must have a tire—
 - (1) That is a proper fit on the rim of the wheel; and
 - (2) Of the proper rating.
- (b) The maximum static load rating of each tire must equal or exceed the static ground reaction obtained at its wheel, assuming—
 - (1) The design maximum weight; and
 - (2) The most unfavorable center of gravity.
- (c) [Each tire installed on a retractable landing gear system must, at the maximum size of the tire type expected in service, have a clearance to surrounding structure and systems that is adequate to prevent contact between the tire and any part of the structure or systems.]

Amdt. 27-11, Eff. 2/1/77

- (ii) The airplane is capable of continued safe flight and landing under any possible position of the thrust reverser.]
- (2) Each system intended for inflight use must be designed so that no unsafe condition will result during normal operation of the system, or from any failure, or likely combination of failures, of the reversing system under any operating condition including ground operation. Failure of structural elements need not be considered if the probability of this kind of failure is extremely remote.
- (3) Each system must have a means to prevent the engine from producing more than [idle thrust] when the reversing system malfunctions; except that it may produce any [greater thrust] that is shown to allow directional control to be maintained, with aerodynamic means alone, under the most critical reversing condition expected in operation.

(b) For propeller reversing systems—

- (1) Each system must be designed so that no single failure, likely combination of failures or malfunction of the system will result in unwanted reverse thrust under any operating condition. Failure of structural elements need not be considered if the probability of this type of failure is extremely remote.
- (2) Compliance with paragraph [(b)](1) of this section must be shown by failure analysis, or testing, or both, for propeller systems that allow the propeller blades to move from the flight low-pitch position to a position that is substantially less than the normal flight, low-pitch position. The analysis may include or be supported by the analysis made to show compliance for the type certification with Sec. 35.21 for the type certification of the propeller and associated installation components. Credit will be given for pertinent analysis and testing completed by the engine and propeller manufacturers.

Amdt. 23-51, Eff. 03/11/96

FAR 23.934 : [Turbojet and turbofan engine thrust reverser systems tests.]

[Thrust reverser systems of turbojet or turbofan engines must meet the requirements of Sec. 33.97 of this chapter or it must be demonstrated by tests that engine operation and vibratory levels are not affected.]

Amdt. 23-43, Eff. 5/10/93

FAR 23.937 : Turbopropeller-drag limiting systems.

- (a) [Turbopropeller-powered airplane propeller-drag limiting systems must be designed so that no single failure or malfunction of any of the systems during normal or emergency operation results in propeller drag in excess of that for which the airplane was designed under the structural requirements of this part. Failure of structural elements of the drag limiting systems need not be considered if the probability of this kind of failure is extremely remote.
- (b) As used in this section, drag limiting systems include manual or automatic devices that, when actuated after engine power loss, can move the propeller blades toward the feather position to reduce windmilling drag to a safe level.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.939 : Powerplant operating characteristics.

- (a) Turbine engine powerplant operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flameout) are present, to a hazardous degree, during normal and emergency operations within the range of operating limitations of the airplane and of the engine.
- (b) [Turbocharged reciprocating engine operating characteristics must be investigated in flight to assure that no adverse characteristics, as a result of an inadvertent overboost, surge, flooding, or vapor lock, are present during normal or emergency operation of the engine(s) throughout the range of operating limitations of both airplane and engine.]
- (c) For turbine engines, the air inlet system must not, as a result of airflow distortion during normal operation, cause vibration harmful to the engine.]

Amdt. 23-42, Eff. 02/04/91

FAR 23.943 : Negative acceleration.

[No hazardous malfunction of an engine, an auxiliary power unit approved for use in flight, or any component or system associated with the powerplant or auxiliary power unit may occur when the airplane is operated at the negative accelerations within the flight envelopes prescribed in Sec. 23.333. This must be shown for the greatest value and duration of the acceleration expected in service.]

Amdt. 23-43, Eff. 05/10/93

32.2 Fuel System**FAR 23.951 : General.**

- (a) [Each fuel system must be constructed and arranged to ensure fuel flow at a rate and pressure established for proper engine and auxiliary power unit functioning under each likely operating condition, including any maneuver for which certification is requested and during which the engine or auxiliary power unit is permitted to be in operation.]
- (b) Each fuel system must be arranged so that—
- (1) No fuel pump can draw fuel from more than one tank at a time; or
 - (2) There are means to prevent introducing air into the system.
- (c) Each fuel system for a turbine engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80° F. and having 0.75cc of free water per gallon added and cooled to the most critical condition for icing likely to be encountered in operation.
- (d) Each fuel system for a turbine engine powered airplane must meet the applicable fuel venting requirements of part 34 of this chapter.

Amdt. 23-43, Eff. 05/10/93

FAR 23.953 : Fuel system independence.

- (a) Each fuel system for a multiengine airplane must be arranged so that, in at least one system configuration, the failure of any one component (other than a fuel tank)

W_e : the effective weight to be used in the drop test (lbs.);

$W = W_M$: for main gear units, equal to the static reaction on the particular unit with the rotorcraft in the most critical attitude. (lbs.)

A rational method may be used in computing a main gear static reaction, taking into consideration the moment arm between the main wheel reaction and the rotorcraft center of gravity.

$W = W_N$: for nose gear units, equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the rotorcraft acts at the center of gravity (lbs.)

$W = W_T$: for tailwheel units, equal to whichever of the following is critical : (lbs.)

- (1) The static weight on the tailwheel with the rotorcraft resting on all wheels; or
- (2) The vertical component of the ground reaction that would occur at the tailwheel, assuming that the mass of the rotorcraft acts at the center of gravity and exerts a force of 1g downward with the rotorcraft in the maximum nose-up attitude considered in the nose-up landing conditions.

h : specified free drop height (inches).

L : ratio of assumed rotor lift to the rotorcraft weight.

d : deflection under impact of the tire (at the proper inflation pressure) plus the vertical component of the axle travels (inches) relative to the drop mass.

n : limit inertia load factor.

n_f : the load factor developed, during impact, on the mass used in the drop test (i.e., the acceleration dv/dt in g's recorded in the drop test plus 1.0).

FAR 27.727 : Reserve energy absorption drop test

The reserve energy absorption drop test must be conducted as follows :

- (a) The drop height must be 1.5 times that specified in Sec. 27.725(a).
- (b) Rotor lift, where considered in a manner similar to that prescribed in Sec. 27.725(b), may not exceed 1.5 times the lift allowed under that paragraph.
- (c) [The landing gear must withstand this test without collapsing. Collapse of the landing gear occurs when a member of the nose, tail, or main gear will not support the rotorcraft in the proper attitude or allows the rotorcraft structure, other than the landing gear and external accessories, to impact the landing surface.]

Amdt. 27-26, Eff. 4/5/90

FAR 27.729 : [Retracting mechanism.]

[For rotorcraft with retractable landing gear, the following apply :

- (a) *Loads*. The landing gear, retracting mechanism, wheel-well doors, and supporting structure must be designed for—
- (1) The loads occurring in any maneuvering condition with the gear retracted;

FAR 27.695 : Power boost and power-operated control system

- (a) If a power boost or power-operated control system is used, an alternate system must be immediately available that allows continued safe flight and landing in the event of—
- (1) Any single failure in the power portion of the system ; or
 - (2) The failure of all engines.
- (b) Each alternate system may be a duplicate power portion or a manually operated mechanical system. The power portion includes the power source (such as hydraulic pumps), and such items as valves, lines, and actuators.
- (c) The failure of mechanical parts (such as piston rods and links), and the jamming of power cylinders, must be considered unless they are extremely improbable.

64.4 Landing Gear**FAR 27.723 : Shock absorption tests**

The landing inertia load factor and the reserve energy absorption capacity of the landing gear must be substantiated by the tests prescribed in Secs. 27.725 and 27.727, respectively. These tests must be conducted on the complete rotorcraft or on units consisting of wheel, tire, and shock absorber in their proper relation.

FAR 27.725 : Limit drop test

The limit drop test must be conducted as follows :

- (a) The drop height must be—
 - (1) 13 inches from the lowest point of the landing gear to the ground ; or
 - (2) Any lesser height, not less than eight inches, resulting in a drop contact velocity equal to the greatest probable sinking speed likely to occur at ground contact in normal power-off landings.
- (b) If considered, the rotor lift specified in Sec. 27.473(a) must be introduced into the drop test, by appropriate energy absorbing devices or by the use of an effective mass.
- (c) Each landing gear unit must be tested in the attitude simulating the landing condition that is most critical from the standpoint of the energy to be absorbed by it.
- (d) When an effective mass is used in showing compliance with paragraph (b) of this section, the following formula may be used instead of more rational computations :

$$W_e = W \left(\frac{h + (1-L)d}{h + d} \right)$$

$$n = n_j \frac{W}{W_e} + L$$

where :

will not result in the loss of power of more than one engine or require immediate action by the pilot to prevent the loss of power of more than one engine.

- (b) If a single fuel tank (or series of fuel tanks interconnected to function as a single fuel tank) is used on a multiengine airplane, the following must be provided :

- (1) Independent tank outlets for each engine, each incorporating a shutoff valve at the tank. This shutoff valve may also serve as the firewall shutoff valve required if the line between the valve and the engine compartment does not contain more than one quart of fuel (or any greater amount shown to be safe) that can [escape] into the engine compartment.
- (2) At least two vents arranged to minimize the probability of both vents becoming obstructed simultaneously.
- (3) Filler caps designed to minimize the probability of incorrect installation or inflight loss.
- (4) A fuel system in which those parts of the system from each tank outlet to any engine are independent of each part of the system supplying fuel to any other engine.

Amdt. 23-43, Eff. 05/10/93

FAR 23.954 : [Fuel system lightning protection.]

[The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by—

- (a) Direct lightning strikes to area having a high probability of stroke attachment ;
- (b) Swept lightning strokes on area where swept strokes are highly probable ; and
- (c) Corona or streamer at fuel vent outlets.]

Amdt. 23-7, Eff. 09/14/69

FAR 23.955 : Fuel flow.

- (a) *General.* The ability of the fuel system to provide fuel at the rates specified in this section and at a pressure sufficient for proper engine operation must be shown in the attitude that is most critical with respect to fuel feed and quantity of unusable fuel. These conditions may be simulated in a suitable mockup. In addition—

- (1) [The quantity of fuel in the tank may not exceed the amount established as the unusable fuel supply for that tank under Sec. 23.959(a) plus that quantity necessary to show compliance with this section.
 - (2) If there is a fuel flowmeter, it must be blocked during the flow test and the fuel must flow through the meter or its bypass.
 - (3) If there is a flowmeter without a bypass, it must not have any probable failure mode that would restrict fuel flow below the level required for this fuel demonstration.
 - (4) The fuel flow must include that flow necessary for vapor return flow, jet pump drive flow, and for all other purposes for which fuel is used.]
- (b) *Gravity systems.* The fuel flow rate for gravity systems (main and reserve supply) must be 150 percent of the takeoff fuel consumption of the engine.

- (c) *Pump systems.* The fuel flow rate for each pump system (main and reserve supply) for each reciprocating engine must be 125 percent of the fuel flow required by the engine at the maximum takeoff power approved under this part.
- (1) This flow rate is required for each main pump and each emergency pump, and must be available when the pump is operating as it would during takeoff.
- (2) For each hand-operated pump, this rate must occur at not more than 60 complete cycles (120 single strokes) per minute.
- (3) The fuel pressure, with main and emergency pumps operating simultaneously, must not exceed the fuel inlet pressure limits of the engine unless it can be shown that no adverse effect occurs.
- (d) *Auxiliary fuel systems and fuel transfer systems.* Paragraphs (b), (c), and (f) of this section apply to each auxiliary and transfer system, except that—
- (1) The required fuel flow rate must be established upon the basis of maximum continuous power and engine rotational speed, instead of takeoff power and fuel consumption; and
- (2) If there is a placard providing operating instructions, a lesser flow rate may be used for transferring fuel from any auxiliary tank into a larger main tank. This lesser flow rate must be adequate to maintain engine maximum continuous power but the flow rate must not overfill the main tank at lower engine powers.
- (e) *Multiple fuel tanks.* For reciprocating engines that are supplied with fuel from more than one tank, if engine power loss becomes apparent due to fuel depletion from the tank selected, it must be possible after switching to any full tank, in level flight, to obtain 75 percent maximum continuous power on that engine in not more than—
- (1) 10 seconds for naturally aspirated single-engine airplanes;
- (2) 20 seconds for turbocharged single-engine airplanes, provided that 75 percent maximum continuous naturally aspirated power is regained within 10 seconds; or
- (3) 20 seconds for multiengine airplanes.
- (f) *Turbine engine fuel systems.* Each turbine engine fuel system must provide at least 100 percent of the fuel flow required by the engine under each intended operation condition and maneuver. The conditions may be simulated in a suitable mockup. This flow must—
- (1) Be shown with the airplane in the most adverse fuel feed condition (with respect to altitudes, attitudes, and other conditions) that is expected in operation; and
- (2) For multiengine airplanes, notwithstanding the lower flow rate allowed by paragraph (d) of this section, be automatically uninterrupted with respect to any engine until all fuel scheduled for use by that engine has been consumed. In addition—
- (i) For the purposes of this section, "fuel scheduled for use by that engine" means all fuel in any tank intended for use by a specific engine.
- (ii) The fuel system design must clearly indicate the engine for which fuel in any tank is scheduled.
- (iii) Compliance with this paragraph must require no pilot action after completion of the engine starting phase of operations.

- (2) The design of the cable systems must prevent any hazardous change in cable tension throughout the range of travel under any operating conditions and temperature variations.
- (3) No cable smaller than three thirty-seconds of an inch diameter may be used in any primary control system.
- (4) Pulley kinds and sizes must correspond to the cables with which they are used. The pulley cable combinations and strength values which must be used are specified in Military Handbook MIL-HDBK-5C, Vol. 1 & Vol. 2 Metallic Materials and Elements for Flight Vehicle Structures, (Sept. 15, 1976, as amended through December 15, 1978). This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. section 552 (a) and 1 CFR Part 51. Copies may be obtained from the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania, 19120. Copies may be inspected at the FAA, Rotorcraft Standards Staff, 4400 Blue Mound Road, Fort Worth, Texas, or at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC.
- (5) Pullleys must have close fitting guards to prevent the cables from being displaced or fouled.
- (6) Pullleys must lie close enough to the plane passing through the cable to prevent the cable from rubbing against the pulley flange.
- (7) No fairlead may cause a change in cable direction of more than 3°.
- (8) No clevis pin subject to load or motion and retained only by cotter pins may be used in the control system.
- (9) Turnbuckles attached to parts having angular motion must be installed to prevent binding throughout the range of travel.
- (10) There must be means for visual inspection at each fairlead, pulley, terminal, and turnbuckle.
- (e) Control system joints subject to angular motion must incorporate the following special factors with respect to the ultimate bearing strength of the softest material used as a bearing :
- (1) 3.33 for push-pull systems other than ball and roller bearing systems.
- (2) 2.0 for cable systems.
- (f) For control system joints, the manufacturer's static, non-Brinell rating of ball and roller bearings must not be exceeded.]
- Amdt. 27-26, EFF. 4/5/90

FAR 27.687 : Spring devices

- (a) Each control system spring device whose failure could cause flutter or other unsafe characteristics must be reliable.
- (b) Compliance with paragraph (a) of this section must be shown by tests simulating service conditions.

FAR 27.691 : Autorotation control mechanism

Each main rotor blade pitch control mechanism must allow rapid entry into autorotation after power failure.

(3) Takeup adjustments.

(c) Each stop must be able to withstand the loads corresponding to the design conditions for the system.

(d) For each main rotor blade—

(1) [Stops that are appropriate to the blade design must be provided to limit travel of the blade about its hinge points; and]

(2) There must be means to keep the blade from hitting the droop stops during any operation other than starting and stopping the rotor.

Amdt. 27-16, Eff. 12/1/78

FAR 27.679 : Control system locks

If there is a device to lock the control system with the rotorcraft on the ground or water, there must be means to—

(a) Give unmistakable warning to the pilot when the lock is engaged; and

(b) Prevent the lock from engaging in flight.

FAR 27.681 : Limit load static tests

(a) Compliance with the limit load requirements of this part must be shown by tests in which—

(1) The direction of the test loads produces the most severe loading in the control system; and

(2) Each fitting, pulley, and bracket used in attaching the system to the main structure is included.

(b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

FAR 27.683 : Operation tests

It must be shown by operation tests that, when the controls are operated from the pilot compartment with the control system loaded to correspond with loads specified for the system, the system is free from—

(a) Jamming;

(b) Excessive friction; and

(c) Excessive deflection.

FAR 27.685 : Control system details

(a) Each detail of each control system must be designed to prevent jamming, chafing, and interference from cargo, passengers, loose objects, or the freezing of moisture.

(b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system.

(c) There must be means to prevent the slapping of cables or tubes against other parts.

(d) [Cable systems must be designed as follows :

(1) Cables, cable fittings, turnbuckles, splices, and pulleys must be of an acceptable kind.

(3) For single-engine airplanes, require no pilot action after completion of the engine starting phase of operations unless means are provided that unmistakably alert the pilot to take any needed action at least five minutes prior to the needed action; such pilot action must not cause any change in engine operation; and such pilot action must not distract pilot attention from essential flight duties during any phase of operations for which the airplane is approved.

Amdt. 23-51, Eff. 03/11/96

FAR 23.957 : Flow between interconnected tanks.

(a) [It must be impossible, in a gravity feed system with interconnected tank outlets, for enough fuel to flow between the tanks to cause an overflow of fuel from any tank vent under the conditions in Sec. 23.959, except that full tanks must be used.

(b) If fuel can be pumped from one tank to another in flight, the fuel tank vents and the fuel transfer system must be designed so that no structural damage to any airplane component can occur because of overfilling of any tank.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.959 : Unusable fuel supply.

(a) [The unusable fuel supply for each tank must be established as not less than that quantity at which the first evidence of malfunctioning occurs under the most adverse fuel feed condition occurring under each intended operation and flight maneuver involving that tank. Fuel system component failures need not be considered.

(b) The effect on the usable fuel quantity as a result of a failure of any pump shall be determined.]

Amdt. 23-51, Eff. 03/11/96

FAR 23.961 : Fuel system hot weather operation.

[Each fuel system must be free from vapor lock when using fuel at its critical temperature, with respect to vapor formation, when operating the airplane in all critical operating and environmental conditions for which approval is requested. For turbine fuel, the initial temperature must be 110°F, -0°, +5° or the maximum outside air temperature for which approval is requested, whichever is more critical.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.963 : Fuel tanks : general.

(a) Each fuel tank must be able to withstand, without failure, the vibration, inertia, fluid, and structural loads that it may be subjected to in operation.

(b) [Each flexible fuel tank liner must be shown to be suitable for the particular application,]

(c) Each integral fuel tank must have adequate facilities for interior inspection and repair.

(d) The total usable capacity of the fuel tanks must be enough for at least one-half hour of operation at maximum continuous power.

(e) Each fuel quantity indicator must be adjusted, as specified in Sec. 23.1337(b), to account for the unusable fuel supply determined under [Sec. 23.959(a).]

(f) [Removed.]

Amdt. 23-51, Eff. 03/11/96

FAR 23.965 : Fuel tank tests.

- (a) Each fuel tank must be able to withstand the following pressures without failure or leakage :
- (1) For each conventional metal tank and nonmetallic tank with walls not supported by the airplane structure, a pressure of 3.5 p.s.i., or that pressure developed during maximum ultimate acceleration with a full tank, whichever is greater.
 - (2) For each integral tank, the pressure developed during the maximum limit acceleration of the airplane with a full tank, with simultaneous application of the critical limit structural loads.
 - (3) For each nonmetallic tank with walls supported by the airplane structure and constructed in an acceptable manner using acceptable basic tank material, and with actual or simulated support conditions, a pressure of 2 p.s.i. for the first tank of a specific design. The supporting structure must be designed for the critical loads occurring in the flight or landing strength conditions combined with the fuel pressure loads resulting from the corresponding accelerations.
- (b) Each fuel tank with large, unsupported, or unstiffened flat surfaces, whose failure or deformation could cause fuel leakage, must be able to withstand the following test without leakage, failure, or excessive deformation of the tank walls :
- (1) Each complete tank assembly and its support must be vibration tested while mounted to simulate the actual installation.
 - (2) Except as specified in paragraph (b)(4) of this section, the tank assembly must be vibrated for 25 hours at a total displacement of not less than $\frac{1}{32}$ of an inch (unless another displacement is substantiated) while $\frac{2}{3}$ filled with water or other suitable test fluid.
 - (i) [If no frequency of vibration resulting from any r.p.m. within the normal operating range of engine or propeller speeds is critical, the test frequency of vibration is :
 - (A) The number of cycles per minute obtained by multiplying the maximum continuous propeller speed in r.p.m. by 0.9 for propeller-driven airplanes, and
 - (B) For non-propeller driven airplanes the test frequency of vibration is 2,000 cycles per minute.]
 - (ii) If only one frequency of vibration resulting from any r.p.m. within the normal operating range of engine or propeller speeds is critical, that frequency of vibration must be the test frequency.
 - (iii) If more than one frequency of vibration resulting from any r.p.m. within the normal operating range of engine or propeller speeds is critical, the most critical of these frequencies must be the test frequency.
 - (4) Under paragraph (b)(3)(ii) and (iii) of this section, the time of test must be adjusted to accomplish the same number of vibration cycles that would be accomplished in 25 hours at the frequency specified in paragraph (b)(3)(i) of this section.

FAR 27.672 : [Stability augmentation, automatic, and power-operated systems.]

[If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this Part, such systems must comply with Sec. 27.671 of this Part and the following :

- (a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring the pilot's attention must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system which could result in an unsafe condition if the pilot is unaware of the failure. Warning systems must not activate the control systems.
 - (b) The design of the stability augmentation system or of any other automatic or power-operated system must allow initial counteraction of failures without requiring exceptional pilot skill or strength by overriding the failure by movement of the flight controls in the normal sense and deactivating the failed system.
 - (c) It must be shown that after any single failure of the stability augmentation system or any other automatic or power-operated system—
 - (1) The rotorcraft is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations ;
 - (2) The controllability and maneuverability requirements of this Part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and rotorcraft configurations) which is described in the Rotorcraft Flight Manual ; and
 - (3) The trim and stability characteristics are not impaired below a level needed to permit continued safe flight and landing.]
- Amdt. 27-21, Eff. 12/6/84

FAR 27.673 : [Primary flight control.]

[Primary flight controls are those used by the pilot for immediate control of pitch, roll, yaw, and vertical motion of the rotorcraft.]

Amdt. 27-21, Eff. 12/6/84

FAR 27.674 : [Interconnected controls.]

[Each primary flight control system must provide for safe flight and landing and operate independently after a malfunction, failure, or jam of any auxiliary interconnected control.]

Amdt. 27-26, Eff. 4/5/90

FAR 27.675 : Stops

- (a) Each control system must have stops that positively limit the range of motion of the pilot's controls.
- (b) Each stop must be located in the system so that the range of travel of its control is not appreciably affected by—
- (1) Wear ;
 - (2) Slackness ; or

64.2 Rotors

FAR 27.653 : Pressure venting and drainage of rotor blades

- (a) [For each rotor blade—
- (1) There must be means for venting the internal pressure of the blade ;
 - (2) Drainage holes must be provided for the blade ; and
 - (3) The blade must be designed to prevent water from becoming trapped in it.
- (b) Paragraphs (a)(1) and (2) of this section do not apply to sealed rotor blades capable of withstanding the maximum pressure differentials expected in service.]

Amdt. 27-2, Eff. 2/25/68

FAR 27.659 : Mass balance

- (a) [The rotors and blades must be mass balanced as necessary to—
- (1) Prevent excessive vibration ; and
 - (2) Prevent flutter at any speed up to the maximum forward speed.
- (b) The structural integrity of the mass balance installation must be substantiated.]

Amdt. 27-2, Eff. 2/25/68

FAR 27.661 : Rotor blade clearance

[There must be enough clearance between the rotor blades and other parts of the structure to prevent the blades from striking any part of the structure during any operating condition.]

Amdt. 27-2, Eff. 2/25/68

FAR 27.663 : Ground resonance prevention means

- (a) [The reliability of the means for preventing ground resonance must be shown either by analysis and tests, or reliable service experience, or by showing through analysis or tests that malfunction or failure of a single means will not cause ground resonance.]
- (b) The probable range of variations, during service, of the damping action of the ground resonance prevention means must be established and must be investigated during the test required by Sec. 27.241.

Amdt. 27-26, Eff. 4/5/90

64.3 Control Systems

FAR 27.671 : General

- (a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function.
- (b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimize the probability of any incorrect assembly that could result in the malfunction of the system.

- (5) During the test, the tank assembly must be rocked at a rate of 16 to 20 complete cycles per minute, through an angle of 15 degrees on either side of the horizontal (30 degrees total), about an axis parallel to the axis of the fuselage, for 25 hours.

- (c) Each integral tank using methods of construction and sealing not previously proven to be adequate by test data or service experience must be able to withstand the vibration test specified in subparagraphs (1) through (4) of paragraph (b).
- (d) Each tank with a nonmetallic liner must be subjected to the sloshing test outlined in subparagraph (5) of paragraph (b) of this section, with the fuel at room temperature. In addition, a specimen liner of the same basic construction as that to be used in the airplane must, when installed in a suitable test tank, withstand the sloshing test with fuel at a temperature of 110° F.

Amdt. 23-51, Eff. 03/11/96

FAR 23.967 : Fuel tank installation.

- (a) Each fuel tank must be supported so that tank loads are not concentrated. In addition—
- (1) There must be pads, if necessary, to prevent chafing between each tank and its supports ;
 - (2) Padding must be non-absorbent or treated to prevent the absorption of fuel ;
 - (3) If a flexible tank liner is used, it must be supported so that it is not required to withstand fluid loads ;
 - (4) Interior surfaces adjacent to the liner must be smooth and free from projections that could cause wear, unless—
 - (i) Provisions are made for protection of the liner at those points ; or
 - (ii) The construction of the liner itself provides such protection ;
 - (5) A positive pressure must be maintained within the vapor space of each bladder cell under all conditions of operation except for a particular condition for which it is shown that a zero or negative pressure will not cause the bladder cell to collapse ; and
 - (6) Siphoning of fuel (other than minor spillage) of collapse of bladder fuel cells may not result from improper securing or loss of the fuel filler cap.
- (b) Each tank compartment must be ventilated and drained to prevent the accumulation of flammable fluids or vapors. Each compartment adjacent to a tank that is an integral part of the airplane structure must also be ventilated and drained.
- (c) No fuel tank may be on the engine side of the firewall. There must be at least one-half inch of clearance between the fuel tank and the firewall. No part of the engine nacelle skin that lies immediately behind a major air opening from the engine compartment may act as the wall of an integral tank.
- (d) [Each fuel tank may be isolated from personnel compartments by a fume-proof and fuel-proof enclosure that is vented and drained to the exterior of the airplane. The required enclosure must sustain any personnel compartment pressurization loads without permanent deformation or failure under the conditions of Secs. 23.365 and 23.843 of this part. A bladder-type fuel cell, if used, must have a retaining shell at least equivalent to a metal fuel tank in structural integrity.]

(e) Fuel tanks must be designed, located, and installed so as to retain fuel—

- (1) When subjected to the inertia loads resulting from the ultimate static load factors prescribed in Sec. 23.561 (b)(2) of this part; and
- (2) Under conditions likely to occur when an airplane lands on a paved runway at a normal landing speed under each of the following conditions :
 - (i) The airplane in a normal landing attitude and its landing gear retracted.
 - (ii) The most critical landing gear leg collapsed and the other landing gear legs extended.

In showing compliance with paragraph (e)(2) of this section, the tearing away of an engine mount must be considered unless all the engines are installed above the wing or on the tail or fuselage of the airplane.

Amdt. 23-43, Eff. 05/10/93

FAR 23.969 : Fuel tank expansion space.

Each fuel tank must have an expansion space of not less than two percent of the tank capacity, unless the tank vent discharges clear of the airplane (in which case no expansion space is required). It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.

FAR 23.971 : Fuel tank sump.

- (a) [Each fuel tank must have a drainable sump with an effective capacity, in the normal ground and flight attitudes, of 0.25 percent of the tank capacity, or $\frac{1}{16}$ gallon, whichever is greater.
- (b) Each fuel tank must allow drainage of any hazardous quantity of water from any part of the tank to its sump with the airplane in the normal ground attitude.
- (c) Each reciprocating engine fuel system must have a sediment bowl or chamber that is accessible for drainage; has a capacity of 1 ounce for every 20 gallons of fuel tank capacity; and each fuel tank outlet is located so that, in the normal flight attitude, water will drain from all parts of the tank except the sump to the sediment bowl or chamber.
- (d) Each sump, sediment bowl, and sediment chamber drain required by paragraphs (a), (b), and (c) of this section must comply with the drain provisions of Sec. 23.999(b)(1) and (2).]

Amdt. 23-43, Eff. 05/10/93

FAR 23.973 : Fuel tank filler connection.

- (a) Each fuel tank filler connection must be marked as prescribed in Sec. 23.1557(c).
- (b) Spilled fuel must be prevented from entering the fuel tank compartment or any part of the airplane other than the tank itself.
- (c) Each filler cap must provide a fuel-tight seal for the main filler opening. However, there may be small openings in the fuel tank cap for venting purposes or for the purpose of allowing passage of a fuel gauge through the cap provided such openings comply with the requirements of Sec. 23.975(a).

(3) For castings procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis—

- (i) A casting factor of 1.0 may be used; and
- (ii) The castings must be inspected as provided in subparagraph (1) of this paragraph for casting factors of “1.25 through 1.50” and tested under paragraph (c)(2) of this section.

Amdt. 27-34, Eff. 11/28/97

FAR 27.623 : Bearing factors

- (a) Except as provided in paragraph (b) of this section, each part that has clearance (free fit), and that is subject to pounding or vibration, must have a bearing factor large enough to provide for the effects of normal relative motion.
- (b) No bearing factor need be used on a part for which any larger special factor is prescribed.

FAR 27.625 : Fitting factors

For each fitting (part or terminal used to join one structural member to another) the following apply :

- (a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1.15 must be applied to each part of—
 - (1) The fitting;
 - (2) The means of attachment; and
 - (3) The bearing on the joined members.
- (b) No fitting factor need be used—
 - (1) For joints made under approved practices and based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood); and
 - (2) With respect to any bearing surface for which a larger special factor is used.
- (c) For each integral fitting, the part must be treated as a fitting up to the point at which the section properties become typical of the member.
- (d) [Each seat, berth, litter, safety belt, and harness attachment to the structure must be shown by analysis, tests, or both, to be able to withstand the inertia forces prescribed in Sec. 27.561(b)(3) multiplied by a fitting factor of 1.33]

Amdt. 27-35, Eff. 9/8/98

FAR 27.629 : Flutter

Each [aerodynamic surface] of the rotorcraft must be free from flutter under each appropriate speed and power condition.

Amdt. 27-26, Eff. 4/5/90

FAR 27.621 : Casting factors

- (a) *General.* The factors, tests, and inspections specified in paragraphs (b) and (c) of this section must be applied in addition to those necessary to establish foundry quality control. The inspections must meet approved specifications. Paragraphs (c) and (d) of this section apply to structural castings except castings that are pressure tested as parts of hydraulic or other fluid systems and do not support structural loads.
- (b) *Bearing stresses and surfaces.* The casting factors specified in paragraphs (c) and (d) of this section—
- (1) Need not exceed 1.25 with respect to bearing stresses regardless of the method of inspection used; and
- (2) Need not be used with respect to the bearing surfaces of a part whose bearing factor is larger than the applicable casting factor.
- (c) *Critical castings.* For each casting whose failure would preclude continued safe flight and landing of the rotorcraft or result in serious injury to any occupant, the following apply :
- (1) Each critical casting must—
- (i) Have a casting factor of not less than 1.25; and
- (ii) Receive 100 percent inspection by visual, radiographic, and magnetic particle (for ferromagnetic materials) or [penetrant] (for nonferromagnetic materials) inspection methods or approved equivalent inspection methods.
- (2) For each critical casting with a casting factor less than 1.50, three sample castings must be static tested and shown to meet—
- (i) The strength requirements of Sec. 27.305 at an ultimate load corresponding to a casting factor of 1.25; and
- (ii) The deformation requirements of Sec. 27.305 at a load of 1.15 times the limit load.

- (d) *Noncritical castings.* For each casting other than those specified in paragraph (c) of this section, the following apply :

- (1) Except as provided in subparagraphs (2) and (3) of this paragraph, the casting factors and corresponding inspections must meet the following table :

Casting factor	Inspection
2.0 or greater	100 percent visual.
Less than 2.0, greater than 1.5.	100 percent visual, and magnetic particle (ferromagnetic materials), penetrant (nonferromagnetic materials), or approved equivalent inspection methods.
1.25 through 1.50	100 percent visual, and magnetic particle (ferromagnetic materials), penetrant (nonferromagnetic materials), and radiographic or approved equivalent inspection methods.

- (2) The percentage of castings inspected by nonvisual methods may be reduced below that specified in subparagraph (1) of this paragraph when an approved quality control procedure is established.

- (d) Each fuel filling point, except pressure fueling connection points, must have a provision for electrically bonding the airplane to ground fueling equipment.
- (e) For airplanes with engines requiring gasoline as the only permissible fuel, the inside diameter of the fuel filler opening must be no larger than 2.36 inches.
- (f) [For airplanes with turbine engines, the inside diameter of the fuel filler opening must be no smaller than 2.95 inches.]

Amdt. 23-51, Eff. 03/11/96

FAR 23.975 : Fuel tank vents and carburetor vapor vents.

- (a) Each fuel tank must be vented from the top part of the expansion space. In addition—
- (1) Each vent outlet must be located and constructed in a manner that minimizes the possibility of its being obstructed by ice or other foreign matter ;
- (2) Each vent must be constructed to prevent siphoning of fuel during normal operation ;
- (3) The venting capacity must allow the rapid relief of excessive differences of pressure between the interior and exterior of the tank;
- (4) Airspaces of tanks with interconnected outlets must be interconnected ;
- (5) [There may be no point in any vent line where moisture can accumulate with the airplane in either the ground or level flight attitudes, unless drainage is provided. Any drain valve installed must be accessible for drainage.]
- (6) No vent may terminate at a point where the discharge of fuel from the vent outlet will constitute a fire hazard or from which fumes may enter personnel compartments ; and
- (7) Vents must be arranged to prevent the loss of fuel, except fuel discharged because of thermal expansion, when the airplane is parked in any direction on a ramp having a one-percent slope.
- (b) Each carburetor with vapor elimination connections and each fuel injection engine employing vapor return provisions must have a separate vent line to lead vapors back to the top of one of the fuel tanks. If there is more than one tank and it is necessary to use these tanks in a definite sequence for any reason, the vapor vent line must lead back to the fuel tank to be used first, unless the relative capacities of the tanks are such that return to another tank is preferable.
- (c) For acrobatic category airplanes, excessive loss of fuel during acrobatic maneuvers, including short periods of inverted flight, must be prevented. It must be impossible for fuel to siphon from the vent when normal flight has been resumed after any acrobatic maneuver for which certification is requested.

Amdt. 23-51, Eff. 03/11/96

FAR 23.977 : Fuel tank outlet.

- (a) There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must—
- (1) For reciprocating engine powered airplanes, have 8 to 16 meshes per inch; and
- (2) For turbine engine powered airplanes, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

- (b) The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line.
 - (c) The diameter of each strainer must be at least that of the fuel tank outlet.
 - (d) [Each strainer must be accessible for inspection and cleaning.]
- Amdt. 23-43, Eff. 05/10/93

FAR 23.979 : Pressure fueling systems.

For pressure fueling systems, the following apply :

- (a) Each pressure fueling system fuel manifold connection must have means to prevent the escape of hazardous quantities of fuel from the system if the fuel entry valve fails.
 - (b) [An automatic shutoff means must be provided to prevent the quantity of fuel in each tank from exceeding the maximum quantity approved for that tank. This means must—
 - (1) Allow checking for proper shutoff operation before each fueling of the tank ; and
 - (2) For commuter category airplanes, indicate at each fueling station, a failure of the shutoff means to stop the fuel flow at the maximum quantity approved for that tank.]
 - (c) A means must be provided to prevent damage to the fuel system in the event of failure of the automatic shutoff means prescribed in paragraph (b) of this section.
 - (d) All parts of the fuel system up to the tank which are subjected to fueling pressures must have a proof pressure of 1.33 times, and an ultimate pressure of at least 2.0 times, the surge pressure likely to occur during fueling.
- Amdt. 23-51, Eff. 03/11/96

32.3 Fuel System Components

FAR 23.991 : Fuel pumps.

- (a) *Main pumps.* For main pumps, the following apply :

- (1) For reciprocating engine installations having fuel pumps to supply fuel to the engine, at least one pump for each engine must be directly driven by the engine and must meet Sec. 23.955. This pump is a main pump.
- (2) For turbine engine installations, each fuel pump required for proper engine operation, or required to meet the fuel system requirements of this subpart (other than those in paragraph (b) of this section), is a main pump. In addition—
 - (i) There must be at least one main pump for each turbine engine ;
 - (ii) The power supply for the main pump for each engine must be independent of the power supply for each main pump for any other engine ; and
 - (iii) For each main pump, provision must be made to allow the bypass of each positive displacement fuel pump other than a fuel injection pump approved as part of the engine.

FAR 27.613 : Material strength properties and design values

- (a) Material strength properties must be based on enough tests of material meeting specifications to establish design values on a statistical basis.
 - (b) [Design values must be chosen to minimize the probability of structural failure due to material variability. Except as provided in paragraphs (d) and (e) of this section, compliance with this paragraph must be shown by selecting design values that assure material strength with the following probability—
 - (1) [Where applied loads are eventually distributed through a single member within an assembly, the failure of which would result in loss of structural integrity of the component, 99 percent probability with 95 percent confidence ; and
 - (2) For redundant structure, those in which the failure of individual elements would result in applied loads being safely distributed to other load-carrying members, 90 percent probability with 95 percent confidence.]
 - (c) The strength, detail design, and fabrication of the structure must minimize the probability of disastrous fatigue failure, particularly at points of stress concentration.
 - (d) [Design values must be those contained in the following publications (available from the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120) or other values approved by the Administrator :]
 - (1) MIL-HDBK-5, "Metallic Materials and Elements for Flight Vehicle Structure".
 - (2) MIL-HDBK-17, "Plastics for Flight Vehicles".
 - (3) ANC-18, "Design of Wood Aircraft Structures".
 - (4) MIL-HDBK-23, "Composite Construction for Flight Vehicles".
 - (e) [Other design values may be used if a selection of the material is made in which a specimen of each individual item is tested before use and it is determined that the actual strength properties of that particular item will equal or exceed those used in design.]
- Amdt. 27-26, Eff. 4/5/90

FAR 27.619 : Special factors

- (a) The special factors prescribed in Secs. 27.621 through 27.625 apply to each part of the structure whose strength is—
 - (1) Uncertain ;
 - (2) Likely to deteriorate in service before normal replacement ; or
 - (3) Subject to appreciable variability due to—
 - (i) Uncertainties in manufacturing processes ; or
 - (ii) Uncertainties in inspection methods.
- (b) For each part to which Secs. 27.621 through 27.625 apply, the factor of safety prescribed in Sec. 27.303 must be multiplied by a special factor equal to—
 - (1) The applicable special factors prescribed in Secs. 27.621 through 27.625 ; or
 - (2) Any other factor great enough to ensure that the probability of the part being understrength because of the uncertainties specified in paragraph (a) of this section is extremely remote.

FAR 27.609 : Protection of structure

Each part of the structure must—

- (a) Be suitably protected against deterioration or loss of strength in service due to any cause, including—
 - (1) Weathering ;
 - (2) Corrosion ; and
 - (3) Abrasion ; and
- (b) Have provisions for ventilation and drainage where necessary to prevent the accumulation of corrosive, flammable, or noxious fluids.

FAR 27.610 : [Lightning and static electricity protection.]

- (a) The rotorcraft must be protected against catastrophic effects from lightning.
- (b) For metallic components, compliance with paragraph (a) of this section may be shown by—
 - (1) Electrically bonding the components properly to the airframe ; or
 - (2) Designing the components so that a strike will not endanger the rotorcraft.
- (c) For nonmetallic components, compliance with paragraph (a) of this section may be shown by—
 - (1) Designing the components to minimize the effect of a strike ; or
 - (2) Incorporating acceptable means of diverting the resulting electrical current so as not to endanger the rotorcraft.
- (d) [The electrical bonding and protection against lightning and static electricity must—
 - (1) Minimize the accumulation of electrostatic charge ;
 - (2) Minimize the risk of electric shock to crew, passengers, and service and maintenance personnel using normal precautions ;
 - (3) Provide an electrical return path, under both normal and fault conditions, on rotorcraft having grounded electrical systems ; and
 - (4) Reduce to an acceptable level the effects of lightning and static electricity on the functioning of essential electrical and electronic equipment.]

Amdt. 27-37, Eff. 10/18/99

FAR 27.611 : Inspection provisions

There must be means to allow the close examination of each part that requires—

- (a) Recurring inspection ;
- (b) Adjustment for proper alignment and functioning ; or
- (c) Lubrication.

- (b) *Emergency pumps.* There must be an emergency pump immediately available to supply fuel to the engine if any main pump (other than a fuel injection pump approved as part of the engine) fails. The power supply for each emergency pump must be independent of the power supply for each corresponding main pump.

- (c) *Warning means.* If both the [main] pump and emergency pump operate continuously, there must be a means to indicate to the appropriate flight crewmembers a malfunction of either pump.

- (d) Operation of any fuel pump may not affect engine operation so as to create a hazard, regardless of the engine power or thrust setting or the functional status of any other fuel pump.

Amdt. 23-43, Eff. 05/10/93

FAR 23.993 : Fuel system lines and fittings.

- (a) Each fuel line must be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure and accelerated flight conditions.
- (b) Each fuel line connected to components of the airplane between which relative motion could exist must have provisions for flexibility.
- (c) Each flexible connection in fuel lines that may be under pressure and subjected to axial loading must use flexible hose assemblies.
- (d) [Each flexible hose must be shown to be suitable for the particular application.]
- (e) No flexible hose that might be adversely affected by exposure to high temperatures may be used where excessive temperatures will exist during operation or after engine shutdown.

Amdt. 23-43, Eff. 05/10/93

FAR 23.994 : Fuel system components.

[Fuel system components in an engine nacelle or in the fuselage must be protected from damage which could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway.]

Amdt. 23-29, Eff. 03/26/84

FAR 23.995 : Fuel valves and controls.

- (a) There must be a means to allow appropriate flight crew members to rapidly shut off, in flight, the fuel to each engine individually.
- (b) No shutoff valve may be on the engine side of any firewall. In addition, there must be means to—
 - (1) Guard against inadvertent operation of each shutoff valve ; and
 - (2) Allow appropriate flight crew members to reopen each valve rapidly after it has been closed.
- (c) Each valve and fuel system control must be supported so that loads resulting from its operation or from accelerated flight conditions are not transmitted to the lines connected to the valve.
- (d) Each valve and fuel system control must be installed so that gravity and vibration will not affect the selected position.

- (e) Each fuel valve handle and its connections to the valve mechanism must have design features that minimize the possibility of incorrect installation.
- (f) Each check valve must be constructed, or otherwise incorporate provisions, to preclude incorrect assembly or connection of the valve.
- (5) [Fuel tank selector valves must—
- (1) Require a separate and distinct action to place the selector in the "OFF" position ; and

- (2) Have the tank selector positions located in such a manner that it is impossible for the selector to pass through the "OFF" position when changing from one tank to another.]

Amdt. 23-29, Eff. 03/26/84

FAR 23.997 : Fuel strainer or filter.

There must be a fuel strainer or filter between the fuel tank outlet and the inlet of either the fuel metering device or an engine driven positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must—

- (a) Be accessible for draining and cleaning and must incorporate a screen or element which is easily removable;
- (b) Have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes;
- (c) Be mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter itself, unless adequate strength margins under all loading conditions are provided in the lines and connections; and
- (d) Have the capacity (with respect to operating limitations established for the engine) to ensure that engine fuel system functioning is not impaired, with the fuel contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine [during its type certification.]
- (e) In addition, for commuter category airplanes, unless means are provided in the fuel system to prevent the accumulation of ice on the filter, a means must be provided to automatically maintain the fuel flow if ice clogging of the filter occurs.

Amdt. 23-43, Eff. 05/10/93

FAR 23.999 : Fuel system drains.

- (a) There must be at least one drain to allow safe drainage of the entire fuel system with the airplane in its normal ground attitude.
- (b) Each drain required by paragraph (a) of this section and Sec. 23.971 must—
- (1) Discharge clear of all parts of the airplane;
- (2) [Have a drain valve—
- (i) That has manual or automatic means for positive locking in the closed position;
- (ii) That is readily accessible;
- (iii) That can be easily opened and closed;
- (iv) That allows the fuel to be caught for examination;

64.1 General

FAR 27.601 : Design

- (a) The rotorcraft may have no design features or details that experience has shown to be hazardous or unreliable.
- (b) The suitability of each questionable design detail and part must be established by tests.

FAR 27.602 : [Critical parts]

- (a) [Critical part. A critical part is a part, the failure of which could have a catastrophic effect upon the rotorcraft, and for which critical characteristics have been identified which must be controlled to ensure the required level of integrity.
- (b) If the type design includes critical parts, a critical parts list shall be established. Procedures shall be established to define the critical design characteristics, identify processes that affect those characteristics, and identify the design change and process change controls necessary for showing compliance with the quality assurance requirements of part 21 of this chapter.]

Amdt. 27-38, Eff. 10/25/99

FAR 27.603 : Materials

The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must—

- (a) [Be established on the basis of experience or tests;
- (b) Meet approved specifications that ensure their having the strength and other properties assumed in the design data ; and
- (c) Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.]

Amdt. 27-16, Eff. 12/1/78

FAR 27.605 : Fabrication methods

- [(a)] The methods of fabrication used must produce consistently sound structures. If a fabrication process (such as gluing, spot welding, or heat-treating) requires close control to reach this objective, the process must be performed according to an approved process specification.

- (b) [Each new aircraft fabrication method must be substantiated by a test program.]

Amdt. 27-16, Eff. 12/1/78

FAR 27.607 : [Fasteners.]

- (a) [Each removable bolt, screw, nut, pin, or other fastener whose loss could jeopardize the safe operation of the rotorcraft must incorporate two separate locking devices. The fastener and its locking devices may not be adversely affected by the environmental conditions associated with the particular installation.
- (b) No self-locking nut may be used on any bolt subject to rotation in operation unless a nonfriction locking device is used in addition to the self-locking device.]

Amdt. 27-4, Eff. 10/27/68

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- (v) That can be observed for proper closing; and
- (vi) That is either located or protected to prevent fuel spillage in the event of a landing with landing gear retracted.]]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1001 : Fuel jettisoning system.

- (a) If the design landing weight is less than that permitted under the requirements of Sec. 23.473(b), the airplane must have a fuel jettisoning system installed that is able to jettison enough fuel to bring the maximum weight down to the design landing weight. The average rate of fuel jettisoning must be at least 1 percent of the maximum weight per minute, except that the time required to jettison the fuel need not be less than 10 minutes.
- (b) Fuel jettisoning must be demonstrated at maximum weight with flaps and landing gear up and in—
- (1) A power-off glide at $1.4 V_{S1}$;
 - (2) [A climb, at the speed at which the one-engine-inoperative enroute climb data have been established in accordance with Sec. 23.69(b), with the critical engine inoperative and the remaining engines at maximum continuous power; and]
 - (3) Level flight at $1.4 V_{S1}$, if the results of the tests in the conditions specified in paragraphs (b)(1) and (2) of this section show that this condition could be critical.
- (c) During the flight tests prescribed in paragraph (b) of this section, it must be shown that—
- (1) The fuel jettisoning system and its operation are free from fire hazard ;
 - (2) The fuel discharges clear of any part of the airplane;
 - (3) Fuel or fumes do not enter any parts of the airplane; and
 - (4) The jettisoning operation does not adversely affect the controllability of the airplane.
- (d) For reciprocating engine powered airplanes, the jettisoning system must be designed so that it is not possible to jettison the fuel in the tanks used for takeoff and landing below the level allowing 45 minutes flight at 75 percent maximum continuous power. However, if there is an auxiliary control independent of the main jettisoning control, the system may be designed to jettison all the fuel.
- (e) For turbine engine powered airplanes, the jettisoning system must be designed so that it is not possible to jettison fuel in the tanks used for takeoff and landing below the level allowing from sea level to 10,000 feet and thereafter allowing 45 minutes cruise at a speed for maximum range.
- (f) The fuel jettisoning valve must be designed to allow flight crewmembers to close the valve during any part of the jettisoning operation.
- (g) Unless it is shown that using any means (including flaps, slots, and slats) for changing the airflow across or around the wings does not adversely affect fuel jettisoning, there must be a placard, adjacent to the jettisoning control, to warn flight crewmembers against jettisoning fuel while the means that change the airflow are being used.

- (h) The fuel jettisoning system must be designed so that any reasonable probable single malfunction in the system will not result in a hazardous condition due to unsymmetrical jettisoning of, or inability to jettison, fuel.

Amdt. 23-51, Eff. 03/11/96

32.4 Oil System

FAR 23.1011 : General.

- (a) [For oil systems and components that have been approved under the engine airworthiness requirements and where those requirements are equal to or more severe than the corresponding requirements of subpart E of this part, that approval need not be duplicated. Where the requirements of subpart E of this part are more severe, substantiation must be shown to the requirements of subpart E of this part.]
- (b) Each engine must have an independent oil system that can supply it with an appropriate quantity of oil at a temperature not above that safe for continuous operation.
- (c) The usable oil tank capacity may not be less than the product of the endurance of the airplane under critical operating conditions and the maximum oil consumption of the engine under the same conditions, plus a suitable margin to ensure adequate circulation and cooling.
- (d) For an oil system without an oil transfer system, only the usable oil tank capacity may be considered. The amount of oil in the engine oil lines, the oil radiator, and the feathering reserve, may not be considered.
- (e) If an oil transfer system is used, and the transfer pump can pump some of the oil in the transfer lines into the main engine oil tanks, the amount of oil in these lines that can be pumped by the transfer pump may be included in the oil capacity.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1013 : Oil tanks.

- (a) *Installation.* Each oil tank must be installed to—
- (1) Meet the requirements of Sec. 23.967 (a) and (b) ; and
- (2) Withstand any vibration, inertia, and fluid loads expected in operation.
- (b) *Expansion space.* Oil tank expansion space must be provided so that—
- (1) Each oil tank used with a reciprocating engine has an expansion space of not less than the greater of 10 percent of the tank capacity or 0.5 gallon, and each oil tank used with a turbine engine has an expansion space of not less than 10 percent of the tank capacity; and
- (2) It is impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.
- (c) *Filter connection.* Each oil tank filter connection must be marked as specified in Sec. 23.1557 (c). Each recessed oil tank filter connection of an oil tank used with a turbine engine, that can retain any appreciable quantity of oil, must have provisions for fitting a drain.
- (d) *Vent.* Oil tanks must be vented as follows :

Chapitre 64

Subpart D : Design and Construction

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- (1) [Each oil tank must be vented to the engine from the top part of the expansion space so that the vent connection is not covered by oil under any normal flight condition.]
- (2) Oil tank vents must be arranged so that condensed water vapor that might freeze and obstruct the line cannot accumulate at any point.
- (3) For acrobatic category airplanes, there must be means to prevent hazardous loss of oil during acrobatic maneuvers, including short periods of inverted flight.
- (e) *Outlet.* No oil tank outlet may be enclosed by any screen or guard that would reduce the flow of oil below a safe value at any operating temperature. No oil tank outlet diameter may be less than the diameter of the engine oil pump inlet. Each oil tank used with a turbine engine must have means to prevent entrance into the tank itself, or into the tank outlet, of any object that might obstruct the flow of oil through the system. There must be a shutoff valve at the outlet of each oil tank used with a turbine engine, unless the external portion of the oil system (including oil tank supports) is fireproof.
- (f) *Flexible liners.* Each flexible oil tank liner must be of an acceptable kind.
- (g) Each oil tank filler cap of an oil tank that is used with an engine must provide an oil-tight seal.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1015 : Oil tank tests.

Each oil tank must be tested under Sec. 23.965, except that—

- (a) The applied pressure must be five p.s.i. for the tank construction instead of the pressures specified in Sec. 23.965(a) ;
- (b) For a tank with a nonmetallic liner the test fluid must be oil rather than fuel as specified in Sec. 23.965(d), and the slosh test on a specimen liner must be conducted with the oil at 250° F. ; [and
- (c) For pressurized tanks used with a turbine engine, the test pressure may not be less than 5 p.s.i. plus the maximum operating pressure of the tank.]

Amdt. 23-15, Eff. 10/31/74

FAR 23.1017 : Oil lines and fittings.

- (a) *Oil lines.* Oil lines must meet Sec. 23.993 and must accommodate a flow of oil at a rate and pressure adequate for proper engine functioning under any normal operating condition.

- (b) *Breather lines.* Breather lines must be arranged so that—

- (1) [Condensed water vapor or oil that might freeze and obstruct the line cannot accumulate at any point ;]
- (2) The breather discharge will not constitute a fire hazard if foaming occurs, or cause emitted oil to strike the pilot's windshield ;
- (3) The breather does not discharge into the engine air induction system ; and
- (4) For acrobatic category airplanes, there is no excessive loss of oil from the breather during acrobatic maneuvers, including short periods of inverted flight.
- (5) [The breather outlet is protected against blockage by ice or foreign matter.]

Amdt. 23-14, Eff. 12/20/73

FAR 23.1019 : Oil strainer or filter.

- (a) Each turbine engine installation must incorporate an oil strainer or filter through which all of the engine oil flows and which meets the following requirements :
 - (1) Each oil strainer or filter that has a bypass, must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter completely blocked.
 - (2) The oil strainer or filter must have the capacity (with respect to operating limitations established for the engine) to ensure that engine oil system functioning is not impaired when the oil is contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine [for its type certification.
 - (3) The oil strainer or filter, unless it is installed at an oil tank outlet, must incorporate a means to indicate contamination before it reaches the capacity established in accordance with paragraph (a)(2) of this section.
 - (4) The bypass of a strainer or filter must be constructed and installed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.
 - (5) An oil strainer or filter that has no bypass, except one that is installed at an oil tank outlet, must have a means to connect it to the warning system required in [Sec. 23.1305(c)(9).]
 - (b) Each oil strainer or filter in a powerplant installation using reciprocating engines must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.
- Amdt. 23-43, Eff. 05/10/93

FAR 23.1021 : Oil system drains.

- A drain [or drains] must be provided to allow safe drainage of the oil system. Each drain must—
- (a) [Be accessible ;
 - (b) Have drain valves, or other closures, employing manual or automatic shut-off means for positive locking in the closed position ; and
 - (c) Be located or protected to prevent inadvertent operation.]
- Amdt. 23-43, Eff. 05/10/93

FAR 23.1023 : Oil radiators.

Each oil radiator and its supporting structures must be able to withstand the vibration, inertia, and oil pressure loads to which it would be subjected in operation.

FAR 23.1027 : Propeller feathering system.

- (a) [If the propeller feathering system uses engine oil and that oil supply can become depleted due to failure of any part of the oil system, a means must be incorporated to reserve enough oil to operate the feathering system.
- (b) The amount of reserved oil must be enough to accomplish feathering and must be available only to the feathering pump.

- (2) The locations of probable failure must be determined.
 - (3) Inflight measurement must be included in determining the following :
 - (i) Loads or stresses in all critical conditions throughout the range of limitations in Sec. 27.309, except that maneuvering load factors need not exceed the maximum values expected in operation.
 - (ii) The effect of altitude upon these loads or stresses.
 - (4) [The loading spectra must be as severe as those expected in operation including, but not limited to, external cargo operations, if applicable, and ground-air-ground cycles. The loading spectra must be based on loads or stresses determined under paragraph (a)(3) of this section.]
 - (b) *Fatigue tolerance evaluation.* It must be shown that the fatigue tolerance of the structure ensures that the probability of catastrophic fatigue failure is extremely remote without establishing replacement times, inspection intervals or other procedures under Sec. A27.4 of Appendix A.
 - (c) *Replacement time evaluation.* It must be shown that the probability of catastrophic fatigue failure is extremely remote within a replacement time furnished under Sec. A27.4 of Appendix A.
 - (d) *Failure evaluation.* The following apply to failure evaluation :
 - (1) It must be shown that all partial failures will become readily detectable under inspection procedures furnished under A27.4 of Appendix A.
 - (2) The interval between the time when any partial failure becomes readily detectable under paragraph (d)(1) of this section, and the time when any such failure is expected to reduce the remaining strength of the structure to limit or maximum attainable loads (whichever is less), must be determined.
 - (3) It must be shown that the interval determined under paragraph (d)(2) of this section is long enough, in relation to the inspection intervals and related procedures furnished under A27.4 of Appendix A, to provide a probability of detection great enough to ensure that the probability of catastrophic failure is extremely remote.
 - (e) *Combination of replacement time and failure evaluations.* A component may be evaluated under a combination of paragraphs (c) and (d) of this section. For such component it must be shown that the probability of catastrophic failure is extremely remote with an approved combination of replacement time, inspection intervals, and related procedures furnished under A27.4 of Appendix A.
- Amdt. 27-26, Eff. 4/5/90

FAR 27.563 : Structural ditching provisions

[If certification with ditching provisions is requested, structural strength for ditching must meet the requirements of this section and Sec. 27.801(e).]

- (a) *Forward speed landing conditions.* The rotorcraft must initially contact the most critical wave for reasonably probable water conditions at forward velocities from zero up to 30 knots in likely pitch, roll, and yaw attitudes. The rotorcraft limit vertical descent velocity may not be less than 5 feet per second relative to the mean water surface. Rotor lift may be used to act through the center of gravity throughout the landing impact. This lift may not exceed two-thirds of the design maximum weight. A maximum forward velocity of less than 30 knots may be used in design if it can be demonstrated that the forward velocity selected would not be exceeded in a normal one-engine-out touchdown.

- (b) *Auxiliary or emergency float conditions.*

(1) *Floats fired or deployed before initial water contact.* In addition to the landing loads in paragraph (a) of this section, each auxiliary or emergency float, or its support and attaching structure in the airframe or fuselage, must be designed for the load developed by a fully immersed float unless it can be shown that full immersion is unlikely. If full immersion is unlikely, the highest likely float buoyancy load must be applied. The highest likely buoyancy load must include consideration of a partially immersed float creating restoring moments to compensate the upsetting moments caused by side wind, unsymmetrical rotorcraft loading, water wave action, rotorcraft inertia, and probable structural damage and leakage considered under Sec. 27.801(d). Maximum roll and pitch angles determined from compliance with Sec. 27.801(d) may be used, if significant, to determine the extent of immersion of each float. If the floats are deployed in flight, appropriate air loads derived from the flight limitations with the floats deployed shall be used in substantiation of the floats and their attachment to the rotorcraft. For this purpose, the design airspeed for limit load is the float deployed airspeed operating limit multiplied by 1.11.

(2) *Floats deployed after initial water contact.* Each float must be designed for full or partial immersion prescribed in paragraph (b)(1) of this section. In addition, each float must be designed for combined vertical and drag loads using a relative limit speed of 20 knots between the rotorcraft and the water. The vertical load may not be less than the highest likely buoyancy load determined under paragraph (b)(1) of this section.]

Amdt. 27-26, Eff. 4/5/90

63.8 Fatigue Evaluation**FAR 27.571 : Fatigue evaluation of flight structure**

- (a) [General. Each portion of the flight structure (the flight structure includes rotors, rotor drive systems between the engines and the rotor hubs, controls, fuselage, landing gear, and their related primary attachments), the failure of which could be catastrophic, must be identified and must be evaluated under paragraph (b), (c), (d), or (e) of this section. The following apply to each fatigue evaluation :]

- (1) The procedure for the evaluation must be approved.

- (c) The ability of the system to accomplish feathering with the reserved oil must be shown.]

- (d) Provision must be made to prevent sludge or other foreign matter from affecting the safe operation of the propeller feathering system.

Amdt. 23-43, Eff. 05/10/93

32.5 Cooling**FAR 23.1041 : General.**

The powerplant and auxiliary power unit cooling provisions must maintain the temperatures of powerplant components and engine fluids, and auxiliary power unit components and fluids within the limits established for those components and fluids under the most adverse ground, water, and flight operations to the maximum altitude [and maximum ambient atmospheric temperature conditions for which approval is requested, and after normal engine and auxiliary power unit shutdown.]

Amdt. 23-51, Eff. 03/11/96

FAR 23.1043 : Cooling tests.

- (a) [General. Compliance with Sec. 23.1041 must be shown on the basis of tests, for which the following apply :

(1) If the tests are conducted under ambient atmospheric temperature conditions deviating from the maximum for which approval is requested, the recorded powerplant temperatures must be corrected under paragraphs (c) and (d) of this section, unless a more rational correction method is applicable.

(2) No corrected temperature determined under paragraph (a)(1) of this section may exceed established limits.

(3) The fuel used during the cooling tests must be of the minimum grade approved for the engine.

(4) For turbocharged engines, each turbocharger must be operated through that part of the climb profile for which operation with the turbocharger is requested.

(5) For a reciprocating engine, the mixture settings must be the leanest recommended for climb.]

- (b) *Maximum ambient atmospheric temperature.* A maximum ambient atmospheric temperature corresponding to sea level conditions of at least 100° F. must be established. The assumed temperature lapse rate is 3.6° F per thousand feet of altitude above sea level until a temperature of -69.7° F. is reached, above which altitude the temperature is considered constant at -69.7° F. However, for winterization installations, the applicant may select a maximum ambient atmospheric temperature corresponding to sea level conditions of less than 100° F.

- (c) [Correction factor (except for cylinder barrels).] Temperatures of engine fluids and powerplant components (except cylinder barrels) for which temperature limits are established, must be corrected by adding to them the difference between the maximum ambient atmospheric temperature for the relevant altitude for which approval has been requested and the temperature of the ambient air at the time of the first

occurrence of the maximum fluid or component temperature recorded during the cooling test.

- (d) *Correction factor for cylinder barrel temperatures.* Cylinder barrel temperatures must be corrected by adding to them 0.7 times the difference between the maximum ambient atmospheric temperature for the relevant altitude for which approval has been requested and the temperature of the ambient air at the time of the first occurrence of the maximum cylinder barrel temperature recorded during the cooling test.]

Amdt. 23-51, Eff. 03/11/96

FAR 23.1045 : Cooling test procedures for turbine engine powered airplanes.

- (a) [Compliance with Sec. 23.1041 must be shown for all phases of operation. The airplane must be flown in the configurations, at the speeds, and following the procedures recommended in the Airplane Flight Manual for the relevant stage of flight, that correspond to the applicable performance requirements that are critical to cooling.]
- (b) Temperatures must be stabilized under the conditions from which entry is made into each stage of flight being investigated, unless the entry condition normally is not one during which component and engine fluid temperatures would stabilize (in which case, operation through the full entry condition must be conducted before entry into the stage of flight being investigated in order to allow temperatures to reach their natural levels at the time of entry). The takeoff cooling test must be preceded by a period during which the powerplant component and engine fluid temperatures are stabilized with the engines at ground idle.
- (c) Cooling tests for each stage of flight must be continued until—
- (1) The component and engine fluid temperatures stabilize;
 - (2) The stage of flight is completed; or
 - (3) An operating limitation is reached.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1047 : Cooling test procedures for reciprocating engine powered airplanes.

[Compliance with Sec. 23.1041 must be shown for the climb (or, for multienGINE airplanes with negative one-engine-inoperative rates of climb, the descent) stage of flight. The airplane must be flown in the configurations, at the speeds and following the procedures recommended in the Airplane Flight Manual, that correspond to the applicable performance requirements that are critical to cooling.]

Amdt. 23-51, Eff. 03/11/96

32.6 Liquid Cooling

FAR 23.1061 : Installation.

- (a) *General.* Each liquid-cooled engine must have an independent cooling system (including coolant tank) installed so that—

- (1) A change in downward velocity of not less than 30 feet per second when the seat or other seating device is oriented in its nominal position with respect to the rotorcraft's reference system, the rotorcraft's longitudinal axis is curved upward 60° with respect to the impact velocity vector, and the rotorcraft's lateral axis is perpendicular to a vertical plane containing the impact velocity vector, and the rotorcraft's longitudinal axis. Peak floor deceleration must occur in not more than 0.031 seconds after impact and must reach a minimum of 30g's.

- (2) A change in forward velocity of not less than 42 feet per second when the seat or other seating device is oriented in its nominal position with respect to the rotorcraft's reference system, the rotorcraft's longitudinal axis is yawed 10° either right or left of the impact velocity vector (whichever would cause the greatest load on the shoulder harness), the rotorcraft's lateral axis is contained in a horizontal plane containing the impact velocity vector, and the rotorcraft's vertical axis is perpendicular to a horizontal plane containing the impact velocity vector. Peak floor deceleration must occur in not more than 0.071 seconds after impact and must reach a minimum of 18.4g's.

- (3) Where floor rails or floor or sidewall floor attachment devices are used to attach the seating devices to the airframe structure for the conditions of this section, the rails or devices must be misaligned with respect to each other by at least 10° vertically (i.e., pitch out of parallel) and by at least a 10° lateral roll, with the directions optional, to account for possible floor warp.

- (c) Compliance with the following must be shown :

- (1) The seating device system must remain intact although it may experience separation intended as part of its design.
- (2) The attachment between the seating device and the airframe structure must remain intact, although the structure may have exceeded its limit load.
- (3) The ATD's shoulder harness strap or straps must remain on or in the immediate vicinity of the ATD's shoulder during the impact.
- (4) The safety belt must remain on the ATD's pelvis during the impact.
- (5) The ATD's head either does not contact any portion of the crew or passenger compartment, or if contact is made, the head impact does not exceed a head injury criteria (HIC) of 1,000 as determined by this equation.

$$HIC = (t_2 - t_1) \left(\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t) dt \right)^{2.5}$$

Where : $a(t)$ is the resultant acceleration at the center of gravity of the head form expressed as a multiple of g (the acceleration of gravity) and $t_2 - t_1$ is the time duration, in seconds, of major head impact, not to exceed 0.05 seconds.

- (6) Loads in individual shoulder harness straps must not exceed 1,750 pounds. If dual straps are used for retaining the upper torso, the total harness strap loads must not exceed 2,000 pounds.
- (7) The maximum compressive load measured between the pelvis and the lumbar column of the ATD must not exceed 1,500 pounds.

- (d) An alternate approach that achieves an equivalent or greater level of occupant protection, as required by this section, must be substantiated on a rational basis.]

Amdt. 27-25, Eff. 12/13/89

- (3) Each occupant and each item of mass inside the cabin that could injure an occupant is restrained when subjected to the following ultimate inertial load factors relative to the surrounding structure :

- (i) Upward-4g.
- (ii) Forward-16g.
- (iii) Sideward-8g.
- (iv) Downward-20g, after the intended displacement of the seat device.
- (v) [Rearward-1.5g.]

- (c) The supporting structure must be designed to restrain, under any ultimate inertial load up to those specified in this paragraph, any item of mass above and/or behind the crew and passenger compartment that could injure an occupant if it came loose in an emergency landing. Items of mass to be considered include, but are not limited to, rotors, transmissions, and engines. The items of mass must be restrained for the following ultimate inertial load factors :

- (1) Upward-1.5g.
- (2) Forward-[12g.]
- (3) Sideward-[6g.]
- (4) Downward-[12g.]
- (5) Rearward-1.5g.]

- (d) Any fuselage structure in the area of internal fuel tanks below the passenger floor level must be designed to resist the following ultimate inertial factors and loads and to protect the fuel tanks from rupture when those loads are applied to that area :

- (i) Upward-1.5g.
- (ii) Forward-4.0g.
- (iii) Sideward-2.0g.
- (iv) Downward-4.0g.

Amdt. 27-32, Eff. 6/11/96

FAR 27.562 : [Emergency landing dynamic conditions.]

- (a) [The rotorcraft, although it may be damaged in an emergency crash landing, must be designed to reasonably protect each occupant when—
- (1) The occupant properly uses the seats, safety belts, and shoulder harnesses provided in the design; and
 - (2) The occupant is exposed to the loads resulting from the conditions prescribed in this section.

- (b) Each seat type design or other seating device approved for crew or passenger occupancy during takeoff and landing must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests of a similar type seat in accordance with the following criteria. The tests must be conducted with an occupant, simulated by a 170-pound anthropomorphic test dummy (ATD), as defined by 49 CFR 572, Subpart B, or its equivalent, sitting in the normal upright position.

- (1) Each coolant tank is supported so that tank loads are distributed over a large part of the tank surface ;
- (2) [There are pads or other isolation means between the tank and its supports to prevent chafing ;
- (3) Pads or any other isolation means that is used must be nonabsorbent or must be treated to prevent absorption of flammable fluids ; and
- (4) No air or vapor can be trapped in any part of the system, except the coolant tank expansion space, during filling or during operation.]
- (b) *Coolant tank.* The tank capacity must be at least one gallon, plus 10 percent of the cooling system capacity. In addition—
 - (1) Each coolant tank must be able to withstand the vibration, inertia, and fluid loads to which it may be subjected in operation ;
 - (2) Each coolant tank must have an expansion space of at least 10 percent of the total cooling system capacity ; and
 - (3) It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.
- (c) *Filler connection.* Each coolant tank filler connection must be marked as specified in Sec. 23.1557(c). In addition—
 - (1) Spilled coolant must be prevented from entering the coolant tank compartment or any part of the airplane other than the tank itself ; and
 - (2) Each recessed coolant filler connection must have a drain that discharges clear of the entire airplane.

- (d) *Lines and fittings.* Each coolant system line and fitting must meet the requirements of Sec. 23.993, except that the inside diameter of the engine coolant inlet and outlet lines may not be less than the diameter of the corresponding engine inlet and outlet connections.

- (e) *Radiators.* Each coolant radiator must be able to withstand any vibration, inertia, and coolant pressure load to which it may normally be subjected. In addition—

- (1) Each radiator must be supported to allow expansion due to operating temperatures and prevent the transmittal of harmful vibration to the radiator ; and
- (2) If flammable coolant is used, the air intake duct to the coolant radiator must be located so that (in case of fire) flames from the nacelle cannot strike the radiator.

- (f) *Drains.* There must be an accessible drain that—

- (1) Drains the entire cooling system (including the coolant tank, radiator, and the engine) when the airplane is in the normal ground attitude ;
- (2) Discharges clear of the entire airplane ; and
- (3) Has means to positively lock it closed.

Amdt. 23-43, Eff. 05/10/93

FAR 23.1063 : Coolant tank tests.

Each coolant tank must be tested under Sec. 23.965, except that—

- (a) The test required by Sec. 23.965(a) (1) must be replaced with a similar test using the sum of the pressure developed during the maximum ultimate acceleration with a full tank or a pressure of 3.5 pounds per square inch, whichever is greater, plus the maximum working pressure of the system; and
- (b) For a tank with a nonmetallic liner the test fluid must be coolant rather than fuel as specified in Sec. 23.965(d), and the slosh test on a specimen liner must be conducted with the coolant at operating temperature.

32.7 Induction System**FAR 23.1091 : Air induction system.**

- (a) The air induction system for each engine and auxiliary power unit and their accessories must supply the air required by that engine and auxiliary power unit and their accessories under the operating conditions for which certification is requested.
- (b) Each reciprocating engine installation must have at least two separate air intake sources, and must meet the following :
 - (1) Primary air intakes may open within the cowlings if that part of the cowlings is isolated from the engine accessory section by a fire-resistant diaphragm or if there are means to prevent the emergence of backfire flames.
 - (2) Each alternate air intake must be located in a sheltered position and may not open within the cowlings if the emergence of backfire flames will result in a hazard.
 - (3) The supplying of air to the engine through the alternate air intake system may not result in a loss of excessive power in addition to the power loss due to the rise in air temperature.
 - (4) Each automatic alternate air door must have an override means accessible to the flight crew.
 - (5) Each automatic alternate air door must have a means to indicate to the flight crew when it is not closed.
- (c) For turbine engine powered airplanes—
 - (1) There must be means to prevent hazardous quantities of fuel leakage or overflow from drains, vents, or other components of flammable fluid systems from entering the engine intake system ; and
 - (2) [The airplane must be designed to prevent water or slush on the runway, taxiway, or other airport operating surfaces from being directed into the engine or auxiliary power unit air intake ducts in hazardous quantities. The air intake ducts must be located or protected so as to minimize the hazard of ingestion of foreign matter during takeoff, landing, and taxiing.]

Amdt. 23-51, Eff. 03/11/96

[(c)] The main rotor structure must be designed to withstand the loads simulating—

- (1) For the rotor blades, hubs, and flapping hinges, the impact force of each blade against its stop during ground operation ; and
 - (2) Any other critical condition expected in normal operation.
- [(d)] The main rotor structure must be designed to withstand the limit torque at any rotational speed, including zero. In addition :

- (1) The limit torque need not be greater than the torque defined by a torque limiting device (where provided), and may not be less than the greater of—
 - (i) The maximum torque likely to be transmitted to the rotor structure in either direction ; and
 - (ii) The limit engine torque specified in Sec. 27.361.
- (2) The limit torque must be distributed to the rotor blades in a rational manner.

Amdt. 27-3, Eff. 10/17/68

FAR 27.549 : Fuselage, landing gear, and rotor pylon structures

- (a) Each fuselage, landing gear, and rotor pylon structure must be designed as prescribed in this section. Resultant rotor forces may be represented as a single force applied at the rotor hub attachment point.
- (b) Each structure must be designed to withstand—
 - (1) The critical loads prescribed in Secs. 27.337 through 27.341 ;
 - (2) The applicable ground loads prescribed in Secs. 27.235, 27.471 through 27.485, 27.493, 27.497, 27.501, 27.505, and 27.521 ; and
 - (3) The loads prescribed in Sec. 27.547 (d)(2) and (e).
- (c) Auxiliary rotor thrust, and the balancing air and inertia loads occurring under accelerated flight conditions, must be considered.
- (d) Each engine mount and adjacent fuselage structure must be designed to withstand the loads occurring under accelerated flight and landing conditions, including engine torque.
- (e) [Deleted.]

Amdt. 27-3, Eff. 10/17/68

63.7 Emergency Landing Conditions**FAR 27.561 : General**

- (a) The rotorcraft, although it may be damaged in emergency landing conditions on land or water, must be designed as prescribed in this section to protect the occupants under those conditions.
- (b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a crash landing when—
 - (1) Proper use is made of seats, belts, and other safety design provisions ;
 - (2) The wheels are retracted (where applicable) ; and

FAR 27.505 : Ski landing conditions

If certification for ski operation is requested, the rotorcraft, with skis, must be designed to withstand the following loading conditions (where P is the maximum static weight on each ski with the rotorcraft at design maximum weight, and n_{z-d} is the limit load factor determined under Sec. 27.473(b)).

- (a) Up-load conditions in which—
 - (1) A vertical load of $P n_{z-d}$ and a horizontal load of $\frac{P n_{z-d}}{4}$ are simultaneously applied at the pedestal bearings; and
 - (2) A vertical load of $1.33 P$ is applied at the pedestal bearings.
- (b) A side-load condition in which a side load of $0.35 P n_{z-d}$ is applied at the pedestal bearings in a horizontal plane perpendicular to the centerline of the rotorcraft.
- (c) A torque-load condition in which a torque load of $1.33 P$ (in foot pounds) is applied to the ski about the vertical axis through the centerline of the pedestal bearings.

63.5 Water Loads**FAR 27.521 : Float landing conditions**

If certification for float operation is requested, the rotorcraft, with floats, must be designed to withstand the following loading conditions (where the limit load factor is determined under Sec. 27.473(b) or assumed to be equal to that determined for wheel landing gear) :

- (a) Up-load conditions in which—
 - (1) A load is applied so that, with the rotorcraft in the static level attitude, the resultant water reaction passes vertically through the center of gravity; and
 - (2) The vertical load prescribed in subparagraph (1) of this paragraph is applied simultaneously with an aft component of 0.25 times the vertical component.
- (b) A side-load condition in which—
 - (1) A vertical load of 0.75 times the total vertical load specified in paragraph (a)(1) of this section is divided equally among the floats; and
 - (2) For each float, the load share determined under subparagraph (1) of this paragraph, combined with a total side load of 0.25 times the total vertical load specified in subparagraph (1) of this paragraph, is applied to that float only.

63.6 Main Component Requirements**FAR 27.547 : Main rotor structure**

- (a) Each main rotor assembly (including rotor hubs and blades) must be designed as prescribed in this section.
- [(b)] The main rotor structure must be designed to withstand the following loads prescribed in Secs. 27.337 and 27.341 :
 - (1) Critical flight loads.
 - (2) Limit loads occurring under normal conditions of autorotation. For this condition, the rotor r.p.m. must be selected to include the effects of altitude.

FAR 23.1093 : Induction system icing protection.

(a) *Reciprocating engines.* Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of 30° F.—

- (1) Each airplane with sea level engines using conventional venturi carburetors has a preheater that can provide a heat rise of 90° F. with the engines at 75 percent of maximum continuous power ;
- (2) Each airplane with altitude engines using conventional venturi carburetors has a preheater that can provide a heat rise of 120° F. with the engines at 75 percent of maximum continuous power ;
- (3) Each airplane with altitude engines using fuel metering device tending to prevent icing has a preheater that, with the engines at 60 percent of maximum continuous power, can provide a heat rise of—
 - (i) 100° F.; or
 - (ii) 40° F., if a fluid deicing system meeting the requirements of Secs. 23.1095 through 23.1099 is installed ;
- (4) Each airplane with a sea level engine(s) using a fuel metering device tending to prevent icing has a sheltered alternate source of air with a preheat of not less than 60° F. with the engines at 75 percent of maximum continuous power ;
- (5) Each airplane with sea level or altitude engine(s) using fuel injection systems having metering component on which impact ice may accumulate has a preheater capable of providing a heat rise of 75° F. with the engine is operating at 75 percent of its maximum continuous power ; and
- (6) Each airplane with sea level or altitude engine(s) using fuel injection systems not having fuel metering components projecting into the airstream on which ice may form, and introducing fuel into the air induction system downstream of any components or other obstruction on which ice produced by fuel evaporation may form, has a sheltered alternate source of air with a preheat of not less than 60° F. with the engines at 75 percent of maximum continuous power.

(b) Turbine engines.

- (1) Each turbine engine and its air inlet system must operate throughout the flight power range of the engine (including idling), without the accumulation of ice on engine or inlet system components that would adversely affect engine operation or cause a serious loss of power or thrust—
 - (i) Under the icing conditions specified in appendix C of part 25 of this chapter; and
 - (ii) In snow, both falling and blowing, within the limitations established for the airplane for such operation.
- (2) Each turbine engine must idle for 30 minutes on the ground, with the air bleed available for engine icing protection at its critical condition, without adverse effect, in an atmosphere that is at a temperature between 15° F and 30° F (between -9° and -1° C) and has a liquid water content not less than 0.3 grams per cubic meter in the form of drops having a mean effective diameter not less than 20 microns, followed by momentary operation at takeoff power or thrust. During the 30 minutes of idle operation, the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator.

- (c) [Reciprocating engines with superchargers.] For airplanes with reciprocating engines having superchargers to pressurize the air before it enters the fuel metering device, the heat rise in the air caused by that supercharging at any altitude may be utilized in determining compliance with paragraph (a) of this section if the heat rise utilized is that which will be available, automatically, for the applicable altitudes and operating condition because of supercharging.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1095 : Carburetor deicing fluid flow rate.

- (a) If a carburetor deicing fluid system is used, it must be able to simultaneously supply each engine with a rate of fluid flow, expressed in pounds per hour, of not less than 2.5 times the square root of the maximum continuous power of the engine.
- (b) The fluid must be introduced into the air induction system—
- (1) Close to, and upstream of, the carburetor; and
 - (2) So that it is equally distributed over the entire cross section of the induction system air passages.

FAR 23.1097 : Carburetor deicing fluid system capacity.

- (a) The capacity of each carburetor deicing fluid system—
- (1) May not be less than the greater of—
 - (i) That required to provide fluid at the rate specified in Sec. 23.1095 for a time equal to three percent of the maximum endurance of the airplane; or
 - (ii) 20 minutes at that flow rate; and
 - (2) Need not exceed that required for two hours of operation.
- (b) If the available preheat exceeds 50° F. but is less than 100° F., the capacity of the system may be decreased in proportion to the heat rise available in excess of 50° F.

FAR 23.1099 : Carburetor deicing fluid system detail design.

Each carburetor deicing fluid system must meet the applicable requirements for the design of a fuel system, except as specified in Secs. 23.1095 and 23.1097.

FAR 23.1101 : [Induction] air preheater design.

[Each exhaust-heated, induction air preheater must be designed and constructed to—

- (a) Ensure ventilation of the preheater when the induction air preheater is not being used during engine operation;]
 - (b) Allow inspection of the exhaust manifold parts that it surrounds; and
 - (c) Allow inspection of critical parts of the preheater itself.
- Amdt. 23-43, Eff. 05/10/93

- (c) *Drag reactions in the level landing attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of both skids, the following apply :
- (1) The vertical reactions must be combined with horizontal drag reactions of 50 percent of the vertical reaction applied at the ground.
 - (2) The resultant ground loads must equal the vertical load specified in paragraph (b) of this section.
 - (i) Equal to the vertical load specified in paragraph (b) of this section; and
 - (ii) Directed through the center of gravity.
 - (d) *Sideloads in the level landing attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of both skids, the following apply :
 - (1) The vertical ground reaction must be—
 - (i) Equal to the vertical loads obtained in the condition specified in paragraph (b) of this section; and
 - (ii) Divided equally among the skids.
 - (2) The vertical ground reactions must be combined with a horizontal sideload of 25 percent of their value.
 - (3) [The total sideload must be applied equally between the skids and along the length of the skids.]
 - (4) The unbalanced moments are assumed to be resisted by angular inertia.
 - (5) The skid gear must be investigated for—
 - (i) Inward acting sideloads; and
 - (ii) Outward acting sideloads.
 - (e) *One-skid landing loads in the level attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of one skid only, the following apply :
 - (1) The vertical load on the ground contact side must be the same as that obtained on that side in the condition specified in paragraph (b) of this section.
 - (2) The unbalanced moments are assumed to be resisted by angular inertia.
 - (f) *Special conditions.* In addition to the conditions specified in paragraphs (b) and (c) of this section, the rotorcraft must be designed for the following ground reactions :
 - (1) A ground reaction load acting up and aft at an angle of 45 degrees to the longitudinal axis of the rotorcraft. This load must be—
 - (i) Equal to 1.33 times the maximum weight;
 - (ii) Distributed symmetrically among the skids;
 - (iii) Concentrated at the forward end of the straight part of the skid tube; and
 - (iv) Applied only to the forward end of the skid tube and its attachment to the rotorcraft.
 - (2) With the rotorcraft in the level landing attitude, a vertical ground reaction load equal to one-half of the vertical load determined under paragraph (b) of this section. This load must be—
 - (i) Applied only to the skid tube and its attachment to the rotorcraft; and
 - (ii) [Distributed equally over 33.3 percent of the length between the skid tube attachments and centrally located midway between the skid tube attachments.]

Amdt. 27-26, Eff. 4/5/90

- (1) The limit vertical load must be based on a limit vertical load factor of not less than—
 - (i) 1.0, for the attitude specified in paragraph (b) of this section ; and
 - (ii) 1.33, for the attitude specified in paragraph (c) of this section.
- (2) For each wheel with brakes, a drag load must be applied, at the ground contact point, of not less than the lesser of—
 - (i) 0.8 times the vertical load ; and
 - (ii) The maximum based on limiting brake torque.
- (h) *Rear wheel turning loads in the static ground attitude.* In the static ground attitude, and with the shock absorbers and tires in their static positions, the rotorcraft must be designed for rear wheel turning loads as follows :
 - (1) A vertical ground reaction equal to the static load on the rear wheel must be combined with an equal sideload.
 - (2) The load specified in subparagraph (1) of this paragraph must be applied to the rear landing gear—
 - (i) Through the axle, if there is a swivel (the rear wheel being assumed to be swiveled 90 degrees to the longitudinal axis of the rotorcraft) ; or
 - (ii) At the ground contact point, if there is a lock, steering device or shimmy damper (the rear wheel being assumed to be in the trailing position).
- (i) Taxiing condition. The rotorcraft and its landing gear must be designed for loads that would occur when the rotorcraft is taxied over the roughest ground that may reasonably be expected in normal operation.

FAR 27.501 : Ground loading conditions : landing gear with skids

- (a) *General.* Rotorcraft with landing gear with skids must be designed for the loading conditions specified in this section. In showing compliance with this section, the following apply :
 - (1) The design maximum weight, center of gravity, and load factor must be determined under Secs. 27.471 through 27.475.
 - (2) Structural yielding of elastic spring members under limit loads is acceptable.
 - (3) Design ultimate loads for elastic spring members need not exceed those obtained in a drop test of the gear with—
 - (i) A drop height of 1.5 times that specified in Sec. 27.725 ; and
 - (ii) An assumed rotor lift of not more than 1.5 times that used in the limit drop tests prescribed in Sec. 27.725.
 - (4) Compliance with paragraphs (b) through (e) of this section must be shown with—
 - (i) The gear in its most critically deflected position for the landing condition being considered ; and
 - (ii) The ground reactions rationally distributed along the bottom of the skid tube.
- (b) *Vertical reactions in the level landing attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of both skids, the vertical reactions must be applied as prescribed in paragraph (a) of this section.

FAR 23.1103 : Induction system ducts.

- (a) Each induction system duct must have a drain to prevent the accumulation of fuel or moisture in the normal ground and flight attitudes. No drain may discharge where it will cause a fire hazard.
- (b) Each duct connected to components between which relative motion could exist must have means for flexibility.
- (c) [Each flexible induction system duct must be capable of withstanding the effects of temperature extremes, fuel, oil, water, and solvents to which it is expected to be exposed in service and maintenance without hazardous deterioration or delamination.
- (d) For reciprocating engine installations, each induction system duct must be—
 - (1) Strong enough to prevent induction system failures resulting from normal backfire conditions ; and
 - (2) Fire resistant in any compartment for which a fire extinguishing system is required.
- (e) Each inlet system duct for an auxiliary power unit must be—
 - (1) Fireproof within the auxiliary power unit compartment ;
 - (2) Fireproof for a sufficient distance upstream of the auxiliary power unit compartment to prevent hot gas reverse flow from burning through the duct and entering any other compartment of the airplane in which a hazard would be created by the entry of the hot gases ;
 - (3) Constructed of materials suitable to the environmental conditions expected in service, except in those areas requiring fireproof or fire resistant materials ; and
 - (4) Constructed of materials that will not absorb or trap hazardous quantities of flammable fluids that could be ignited by a surge or reverse-flow condition.
- (f) Induction system ducts that supply air to a cabin pressurization system must be suitably constructed of material that will not produce hazardous quantities of toxic gases or isolated to prevent hazardous quantities of toxic gases from entering the cabin during a powerplant fire.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1105 : Induction system screens.

If induction system screens are used—

- (a) [Each screen must be upstream of the carburetor or fuel injection system.]
- (b) No screen may be in any part of the induction system that is the only passage through which air can reach the engine, unless—
 - (1) The available preheat is at least 100° F. ; and
 - (2) The screen can be deiced by heated air ;
- (c) No screen may be deiced by alcohol alone ; and
- (d) It must be impossible for fuel to strike any screen.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1107 : Induction system filters.

[If an air filter is used to protect the engine against foreign material particles in the induction air supply-]

- (a) Each air filter must be capable of withstanding the effects of temperature extremes, rain, fuel, oil, and solvents to which it is expected to be exposed in service and maintenance; and
- (b) Each air filter shall have a design feature to prevent material separated from the filter media from interfering with proper fuel metering operation.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1109 : [Turbocharger bleed air system.]

[The following applies to turbo-charged bleed air systems used for cabin pressurization :

- (a) The cabin air system may not be subject to hazardous contamination following any probable failure of the turbocharger or its lubrication system.
- (b) The turbocharger supply air must be taken from a source where it cannot be contaminated by harmful or hazardous gases or vapors following any probable failure or malfunction of the engine exhaust, hydraulic, fuel, or oil system.]

Amdt. 23-42, Eff. 02/04/91

FAR 23.1111 : Turbine engine bleed air system.

For turbine engine bleed air systems, the following apply :

- (a) No hazard may result if duct rupture or failure occurs anywhere between the engine port and the airplane unit served by the bleed air.
- (b) The effect on airplane and engine performance of using maximum bleed air must be established.
- (c) [Hazardous contamination of cabin air systems may not result from failures of the engine lubricating system.]

Amdt. 23-17, Eff. 02/01/77

32.8 Exhaust System**FAR 23.1121 : General.**

For powerplant and auxiliary power unit installations, the following apply-

- (a) Each exhaust system must ensure safe disposal of exhaust gases without fire hazard or carbon monoxide contamination in any personnel compartment.
- (b) Each exhaust system part with a surface hot engine to ignite flammable fluids or vapors must be located or shielded so that leakage from any system carrying flammable fluids or vapors will not result in a fire caused by impingement of the fluids or vapors on any part of the exhaust system including shields for the exhaust system.
- (c) Each exhaust system must be separated by fireproof shields from adjacent flammable parts of the airplane that are outside of the engine and auxiliary power unit compartments.

FAR 27.497 : Ground loading conditions : landing gear with tail wheels

- (a) *General.* Rotorcraft with landing gear with two wheels forward, and one wheel aft, of the center of gravity must be designed for loading conditions as prescribed in this section.
- (b) *Level landing attitude with only the forward wheels contacting the ground.* In this attitude-
 - (1) The vertical loads must be applied under Secs. 27.471 through 27.475;
 - (2) The vertical load at each axle must be combined with a drag load at that axle of not less than 25 percent of that vertical load ; and
 - (3) Unbalanced pitching moments are assumed to be resisted by angular inertia forces.
- (c) *Level landing attitude with all wheels contacting the ground simultaneously.* In this attitude, the rotorcraft must be designed for landing loading conditions as prescribed in paragraph (b) of this section.
- (d) *Maximum nose-up attitude with only the rear wheel contacting the ground.* The attitude for this condition must be the maximum nose-up attitude expected in normal operation, including autorotative landings. In this attitude-
 - (1) The appropriate ground loads specified in paragraphs (b)(1) and (2) of this section must be determined and applied, using a rational method to account for the moment arm between the rear wheel ground reaction and the rotorcraft center of gravity ; or
 - (2) The probability of landing with initial contact on the rear wheel must be shown to be extremely remote.
- (e) *Level landing attitude with only one forward wheel contacting the ground.* In this attitude, the rotorcraft must be designed for ground loads as specified in paragraphs (b)(1) and (3) of this section.
- (f) *Side loads in the level landing attitude.* In the attitudes specified in paragraphs (b) and (c) of this section, the following apply :
 - (1) The side loads must be combined at each wheel with one-half of the maximum vertical ground reactions obtained for that wheel under paragraphs (b) and (c) of this section. In this condition, the side loads must be-
 - (i) For the forward wheels, 0.8 times the vertical reaction (on one side) acting inward, and 0.6 times the vertical reaction (on the other side) acting outward ; and
 - (ii) For the rear wheel, 0.8 times the vertical reaction.
 - (2) The loads specified in subparagraph (1) of this paragraph must be applied-
 - (i) At the ground contact point with the wheel in the trailing position (for non-full swiveling landing gear or for full swiveling landing gear with a lock, steering device, or shimmy damper to keep the wheel in the trailing position) ; or
 - (ii) At the center of the axle (for full swiveling landing gear without a lock, steering device, or shimmy damper).
- (g) *Braked roll conditions in the level landing attitude.* In the attitudes specified in paragraphs (b) and (c) of this section, and with the shock absorbers in their static positions, the rotorcraft must be designed for braked roll loads as follows :

FAR 27.481 : Tail-down landing conditions

- (a) The rotorcraft is assumed to be in the maximum nose-up attitude allowing ground clearance by each part of the rotorcraft.
- (b) In this attitude, ground loads are assumed to act perpendicular to the ground.

FAR 27.483 : One-wheel landing conditions

For the one-wheel landing condition, the rotorcraft is assumed to be in the level attitude and to contact the ground on one aft wheel. In this attitude—

- (a) The vertical load must be the same as that obtained on that side under Sec. 27.479(b)(1); and
- (b) The unbalanced external loads must be reacted by rotorcraft inertia.

FAR 27.485 : Lateral drift landing conditions

- (a) The rotorcraft is assumed to be in the level landing attitude, with—

- (1) Side loads combined with one-half of the maximum ground reactions obtained in the level landing conditions of Sec. 27.479 (b)(1) ; and

- (2) The loads obtained under subparagraph (1) of this paragraph applied—

- (i) At the ground contact point ; or
- (ii) For full-swiveling gear, at the center of the axle.

- (b) The rotorcraft must be designed to withstand, at ground contact—

- (1) When only the aft wheels contact the ground, side loads of 0.8 times the vertical reaction acting inward on one side, and 0.6 times the vertical reaction acting outward on the other side, all combined with the vertical loads specified in paragraph (a) ; and

- (2) When all wheels contact the ground simultaneously—

- (i) For the aft wheels, the side loads specified in subparagraph (1) of this paragraph; and
- (ii) For the forward wheels, a side load of 0.8 times the vertical reaction combined with the vertical load specified in paragraph (a) of this section.

FAR 27.493 : Braked roll conditions

Under braked roll conditions with the shock absorbers in their static positions—

- (a) The limit vertical load must be based on a load factor of at least—
 - (1) 1.33, for the attitude specified in Sec. 27.479(a)(1) ; and
 - (2) 1.0 for the attitude specified in Sec. 27.479(a)(2) ; and
- (b) The structure must be designed to withstand, at the ground contact point of each wheel with brakes, a drag load at least the lesser of—
 - (1) The vertical load multiplied by a coefficient of friction of 0.8; and
 - (2) The maximum value based on limiting brake torque.

- (d) No exhaust gases may discharge dangerously near any fuel or oil system drain.
- (e) No exhaust gases may be discharged where they will cause a glare seriously affecting pilot vision at night.
- (f) Each exhaust system component must be ventilated to prevent points of excessively high temperature.
- (g) If significant traps exists, each turbine engine and auxiliary power unit exhaust system must have drains discharging clear of the airplane, in any normal ground and flight attitude, to prevent fuel accumulation after the failure of an attempted engine or auxiliary power unit start.]
- (h) Each exhaust heat exchanger must incorporate means to prevent blockage of the exhaust port after any internal heat exchanger failure.
- (i) For the purpose of compliance with Sec. 23.603, the failure of any part of the exhaust system will be considered to adversely affect safety.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1123 : Exhaust [system.]

- (a) [Each exhaust system must be fireproof and corrosion-resistant, and must have means to prevent failure due to expansion by operating temperatures.
- (b) Each exhaust system must be supported to withstand the vibration and inertia loads to which it may be subjected in operation.
- (c) Parts of the system connected to components between which relative motion could exist must have means for flexibility.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1125 : Exhaust heat exchangers.

[For reciprocating engine powered airplanes the following apply :]

- (a) Each exhaust heat exchanger must be constructed and installed to withstand the vibration, inertia, and other loads that it may be subjected to in normal operation. In addition—
 - (1) Each exchanger must be suitable for continued operation at high temperatures and resistant to corrosion from exhaust gases ;
 - (2) There must be means for inspection of critical parts of each exchanger ; and
 - (3) [Each exchanger must have cooling provisions wherever it is subject to contact with exhaust gases.]
- (b) Each heat exchanger used for heating ventilating air must be constructed so that exhaust gases may not enter the ventilating air.

Amdt. 23-17, Eff. 02/01/77

32.9 Powerplant Controls and Accessories**FAR 23.1141 : Powerplant controls : general.**

- (a) Powerplant controls must be located and arranged under Sec. 23.777 and marked under Sec. 23.1555(a).

- (b) [Each flexible control must be shown to be suitable for the particular application.]
- (c) Each control must be able to maintain any necessary position without—
 - (1) Constant attention by flight crew members ; or
 - (2) Tendency to creep due to control loads or vibration.
- (d) Each control must be able to withstand operating loads without failure or excessive deflection.
- (e) For turbine engine powered airplanes, no single failure or malfunction, or probable combination thereof, in any powerplant control system may cause the failure of any powerplant function necessary for safety.
- (f) The portion of each powerplant control located in the engine compartment that is required to be operated in the event of fire must be at least fire resistant.
- (g) Powerplant valve controls located in the cockpit must have—
 - (1) For manual valves, positive stops or in the case of fuel valves suitable index provisions, in the open and closed position ; and
 - (2) For power-assisted valves, a means to indicate to the flight crew when the valve—
 - (i) Is in the fully open or fully closed position ; or
 - (ii) Is moving between the fully open and fully closed position.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1142 : [Auxiliary power unit controls.]

[Means must be provided on the flight deck for the starting, stopping, monitoring, and emergency shutdown of each installed auxiliary power unit.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1143 : Engine controls.

- (a) There must be a separate power or thrust control for each engine and a separate control for each supercharger that requires a control.
- (b) Power, thrust, and supercharger controls must be arranged to allow—
 - (1) Separate control of each engine and each supercharger ; and
 - (2) Simultaneous control of all engines and all superchargers.
- (c) Each power, thrust, or supercharger control must give a positive and immediate responsive means of controlling its engine or supercharger.
- (d) The power, thrust, or supercharger controls for each engine or supercharger must be independent of those for every other engine or supercharger.
- (e) For each fluid injection (other than fuel) system and its controls not provided as part of the engine, the applicant must show that the flow of the injection fluid is adequately controlled.
- (f) [If a power, thrust, or a fuel control (other than a mixture control) incorporates a fuel shutoff feature, the control must have a means to prevent the inadvertent movement of the control into the shutoff position. This means must—]
 - (1) Have a positive lock or stop at the idle position ; and

- (b) *Critical centers of gravity.* The critical centers of gravity within the range for which certification is requested must be selected so that the maximum design loads are obtained in each landing gear element.

FAR 27.473 : Ground loading conditions and assumptions

- (a) [For specified landing conditions, a design maximum weight must be used that is not less than the maximum weight. A rotor lift may be assumed to act through the center of gravity throughout the landing impact. This lift may not exceed two-thirds of the design maximum weight.
- (b) Unless otherwise prescribed, for each specified landing condition, the rotorcraft must be designed for a limit load factor of not less than the limit inertia load factor substantiated under Sec. 27.725.]

Amdt. 27-2, Eff. 2/25/68

FAR 27.475 : Tires and shock absorbers

Unless otherwise prescribed, for each specified landing condition, the tires must be assumed to be in their static position and the shock absorbers to be in their most critical position.

FAR 27.477 : Landing gear arrangement

Sections 27.235, 27.479 through 27.485, and 27.493 apply to landing gear with two wheels aft, and one or more wheels forward, of the center of gravity.

FAR 27.479 : Level landing conditions

- (a) Attitudes. Under each of the loading conditions prescribed in paragraph (b) of this section, the rotorcraft is assumed to be in each of the following level landing attitudes :
 - (1) An attitude in which all wheels contact the ground simultaneously.
 - (2) An attitude in which the aft wheels contact the ground with the forward wheels just clear of the ground.
- (b) Loading conditions. The rotorcraft must be designed for the following landing loading conditions :
 - (1) Vertical loads applied under Sec. 27.471.
 - (2) The loads resulting from a combination of the loads applied under subparagraph (1) of this paragraph with drag loads at each wheel of not less than 25 percent of the vertical load at that wheel.
 - (3) If there are two wheels forward, a distribution of the loads applied to those wheels under subparagraphs (1) and (2) of this paragraph in a ratio of 40 :60.
- (c) Pitching moments. Pitching moments are assumed to be resisted by—
 - (1) In the case of the attitude in paragraph (a)(1) of this section, the forward landing gear ; and
 - (2) In the case of the attitude in paragraph (a)(2) of this section, the angular inertia forces.

FAR 27.411 : Ground clearance : tail rotor guard

- (a) It must be impossible for the tail rotor to contact the landing surface during a normal landing.
- (b) If a tail rotor guard is required to show compliance with paragraph (a) of this section—
- (1) Suitable design loads must be established for the guard; and
 - (2) The guard and its supporting structure must be designed to withstand those loads.

FAR 27.413 : [Removed.]

[Removed.]

Amdt. 27-27, Eff. 10/22/90

FAR 27.427 : Unsymmetrical loads

- (a) Horizontal tail surfaces and their supporting structure must be designed for unsymmetrical loads arising from yawing and rotor wake effects in combination with the prescribed flight conditions.
- (b) To meet the design criteria of paragraph (a) of this section, in the absence of more rational data, both of the following must be met :
- (1) [One hundred percent of the maximum loading from the symmetrical flight conditions in acts on the surface on one side of the plane of symmetry, and no loading acts on the other side.
 - (2) Fifty percent of the maximum loading from the symmetrical flight conditions in acts on the surface on each side of the plane of symmetry but in opposite directions.]
- (c) For empennage arrangements where the horizontal tail surfaces are supported by the vertical tail surfaces, the vertical tail surfaces and supporting structure must be designed for the combined vertical and horizontal surface loads resulting from each prescribed flight condition, considered separately. The flight conditions must be selected so the maximum design loads are obtained on each surface. In the absence of more rational data, the unsymmetrical horizontal tail surface loading distributions described in this section must be assumed.

Amdt. 27-27, Eff. 10/22/90

63.4 Ground Loads**FAR 27.471 : General**

- (a) *Loads and equilibrium.* For limit ground loads—
- (1) The limit ground loads obtained in the landing conditions in this part must be considered to be external loads that would occur in the rotorcraft structure if it were acting as a rigid body; and
 - (2) In each specified landing condition, the external loads must be placed in equilibrium with linear and angular inertia loads in a rational or conservative manner.

- (2) Require a separate and distinct operation to place the control in the shutoff position.

- (g) For reciprocating single-engine airplanes, each power or thrust control must be designed so that if the control separates at the engine fuel metering device, the airplane is capable of continued safe flight and landing.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1145 : Ignition switches.

- (a) Ignition switches must control [and shut off] each ignition circuit on each engine.
- (b) There must be means to quickly shut off all ignition on multiengine airplanes by the groupings of switches or by a master ignition control.
- (c) Each group of ignition switches, except ignition switches for turbine engines for which continuous ignition is not required, and each master ignition control must have a means to prevent its inadvertent operation.

Amdt. 23-43, Eff. 05/10/93

FAR 23.1147 : Mixture controls.

If there are mixture controls, each engine must have a separate control, and each mixture control must have guards or must be shaped or arranged to prevent confusion by fuel with other controls.

(a) [

- (1) The controls must be grouped and arranged to allow—
 - (i) Separate control of each engine; and
 - (ii) Simultaneous control of all engines.
 - (2) The control must require a separate and distinct operation to move the control toward lean or shut-off position.
- (b) For reciprocating single-engine airplanes, each manual engine mixture control must be designed so that, if the control separates at the engine fuel metering device, the airplane is capable of continued safe flight and landing.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1149 : Propeller speed and pitch controls.

- (a) If there are propeller speed or pitch controls, they must be grouped and arranged to allow—
- (1) Separate control of each propeller; and
 - (2) Simultaneous control of all propellers.
- (b) The controls must allow ready synchronization of all propellers on multiengine airplanes.

FAR 23.1153 : Propeller feathering controls.

[If there are propeller feathering controls installed, it must be possible to feather each propeller separately. Each control must have a means to prevent inadvertent operation.]

Amdt. 23-51, Eff. 03/11/96

FAR 23.1155 : [Turbine engine reverse thrust and propeller pitch settings below the flight regime.]

[For turbine engine installations, each control for reverse thrust and for propeller pitch settings below the flight regime must have means to prevent its inadvertent operation. The means must have a positive lock or stop at the flight idle position and must require a separate and distinct operation by the crew to displace the control from the flight regime (forward thrust regime for turbojet powered airplanes).]
Amdt. 23-7, EFF. 09/14/69

FAR 23.1157 : Carburetor air temperature controls.

There must be a separate carburetor air temperature control for each engine.

FAR 23.1163 : Powerplant accessories.

- (a) Each engine mounted accessory must—
 - (1) [Be approved for mounting on the engine involved and use the provisions on the engines for mounting; or
 - (2) Have torque limiting means on all accessory drives in order to prevent the torque limits established for those drives from being exceeded; and
 - (3) In addition to paragraphs (a)(1) or (a)(2) of this section, be sealed to prevent contamination of the engine oil system and the accessory system.]
- (b) Electrical equipment subject to arcing or sparking must be installed to minimize the probability of contact with any flammable fluids or vapors that might be present in a free state.
- (c) Each generator rated at or more than 6 kilowatts must be designed and installed to minimize the probability of a fire hazard in the event it malfunctions.
- (d) [If the continued rotation of any accessory remotely driven by the engine is hazardous when malfunctioning occurs, a means to prevent rotation without interfering with the continued operation of the engine must be provided.
- (e) Each accessory driven by a gearbox that is not approved as part of the powerplant driving the gearbox must—
 - (1) Have torque limiting means to prevent the torque limits established for the affected drive from being exceeded;
 - (2) Use the provisions on the gearbox for mounting; and
 - (3) Be sealed to prevent contamination of the gearbox oil system and the accessory system.]

Amdt. 23-42, EFF. 02/04/91

FAR 23.1165 : Engine ignition systems.

- (a) Each battery ignition system must be supplemented by a generator that is automatically available as an alternate source of electrical energy to allow continued engine operation if any battery becomes depleted.
- (b) The capacity of batteries and generators must be large enough to meet the simultaneous demands of the engine ignition system and the greatest demands of any electrical system components that draw from the same source.

- (3) If the system design or the normal operating loads are such that a part of the system cannot react to the limit pilot forces prescribed in Sec. 27.397, that part of the system must be designed to withstand the maximum loads that can be obtained in normal operation. The minimum design loads must, in any case, provide a rugged system for service use, including consideration of fatigue, jacking, ground gusts, control inertia, and friction loads. In the absence of rational analysis, the design loads resulting from 0.60 of the specified limit pilot forces are acceptable minimum design loads.
- (4) If operational loads may be exceeded through jacking, ground gusts, control inertia, or friction, the system must withstand the limit pilot forces specified in Sec. 27.397, without yielding.]

Amdt. 27-26, EFF. 4/5/90

FAR 27.397 : Limit pilot forces and torques

- (a) Except as provided in paragraph (b) of this section, the limit pilot forces are as follows :
 - (1) For foot controls, 130 pounds.
 - (2) For stick controls, 100 pounds fore and aft, and 67 pounds laterally.
- (b) For flap, tab, stabilizer, rotor brake, and landing gear operating controls, the following apply (R=radius in inches) :
 - (1) Crank, wheel, and level controls, $\frac{(1+R)}{3}$ 50 pounds, but not less than 50 pounds nor more than 100 pounds for hand operated controls or 130 pounds for foot operated controls, applied at any angle within 20 degrees of the plane of motion of the control.
 - (2) Twist controls, [80R inch-pounds.]

Amdt. 27-40, EFF. 5/9/2001

FAR 27.399 : Dual control system

Each dual primary flight control system must be designed to withstand the loads that result when pilot forces of 0.75 times those obtained under Sec. 27.395 are applied—

- (a) In opposition; and
- (b) In the same direction.

FAR 27.401 : [Removed.]

[Removed.]
Amdt. 27-27, EFF. 10/22/90

FAR 27.403 : [Removed.]

[Removed.]
Amdt. 27-27, EFF. 10/22/90

- (2) Attain a resulting sideslip angle or 15° , whichever is less, at the lesser speed of V_{NE} or V_H ;
- (3) Vary the sideslip angles of paragraphs (b)(2) and (c)(2) of this section directly with speed ; and
- (4) Return the directional control suddenly to neutral.

Amdt. 27-34, Eff. 11/28/97

FAR 27.361 : Engine torque

- (a) [For turbine engines, the limit torque may not be less than the highest of—
 - (1) The mean torque for maximum continuous power multiplied by 1.25;
 - (2) The torque required by Sec. 27.923;
 - (3) The torque required by Sec. 27.927 ; or
 - (4) The torque required by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming).
- (b) For reciprocating engines, the limit torque may not be less than the mean torque for maximum continuous power multiplied by—
 - (1) 1.33, for engines with five or more cylinders ; and
 - (2) Two, three, and four, for engines with four, three, and two cylinders, respectively.]

Amdt. 27-23, Eff. 10/3/88

63.3 Control Surface and System Loads

FAR 27.391 : General

Each auxiliary rotor, each fixed or movable stabilizing or control surface, and each system operating any flight control must meet the requirements of [Secs. 27.395, 27.397, 27.399, 27.411, and 27.427.]

Amdt. 27-34, Eff. 11/28/97

FAR 27.395 : Control system

- (a) The part of each control system from the pilot's controls to the control stops must be designed to withstand pilot forces of not less than—
 - (1) The forces specified in Sec. 27.397 ; or
 - (2) If the system prevents the pilot from applying the limit pilot forces to the system, the maximum forces that the system allows the pilot to apply, but not less than 0.60 times the forces specified in Sec. 27.397.
- (b) [Each primary control system, including its supporting structure, must be designed as follows :
 - (1) The system must withstand loads resulting from the limit pilot forces prescribed in Sec. 27.397.
 - (2) Notwithstanding paragraph (b)(3) of this section, when power-operated actuator controls or power boost controls are used, the system must also withstand the loads resulting from the force output of each normally energized power device, including any single power boost or actuator system failure.

- (c) The design of the engine ignition system must account for—
 - (1) The condition of an inoperative generator ;
 - (2) The condition of a completely depleted battery with the generator running at its normal operating speed ; and
 - (3) The condition of a completely depleted battery with the generator operating at idling speed, if there is only one battery.
- (d) There must be means to warn appropriate crewmembers if malfunctioning of any part of the electrical system is causing the continuous discharge of any battery used for engine ignition.
- (e) Each turbine engine ignition system must be independent of any electrical circuit that is not used for assisting, controlling, or analyzing the operation of that system.
- (f) [In addition, for commuter category airplanes, each turbopropeller ignition system must be an essential electrical load.]

Amdt. 23-34, Eff. 02/17/87

32.10 Powerplant Fire Protection

FAR 23.1181 : Designated fire zones ; regions included.

Designated fire zones are—

- (a) For reciprocating engines—
 - (1) The power section ;
 - (2) The accessory section ;
 - (3) Any complete powerplant compartment in which there is no isolation between the power section and the accessory section.
- (b) For turbine engines—
 - (1) The compressor and accessory sections ;
 - (2) The combustor, turbine and tailpipe sections that contain lines or components carrying flammable fluids or gases.
 - (3) [Any complete powerplant compartment in which there is no isolation between compressor, accessory, combustor, turbine, and tailpipe sections.]
 - (c) Any auxiliary power unit compartment ; and
 - (d) Any fuel-burning heater, and other combustion equipment installation described in Sec. 23.859.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1182 : [Nacelle areas behind firewalls.]

[Components, lines, and fittings, except those subject to the provisions of Sec. 23.1351(e), located behind the engine-compartment firewall must be constructed of such materials and located at such distances from the firewall that they will not suffer damage sufficient to endanger the airplane if a portion of the engine side of the firewall is subjected to a flame temperature of not less than 2000° F for 15 minutes.]

Amdt. 23-14, Eff. 12/20/73

FAR 23.1183 : Lines, fittings and components.

(a) Except as provided in paragraph (b) of this section, each component, line, and fitting carrying flammable fluids, gas, or air in any area subject to engine fire conditions must be at least fire resistant, except that 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. Components must be shielded or located so as to safeguard against the ignition of leaking flammable fluid. Flexible hose assemblies (hose and end fittings) must be shown to be suitable for the particular application. An integral oil sump of less than 25 quart capacity on a reciprocating engine need not be fireproof nor be enclosed by a fireproof shield.

(b) Paragraph (a) of this section does not apply to—

- (1) Lines, fittings, and components which are already approved as part of the type certificated engine ; and
- (2) Vent and drain lines, and their fittings, whose failure will not result in, or add to, a fire hazard.

Amdt. 23-51, EFF. 03/11/96

FAR 23.1189 : Shutoff means.

(a) [For each multiengine airplane, the following apply:]

- (1) Each engine installation must have means to shut off or otherwise prevent hazardous quantities of fuel, oil, deicing fluid, and other flammable liquids from flowing into, within, or through any engine compartment, except in lines, fittings, and components forming an integral part of an engine.
- (2) The closing of the fuel shutoff valve for any engine may not make any fuel unavailable to the remaining engines that would be available to those engines with that valve open.
- (3) Operation of any shutoff means may not interfere with the later emergency operation of other equipment such as propeller feathering devices.
- (4) Each shutoff must be outside of the engine compartment unless an equal degree of safety is provided with the shutoff inside the compartment.
- (5) [Not more than one quart of flammable fluid may escape into the engine compartment after engine shutoff. For those installations where the flammable fluid that escapes after shutdown cannot be limited to one quart, it must be demonstrated that this greater amount can be safely contained or drained overboard.]
- (6) There must be means to guard against inadvertent operations of each shutoff means, and to make it possible for the crew to reopen the shutoff means in flight after it has been closed.
- (b) Turbine engine installations need not have an engine oil system shutoff if—
 - (1) The oil tank is integral with, or mounted on, the engine ; and
 - (2) All oil system components external to the engine are fireproof or located in areas not subject to engine fire conditions.

FAR 27.339 : Resultant limit maneuvering loads

The loads resulting from the application of limit maneuvering load factors are assumed to act at the center of each rotor hub [and at each auxiliary lifting surface] and to act in directions, and with distributions of load among the rotors and auxiliary lifting surfaces, so as to represent each critical maneuvering condition, including power-on and power-off flight with the maximum design rotor tip speed ratio. The rotor tip speed ratio is the ratio of the rotorcraft flight velocity component in the plane of the rotor disc to the rotational tip speed of the rotor blades, and is expressed as follows :

$$\mu = \frac{V \cos \alpha}{\Omega R}$$

where—

V	The airspeed along flight path	(ft/s)
α	The angle between the projection, in the plane of symmetry, of the axis of no feathering and a line perpendicular to the flight path (positive when axis is pointing aft)	(rad)
Ω	The angular velocity of rotor	(rad/s)
R	The rotor radius	(ft)

Amdt. 27-11, EFF. 2/1/77

FAR 27.341 : Gust loads

The rotorcraft must be designed to withstand, at each critical airspeed including hovering, the loads resulting from a vertical gust of 30 feet per second.

FAR 27.351 : Yawing conditions

- (a) Each rotorcraft must be designed for the loads resulting from the maneuvers specified in paragraphs (b) and (c) of this section with—
- (1) Unbalanced aerodynamic moments about the center of gravity which the aircraft reacts to in a rational or conservative manner considering the principal masses furnishing the reacting inertia forces ; and
 - (2) Maximum main rotor speed.
- (b) To produce the load required in paragraph (a) of this section, in unaccelerated flight with zero yaw, at forward speeds from zero up to $0.6 V_{NE}$ —
- (1) Displace the cockpit directional control suddenly to the maximum deflection limited by the control stops or by the [maximum pilot force specified in Sec. 27.397(a)] ;
 - (2) Attain a resulting sideslip angle or 90° , whichever is less ; and
 - (3) Return the directional control suddenly to neutral.
- (c) To produce the load required in paragraph (a) of this section, in unaccelerated flight with zero yaw, at forward speeds from $0.6 V_{NE}$ up to V_{NE} or V_H , whichever is less—
- (1) Displace the cockpit directional control suddenly to the maximum deflection limited by the control stops or by the [maximum pilot force specified in Sec. 27.397(a)] ;

FAR 27.309 : Design limitations

The following values and limitations must be established to show compliance with the structural requirements of this subpart :

- (a) The design maximum weight.
- (b) The main rotor r.p.m. ranges, power on and power off.
- (c) The maximum forward speeds for each main rotor r.p.m. within the ranges determined under paragraph (b) of this section.
- (d) The maximum rearward and sideward flight speeds.
- (e) The center of gravity limits corresponding to the limitations determined under paragraphs (b), (c), and (d) of this section.
- (f) The rotational speed ratios between each powerplant and each connected rotating component.
- (g) The positive and negative limit maneuvering load factors.

63.2 Flight Loads**FAR 27.321 : General**

- (a) [The flight load factor must be assumed to act normal to the longitudinal axis of the rotorcraft, and to be equal in magnitude and opposite in direction to the rotorcraft inertia load factor at the center of gravity.]
- (b) Compliance with the flight load requirements of this subpart must be shown—
 - (1) At each weight from the design minimum weight to the design maximum weight ; and
 - (2) With any practical distribution of disposable load within the operating limitations in the Rotorcraft Flight Manual.

Amdt. 27-11, Eff. 2/1/77

FAR 27.337 : Limit maneuvering load factor

[The rotorcraft must be designed for—

- (a) A limit maneuvering load factor ranging from a positive limit of 3.5 to a negative limit of -1.0 ; or
- (b) Any positive limit maneuvering load factor not less than 2.0 and any negative limit maneuvering load factor of not less than -0.5 for which—
 - (1) The probability of being exceeded is shown by analysis and flight tests to be extremely remote ; and
 - (2) The selected values are appropriate to each weight condition between the design maximum and design minimum weights.]

Amdt. 27-26, Eff. 4/5/90

- (c) Power operated valves must have means to indicate to the flight crew when the valve has reached the selected position and must be designed so that the valve will not move from the selected position under vibration conditions likely to exist at the valve location.

Amdt. 23-43, Eff. 05/10/93

FAR 23.1191 : Firewalls.

- (a) Each engine, auxiliary power unit, fuel burning heater, and other combustion equipment must be isolated from the rest of the airplane by firewalls, shrouds, or equivalent means.
- (b) [Each firewall or shroud must be constructed so that no hazardous quantity of liquid, gas, or flame can pass from the compartment created by the firewall or shroud to other parts of the airplane.]
- (c) Each opening in the firewall or shroud must be sealed with close fitting, fireproof grommets, bushings, or firewall fittings.
- (d) Removed and Reserved.
- (e) Each firewall and shroud must be fireproof and protected against corrosion.
- (f) Compliance with the criteria for fireproof materials or components must be shown as follows :
 - (1) The flame to which the materials or components are subjected must be 2,000 $\pm$ 150° F.
 - (2) Sheet materials approximately 10 inches square must be subjected to the flame from a suitable burner.
 - (3) The flame must be large enough to maintain the required test temperature over an area approximately five inches square.
- (g) Firewall materials and fittings must resist flame penetration for at least 15 minutes.
- (h) The following materials may be used in firewalls or shrouds without being tested as required by this section :
 - (1) Stainless steel sheet, 0.015 inch thick.
 - (2) Mild steel sheet (coated with aluminium or otherwise protected against corrosion) 0.018 inch thick.
 - (3) Terne plate, 0.018 inch thick.
 - (4) Monel metal, 0.018 inch thick.
 - (5) Steel or copper base alloy firewall fittings.
 - (6) Titanium sheet, 0.016 inch thick.

Amdt. 23-51, Eff. 03/11/96

FAR 23.1192 : [Engine accessory compartment diaphragm.]

[For aircooled radial engines, the engine power section and all portions of the exhaust system must be isolated from the engine accessory compartment by a diaphragm that meets the firewall requirements of Sec. 23.1191.]

Amdt. 23-14, Eff. 12/20/73

FAR 23.1193 : Cowling and nacelle.

- (a) Each cowling must be constructed and supported so that it can resist any vibration, inertia, and air loads to which it may be subjected in operation.
- (b) [There must be means for rapid and complete drainage of each part of the cowling in the normal ground and flight attitudes. Drain operation may be shown by test, analysis, or both, to ensure that under normal aerodynamic pressure distribution expected in service each drain will operate as designed. No drain may discharge where it will cause a fire hazard.]
- (c) Cowling must be at least fire resistant.
- (d) Each part behind an opening in the engine compartment cowling must be at least fire resistant for a distance of at least 24 inches aft of the opening.
- (e) Each part of the cowling subjected to high temperatures due to its nearness to exhaust system ports or exhaust gas impingement, must be fireproof.
- (f) Each nacelle of a multengine airplane with supercharged engines must be designed and constructed so that with the landing gear retracted, a fire in the engine compartment will not burn through a cowling or nacelle and enter a nacelle area other than the engine compartment.
- (g) In addition, for commuter category airplanes, the airplane must be designed so that no fire originating in any engine compartment can enter, either through openings or by burnthrough, any other region where it would create additional hazards.

Amdt. 23-43, Eff. 5/10/93

FAR 23.1195 : Fire extinguishing systems.

- (a) [For commuter category airplanes, fire extinguishing systems must be installed and compliance shown with the following :
 - (1) Except for combustor, turbine, and tailpipe sections of turbine-engine installations that contain lines or components carrying flammable fluids or gases for which a fire originating in these sections is shown to be controllable, a fire extinguisher system must serve each engine compartment ;
 - (2) The fire extinguishing system, the quantity of the extinguishing agent, the rate of discharge, and the discharge distribution must be adequate to extinguish fires. An individual "one shot" system may be used.
 - (3) The fire extinguishing system for a nacelle must be able to simultaneously protect each compartment of the nacelle for which protection is provided.
- (b) If an auxiliary power unit is installed in any airplane certificated to this part, that auxiliary power unit compartment must be served by a fire extinguishing system meeting the requirements of paragraph (a)(2) of this section.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1197 : [Fire extinguishing agents.]

- [For commuter category airplanes, the following applies :
 - (a) Fire extinguishing agents must—
 - (1) Be capable of extinguishing flames emanating from any burning fluids or other combustible materials in the area protected by the fire extinguishing system ; and

63.1 General**FAR 27.301 : Loads**

- (a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.
- (b) Unless otherwise provided, the specified air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the rotorcraft. These loads must be distributed to closely approximate or conservatively represent actual conditions.
- (c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

FAR 27.303 : Factor of safety

Unless otherwise provided, a factor of safety of 1.5 must be used. This factor applies to external and inertia loads unless its application to the resulting internal stresses is more conservative.

FAR 27.305 : Strength and deformation

- (a) The structure must be able to support limit loads without detrimental or permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation.
- (b) The structure must be able to support ultimate loads without failure. This must be shown by—
 - (1) Applying ultimate loads to the structure in a static test for at least three seconds ; or
 - (2) Dynamic tests simulating actual load application.

FAR 27.307 : Proof of structure

- (a) [Compliance with the strength and deformation requirements of this subpart must be shown for each critical loading condition accounting for the environment to which the structure will be exposed in operation. Structural analysis (static or fatigue) may be used only if the structure conforms to those structures for which experience has shown this method to be reliable. In other cases, substantiating load tests must be made.]
- (b) Proof of compliance with the strength requirements of this subpart must include—
 - (1) Dynamic and endurance tests of rotors, rotor drives, and rotor controls ;
 - (2) Limit load tests of the control system, including control surfaces ;
 - (3) Operation tests of the control system ;
 - (4) Flight stress measurement tests ;
 - (5) Landing gear drop tests ; and
 - (6) Any additional test required for new or unusual design features.

Amdt. 27-26, Eff. 4/5/90

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(2) Have thermal stability over the temperature range likely to be experienced in the compartment in which they are stored.

(b) If any toxic extinguishing agent is used, provisions must be made to prevent harmful concentrations of fluid or fluid vapors (from leakage during normal operation of the airplane or as a result of discharging the fire extinguisher on the ground or in flight) from entering any personnel compartment, even though a defect may exist in the extinguishing system. This must be shown by test except for built-in carbon dioxide fuselage compartment fire extinguishing systems for which—

(1) Five pounds or less of carbon dioxide will be discharged, under established fire control procedures, into any fuselage compartment ; or

(2) Protective breathing equipment is available for each flight crewmember on flight deck duty.]

Amdt. 23-34, Eff. 02/17/87

FAR 23.1199 : [Extinguishing agent containers.]

[For commuter extinguishing airplanes, the following applies :

(a) Each extinguishing agent container must have a pressure relief to prevent bursting of the container by excessive internal pressures.

(b) The discharge end of each discharge line from a pressure relief connection must be located so that discharge of the fire extinguishing agent would not damage the airplane. The line must also be located or protected to prevent clogging caused by ice or other foreign matter.

(c) A means must be provided for each fire extinguishing agent container to indicate that the container has discharged or that the charging pressure is below the established minimum necessary for proper functioning.

(d) The temperature of each container must be maintained, under intended operating conditions, to prevent the pressure in the container from—

(1) Falling below that necessary to provide an adequate rate of discharge ; or

(2) Rising high enough to cause premature discharge.

(e) If a pyrotechnic capsule is used to discharge the extinguishing agent, each container must be installed so that temperature conditions will not cause hazardous deterioration of the pyrotechnic capsule.]

Amdt. 23-34, Eff. 02/17/87

FAR 23.1201 : [Fire extinguishing system materials.]

[For commuter category airplanes, the following apply :

(a) No material in any fire extinguishing system may react chemically with any extinguishing agent so as to create a hazard.

(b) Each system component in an engine compartment must be fireproof.]

Amdt. 23-34, Eff. 02/17/87

FAR 23.1203 : Fire detector system.

- (a) There must be means that ensure the prompt detection of a fire in—
- (1) An engine compartment of—
 - (i) Multiengine turbine powered airplanes;
 - (ii) Multiengine reciprocating engine powered airplanes incorporating turbochargers;
 - (iii) Airplanes with engine(s) located where they are not readily visible from the cockpit; and
 - (iv) All commuter category airplanes.
 - (2) The auxiliary power unit compartment of any airplane incorporating an auxiliary power unit.
- (b) Each fire detector must be constructed and installed to withstand the vibration, inertia, and other loads to which it may be subjected in operation.
- (c) No fire detector may be affected by any oil, water, other fluids, or fumes that might be present.
- (d) There must be means to allow the crew to check, in flight, the functioning of each fire detector electric circuit.
- (e) [Wiring and other components of each fire detector system in a designated fire zone must be at least fire resistant.]
- Amdt. 23-51, EF. 03/11/96

Chapitre 63

Subpart C : Strength Requirements

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62.4 Ground and Water Handling Characteristics

FAR 27.231 : General

The rotorcraft must have satisfactory ground and water handling characteristics, including freedom from uncontrollable tendencies in any condition expected in operation.

FAR 27.235 : Taxiing condition

The rotorcraft must be designed to withstand the loads that would occur when the rotorcraft is taxied over the roughest ground that may reasonably be expected in normal operation.

FAR 27.239 : Spray characteristics

If certification for water operation is requested, no spray characteristics during taxiing, takeoff, or landing may obscure the vision of the pilot or damage the rotors, propellers, or other parts of the rotorcraft.

FAR 27.241 : Ground resonance

The rotorcraft may have no dangerous tendency to oscillate on the ground with the rotor turning.

62.5 Miscellaneous Flight Requirements

FAR 27.251 : Vibration

Each part of the rotorcraft must be free from excessive vibration under each appropriate speed and power condition.

Chapitre 33

Subpart F : Equipment

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FAR 27.175 : Demonstration of static longitudinal stability

- (a) Climb. Static longitudinal stability must be shown in the climb condition at speeds from $0.85 V_Y$ to $1.2 V_Y$, with—
- (1) Critical weight;
 - (2) Critical center of gravity;
 - (3) Maximum continuous power ;
 - (4) The landing gear retracted; and
 - (5) The rotorcraft trimmed at $\dot{V}_Y$.
- (b) Cruise. Static longitudinal stability must be shown in the cruise condition at speeds from $0.7 V_H$ or $0.7 V_{NE}$, whichever is less, to $1.1 V_H$ or $1.1 V_{NE}$, whichever is less, with—
- (1) Critical weight;
 - (2) Critical center of gravity;
 - (3) Power for level flight at $0.9 V_H$ or $0.9 V_{NE}$, whichever is less ;
 - (4) The landing gear retracted; and
 - (5) [The rotorcraft trimmed at $0.9 V_H$ or $0.9 V_{NE}$, whichever is less.]
- (c) Autorotation. Static longitudinal stability must be shown in autorotation at airspeeds from 0.5 times the speed for minimum rate of descent to V_{NE} or to $1.1 V_{NE}$ (power-off) if V_{NE} (power-off) is established under Sec. 27.1505(c), and with—
- (1) Critical weight;
 - (2) Critical center of gravity;
 - (3) Power off ;
 - (4) The landing gear—
 - (i) Retracted ; and
 - (ii) Extended ; and
 - (5) The rotorcraft trimmed at appropriate speeds found necessary by the Administrator to demonstrate stability throughout the prescribed speed range.
- (d) Hovering. For helicopters, the longitudinal cyclic control must operate with the sense and direction of motion prescribed in Sec. 27.173 between the maximum approved rearward speed and a forward speed of 17 knots with—
- (1) Critical weight ;
 - (2) Critical center of gravity;
 - (3) Power required to maintain an approximate constant height in ground effect ;
 - (4) The landing gear extended ; and
 - (5) The helicopter trimmed for hovering.
- Amtd. 27-34, EFF. 11/28/97

FAR 27.177 : [Static directional stability.]

[Static directional stability must be positive with throttle and collective controls held constant at the trim conditions specified in Sec. 27.175 (a) and (b). This must be shown by steadily increasing directional control deflection for sideslip angles up to 10° from trim. Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits.]

Amtd. 27-21, EFF. 12/6/84

- (ii) For any other condition, normal pilot reaction time.

(e) For helicopters for which a V_{NE} (power-off) is established under Sec. 27.1505(c), compliance must be demonstrated with the following requirements with critical weight, critical center of gravity, and critical rotor r.p.m. :

- (1) The helicopter must be safely slowed to V_{NE} (power-off), without exceptional pilot skill, after the last operating engine is made inoperative at power-on V_{NE} .
- (2) At a speed of 1.1 V_{NE} (power-off), the margin of cyclic control must allow satisfactory roll and pitch control with power off.

Amdt. 27-21, Eff. 12/6/84

FAR 27.151 : [Flight controls.]

- (a) [Longitudinal, lateral, directional, and collective controls may not exhibit excessive breakout force, friction, or preload.
- (b) Control system forces and free play may not inhibit a smooth, direct rotorcraft response to control system input.]

Amdt. 27-21, Eff. 12/6/84

FAR 27.161 : Trim control

The trim control—

- (a) [Must trim any steady longitudinal, lateral, and collective control forces to zero in level flight at any appropriate speed ; and]
- (b) May not introduce any undesirable discontinuities in control force gradients.

Amdt. 27-21, Eff. 12/6/84

FAR 27.171 : Stability : general

The rotorcraft must be able to be flown, without undue pilot fatigue or strain, in any normal maneuver for a period of time as long as that expected in normal operation. At least three landings and takeoffs must be made during this demonstration.

FAR 27.173 : Static longitudinal stability

- (a) [The longitudinal control must be designed so that a rearward movement of the control is necessary to obtain a speed less than the trim speed, and a forward movement of the control is necessary to obtain a speed more than the trim speed.
- (b) With the throttle and collective pitch held constant during the maneuvers specified in Sec. 27.175 (a) through (c), the slope of the control position versus speed curve must be positive throughout the full range of altitude for which certification is requested.
- (c) During the maneuver specified in Sec. 27.175(d), the longitudinal control position versus speed curve may have a negative slope within the specified speed range if the negative motion is not greater than 10 percent of total control travel.]

Amdt. 27-21, Eff. 12/6/84

33.1 General

FAR 23.1301 : Function and installation.

[Each item of installed equipment must—

- (a) Be of a kind and design appropriate to its intended function ;
- (b) Be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors ;
- (c) Be installed according to limitations specified for that equipment ; and
- (d) Function properly when installed.]

Amdt. 23-20, Eff. 09/01/77

FAR 23.1303 : Flight and navigation instruments.

The following are [the minimum] required flight and navigational instruments :

- (a) An airspeed indicator.
- (b) An altimeter.
- (c) A direction indicator nonstabilized magnetic compass.
- (d) For [reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight and [turbine engine powered airplanes, a free air-temperature indicator or an air temperature indicator which provides indications that are convertible to free-air.
- (e) A speed warning device for—
 - (1) Turbine engine powered airplanes ; and
 - (2) Other airplanes for which V_{MO}/M_{MO} and V_D/M_D are established under Secs. 23.335 (b)(4) and 23.1505 (c) if V_{MO}/M_{MO} is greater than 0.8 V_D/M_D .

The speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots whenever the speed exceeds V_{MO} plus 6 knots or $M_{MO} + 0.01$. The upper limit of the production tolerance for the warning device may not exceed the prescribed warning speed.

[The lower limit of the warning device must be set to minimize nuisance warning.
- (f) When an attitude display is installed, the instrument design must not provide any means, accessible to the flightcrew, of adjusting the relative positions of the attitude reference symbol and the horizon line beyond that necessary for parallax correction.
- (g) In addition, for commuter category airplanes :
 - (1) If airspeed limitations vary with altitude, the airspeed indicator must have a maximum allowable airspeed indicator showing the variation of V_{MO} with altitude.
 - (2) The altimeter must be a sensitive type.
 - (3) Having a passenger seating configuration of 10 or more, excluding the pilot's seats and that are approved for IFR operations, a third attitude instrument must be provided that :
 - (i) Is powered from a source independent of the electrical generating system ;
 - (ii) Continues reliable operation for a minimum of 30 minutes after total failure of the electrical generating system ;

- (iii) Operates independently of any other attitude indicating system ;
- (iv) Is operative without selection after total failure of the electrical generating system ;
- (v) Is located on the instrument panel in a position acceptable to the Administrator that will make it plainly visible to and usable by any pilot at the pilot's station ; and
- (vi) Is appropriately lighted during all phases of operation.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1305 : Powerplant instruments.

The following are required powerplant instruments :

(a) For all airplanes.

- (1) A fuel quantity indicator for each fuel tank, installed in accordance with Sec. 23.1337(b).
- (2) An oil pressure indicator for each engine.
- (3) An oil temperature indicator for each engine.
- (4) An oil quantity measuring device for each oil tank which meets the requirements of Sec. 23.1337(d).
- (5) A fire warning means for those airplanes required to comply with Sec. 23.1203.

(b) For reciprocating engine-powered airplanes. In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required :

- (1) An induction system air temperature indicator for each engine equipped with a preheater and having induction air temperature limitations that can be exceeded with preheat.
- (2) A tachometer indicator for each engine.
- (3) A cylinder head temperature indicator for—
 - (i) Each air-cooled engine with cowl flaps ;
 - (ii) Removed and reserved.
 - (iii) Each commuter category airplane.
- (4) [For each pump-fed engine, a means :
 - (i) That continuously indicates, to the pilot, the fuel pressure or fuel flow ; or
 - (ii) That continuously monitors the fuel system and warns the pilot of any fuel flow trend that could lead to engine failure.]
- (5) A manifold pressure indicator for each altitude engine and for each engine with a controllable propeller.
- (6) For each turbocharger installation :
 - (i) If limitations are established for either carburetor (or manifold) air inlet temperature or exhaust gas or turbocharger turbine inlet temperature, indicators must be furnished for each temperature for which the limitation is established unless it is shown that the limitation will not be exceeded in all intended operations.

- (c) Have any additional characteristic required for night or instrument operation, if certification for those kinds of operation is requested. Requirements for helicopter instrument flight are contained in Appendix B of this Part.

Amdt. 27-21, Eff. 12/6/84

FAR 27.143 : Controllability and maneuverability

- (a) The rotorcraft must be safely controllable and maneuverable—

- (1) During steady flight ; and
- (2) During any maneuver appropriate to the type, including—
 - (i) Takeoff ;
 - (ii) Climb ;
 - (iii) Level flight ;
 - (iv) Turning flight ;
 - (v) Glide ;
 - (vi) Landing (power on and power off) ; and
 - (vii) Recovery to power-on flight from a balked autorotative approach.
- (b) The margin of cyclic control must allow satisfactory roll and pitch control at V_{NE} with—
 - (1) Critical weight ;
 - (2) Critical center of gravity ;
 - (3) Critical rotor r.p.m. ; and
 - (4) Power off (except for helicopters demonstrating compliance with paragraph (c) of this section) and power on.
- (c) A wind velocity of not less than 17 knots must be established in which the rotorcraft can be operated without loss of control on or near the ground in any maneuver appropriate to the type (such as crosswind takeoffs, sideward flight, and rearward flight), with—
 - (1) Critical weight ;
 - (2) [Critical center of gravity ;
 - (3) Critical rotor r.p.m. ; and
 - (4) Altitude, from standard sea level conditions to the maximum altitude capability of the rotorcraft or 7,000 feet, whichever is less.]
- (d) The rotorcraft, after
 - (1) failure of one engine in the case of multiengine rotorcraft that meet Transport Category A engine isolation requirements, or
 - (2) complete engine failure in the case of other rotorcraft, must be controllable over the range of speeds and altitudes for which certification is requested when such power failure occurs with maximum continuous power and critical weight. No corrective action time delay for any condition following power failure may be less than—
 - (i) For the cruise condition, one second, or normal pilot reaction time (whichever is greater) ; and

FAR 27.29 : Limiting height-speed envelope

- (a) If there is any combination of height and forward speed (including hover) under which a safe landing cannot be made under the applicable power failure condition in paragraph (b) of this section, a limiting height-speed envelope must be established (including all pertinent information) for that condition, throughout the ranges of—
- (1) Altitude, from standard sea level conditions to the maximum altitude capability of the rotorcraft, or 7,000 feet, whichever is less; and
 - (2) [Weight, from the maximum weight (at sea level) to the lesser weight selected by the applicant for each altitude covered by paragraph (a)(1) of this section. For helicopters, the weight at altitudes above sea level may not be less than the maximum weight or the highest weight allowing hovering out of ground effect, which is lower.]
- (b) The applicable power failure conditions are—
- (1) For single-engine helicopters, full autorotation;
 - (2) For multiengine helicopters, one engine inoperative (where engine isolation features ensure continued operation of the remaining engines); and the remaining engines at the greatest power for which certification is requested; and
 - (3) For other rotorcraft, conditions appropriate to the type.

Amdt. 27-21, Eff. 12/6/84

62.3 Flight Characteristics**FAR 27.141 : General**

The rotorcraft must—

- (a) [Except as specifically required in the applicable section meet the flight characteristics requirements of this subpart—
- (1) At the altitudes and temperatures expected in operation;]
 - (2) Under any critical loading condition within the range of weights and centers of gravity for which certification is requested;
 - (3) For power-on operations, under any condition of speed, power, and rotor r.p.m. for which certification is requested; and
 - (4) For power-off operations, under any condition of speed and rotor r.p.m. for which certification is requested that is attainable with the controls rigged in accordance with the approved rigging instructions and tolerances;
- (b) Be able to maintain any required flight condition and make a smooth transition from any flight condition to any other flight condition without exceptional piloting skill, alertness, or strength, and without danger of exceeding the limit load factor under any operating condition probable for the type, including—
- (1) Sudden failure of one engine, for multiengine rotorcraft meeting Transport Category A engine isolation requirements of Part 29 of this chapter; and
 - (2) Sudden, complete power failure, for other rotorcraft; and
 - (3) Sudden, complete control system failures specified in Sec. 27.695 of this Part; and

- (ii) If its oil system is separate from the engine oil system, oil pressure and oil temperature indicators must be provided.

- (7) A coolant temperature indicator for each liquid-cooled engine.

- (c) For *turbine engine-powered airplanes*. In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required :

- (1) A gas temperature indicator for each engine.
 - (2) A fuel flowmeter indicator for each engine.
 - (3) A fuel low pressure warning means for each engine.
 - (4) A fuel low level warning means for any fuel tank that should not be depleted of fuel in normal operations.
 - (5) A tachometer indicator (to indicate the speed of the rotors with established limiting speeds) for each engine.
 - (6) An oil low pressure warning means for each engine.
 - (7) An indicating means to indicate the functioning of the powerplant ice protection system for each engine.
 - (8) For each engine, an indicating means for the fuel strainer or filter required by Sec. 23.997 to indicate the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with Sec. 23.997(d).
 - (9) For each engine, a warning means for the oil strainer or filter required by Sec. 23.1019, if it has no bypass, to warn the pilot of the occurrence of contamination of the strainer or filter screen before it reaches the capacity established in accordance with Sec. 23.1019(a)(5).
 - (10) An indicating means to indicate the functioning of any heater used to prevent ice clogging of fuel system components.
- (d) For *turbojet/turbofan engine-powered airplanes*. In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required :
- (1) For each engine, an indicator to indicate thrust or to indicate a parameter that can be related to thrust, including a free air temperature indicator if needed for this purpose.
 - (2) For each engine, a position indicating means to indicate to the flight crew when the thrust reverser, if installed, is in the reverse thrust position.
- (e) For *turbopropeller-powered airplanes*. In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required :
- (1) A torque indicator for each engine.
 - (2) A position indicating means to indicate to the flight crew when the propeller blade angle is below the flight low pitch position, for each propeller, unless it can be shown that such occurrence is highly improbable.

Amdt. 23-52, Eff. 07/25/96

FAR 23.1307 : Miscellaneous equipment.

[The equipment necessary for an airplane to operate at the maximum operating altitude and in the kinds of operations and meteorological conditions for which certification is requested and is approved in accordance with Sec. 23.1559 must be included in the type design.]
Amdt. 23-49, EFF. 03/11/96

FAR 23.1309 : Equipment, systems, and installations.

- (a) Each item of equipment, each system, and each installation :
 - (1) When performing its intended function, may not adversely affect the response, operation, or accuracy of any—
 - (i) Equipment essential to safe operation ; or
 - (ii) Other equipment unless there is a means to inform the pilot of the effect.
 - (2) In a single-engine airplane, must be designed to minimize hazards to the airplane in the event of a probable malfunction or failure.
 - (3) In a multiengine airplane, must be designed to prevent hazards to the airplane in the event of a probable malfunction or failure.
 - (4) [In a commuter category airplane, must be designed to safeguard against hazards to the airplane in the event of their malfunction or failure.]
- (b) The design of each item of equipment, each system, and each installation must be examined separately and in relationship to other airplane systems and installations to determine if the airplane is dependent upon its function for continued safe flight and landing and, for airplanes not limited to VFR conditions, if failure of a system would significantly reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions. Each item of equipment, each system, and each installation identified by this examination as one upon which the airplane is dependent for proper functioning to ensure continued safe flight and landing, or whose failure would significantly reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions, must be designed to comply with the following additional requirements :
 - (1) It must perform its intended function under any foreseeable operating condition.
 - (2) When systems and associated components are considered separately and in relation to other systems—
 - (i) The occurrence of any failure condition that would prevent the continued safe flight and landing of the airplane must be extremely improbable; and
 - (ii) The occurrence of any other failure condition that would significantly reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions must be improbable.
 - (3) Warning information must be provided to alert the crew to unsafe system operating conditions and to enable them to take appropriate corrective action. Systems, controls, and associated monitoring and warning means must be designed to minimize crew errors that could create additional hazards.
 - (4) Compliance with the requirements of paragraph (b)(2) of this section may be shown by analysis and, where necessary, by appropriate ground, flight, or simulator test. The analysis must consider—

FAR 27.71 : [Glide performance.]

[For single-engine helicopters and multiengine helicopters that do not meet the Category A engine isolation requirements of Part 29 of this chapter, the minimum rate of descent airspeed and the best angle-of-glide airspeed must be determined in autorotation at—

- (a) Maximum weight; and
- (b) Rotor speed(s) selected by the applicant.]
Amdt. 27-21, EFF. 12/6/84

FAR 27.73 : Performance at minimum operating speed

- (a) For helicopters—
 - (1) The hovering ceiling must be determined over the ranges of weight, altitude, and temperature for which certification is requested, with—
 - (i) Takeoff power; and
 - (ii) The landing gear extended ; and
 - (iii) The helicopter in ground effect at a height consistent with normal takeoff procedures ; and
 - (2) The hovering ceiling determined under subparagraph (1) of this paragraph must be at least—
 - (i) For reciprocating engine powered helicopters, 4,000 feet at maximum weight with a standard atmosphere ; or
 - (ii) For turbine engine powered helicopters, 2,500 feet pressure altitude at maximum weight at a temperature of standard +40 degrees F.
 - (b) For rotorcraft other than helicopters, the steady rate of climb at the minimum operating speed must be determined, over the ranges of weight, altitude, and temperature for which certification is requested, with—
 - (1) Takeoff power ; and
 - (2) The landing gear extended.
- FAR 27.75 : Landing**
- (a) The rotorcraft must be able to be landed with no excessive vertical acceleration, no tendency to bounce, nose over, ground loop, porpoise, or water loop, and without exceptional piloting skills or exceptionally favorable conditions, with—
 - (1) Approach or glide speeds appropriate to the type of rotorcraft and selected by the applicant ;
 - (2) The approach and landing made with—
 - (i) Power off, for single-engine rotorcraft ; and
 - (ii) [For multiengine rotorcraft, one engine inoperative and with each operating engine within approved operating limitations ; and]
 - (3) The approach and landing entered from steady autorotation.
 - (b) Multiengine rotorcraft must be able to be landed safely after complete power failure under normal operating conditions.
Amdt. 27-14, EFF. 3/1/78

FAR 27.65 : Climb : All engines operating

- (a) For rotorcraft other than helicopters—
- (1) The steady rate of climb, at V_Y , must be determined—
 - (i) With maximum continuous power on each engine;
 - (ii) With the landing gear retracted; and
 - (iii) For the weights, altitudes, and temperatures for which certification is requested; and
 - (2) [The climb gradient, at the rate of climb determined in accordance with paragraph (a)(1) of this section, must be either—]
 - (i) At least 1:10 if the horizontal distance required to take off and climb over a 50-foot obstacle is determined for each weight, altitude, and temperature within the range for which certification is requested; or
 - (ii) [At least 1:6 under standard sea level conditions.]
- (b) Each helicopter must meet the following requirements :
- (1) V_Y must be determined—
 - (i) For standard sea level conditions;
 - (ii) At maximum weight; and
 - (iii) With maximum continuous power on each engine.
 - (2) [The steady rate of climb must be determined—
 - (i) At the climb speed selected by the applicant at or below V_{NE} ;
 - (ii) Within the range from sea level up to the maximum altitude for which certification is requested;
 - (iii) For the weights and temperatures that correspond to the altitude range set forth in paragraph (b)(2)(i) of this section and for which certification is requested; and
 - (iv) With maximum continuous power on each engine.]

Amdt. 27-33, Eff. 8/8/96

FAR 27.67 : Climb : one engine inoperative

For multieengineed helicopters, the steady rate of climb (or descent), at V_Y (or at the speed for minimum rate of descent), must be determined with—

- (a) Maximum weight;
- (b) [The critical engine inoperative and the remaining engines at either—
 - (1) Maximum continuous power and, for helicopters for which certification for the use of 30-minute OEI power is requested, at 30-minute OEI power; or
 - (2) Continuous OEI power for helicopters for which certification for the use of continuous OEI power is requested.]

Amdt. 27-23, Eff. 10/3/88

- (i) Possible modes of failure, including malfunctions and damage from external sources;
 - (ii) The probability of multiple failures and the probability or undetected faults;
 - (iii) The resulting effects of the airplane and occupants, considering the stage of flight and operating conditions; and
 - (iv) The crew warning cues, corrective action required, and the crew's capability of determining faults.
- (c) Each item of equipment, each system, and each installation whose functioning is required by this chapter and that requires a power supply is an "essential load" on the power supply. The power sources and the system must be able to supply the following power loads in probable operating combinations and for probable durations :
- (1) Loads connected to the power distribution system with the system functioning normally.
 - (2) Essential loads after failure of—
 - (i) Any one engine on two-engine airplanes; or
 - (ii) Any two engines on an airplane with three or more engines; or
 - (iii) Any power converter or energy storage device.
 - (3) Essential loads for which an alternate source of power is required, as applicable, by the operating rules of this chapter, after any failure or malfunction in any one power supply system, distribution system, or other utilization system.
 - (d) In determining compliance with paragraph (c)(2) of this section, the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operations authorized. Loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airplanes with three or more engines.
 - (e) In showing compliance with this section with regard to the electrical power system and to equipment design and installation, critical environmental and atmospheric conditions, including radio frequency energy and the effects (both direct and indirect) of lightning strikes, must be considered. For electrical generation, distribution, and utilization equipment required by or used in complying with this chapter, the ability to provide continuous, safe service under foreseeable environmental conditions may be shown by environmental tests, design analysis, or reference to previous comparable service experience on other airplanes.
 - (f) As used in this section, "systems" refers to all pneumatic systems, fluid systems, electrical systems, mechanical systems, and powerplant systems included in the airplane design, except for the following :
 - (1) Powerplant systems provided as part of the certificated engine.
 - (2) The flight structure (such as wing, empennage, control surfaces and their systems, the fuselage, engine mounting, and landing gear and their related primary attachments) whose requirements are specific in subparts C and D of this part.

Amdt. 23-49, Eff. 03/11/96

33.2 Instruments : Installation

FAR 23.1311 : Electronic display instrument systems.

- (a) [Electronic display indicators, including those with features that make isolation and independence between powerplant instrument systems impractical, must :
 - (1) Meet the arrangement and visibility requirements of Sec. 23.1321.
 - (2) Be easily legible under all lighting conditions encountered in the cockpit, including direct sunlight, considering the expected electronic display brightness level at the end of an electronic display indicator's useful life. Specific limitations on display system useful life must be contained in the Instructions for Continued Airworthiness required by Sec. 23.1529.
 - (3) Not inhibit the primary display of attitude, airspeed, altitude, or powerplant parameters needed by any pilot to set power within established limitations, in any normal mode of operation.
 - (4) Not inhibit the primary display of engine parameters needed by any pilot to properly set or monitor powerplant limitations during the engine starting mode of operation.
 - (5) Have an independent magnetic direction indicator and either an independent secondary mechanical altimeter, airspeed indicator, and attitude instrument or individual electronic display indicators for the altitude, airspeed, and attitude that are independent from the airplane's primary electrical power system. These secondary instruments may be installed in panel positions that are displaced from the primary positions specified by Sec. 23.1321(d), but must be located where they meet the pilot's visibility requirements of Sec. 23.1321(a).
 - (6) Incorporate sensory cues for the pilot that are equivalent to those in the instrument being replaced by the electronic display indicators.
 - (7) Incorporate visual displays of instrument markings, required by Secs. 23.1541 through 23.1553, or visual displays that alert the pilot to abnormal operational values or approaches to established limitation values, for each parameter required to be displayed by this part.
 - (b) The electronic display indicators, including their systems and installations, and considering other airplane systems, must be designed so that one display of information essential for continued safe flight and landing will remain available to the crew, without need for immediate action by any pilot for continued safe operation, after any single failure or probable combination of failures.
 - (c) As used in this section, "instrument" includes devices that are physically contained in one unit, and devices that are composed of two or more physically separate units or components connected together (such as a remote indicating gyroscopic direction indicator that includes a magnetic sensing element, a gyroscopic unit, an amplifier, and an indicator connected together). As used in this section, "primary" display refers to the display of a parameter that is located in the instrument panel such that the pilot looks at it first when wanting to view that parameter.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1321 : Arrangement and visibility.

- (a) Each flight, navigation, and powerplant instrument for use by any required pilot during takeoff, initial climb, final approach, and landing must be located so that

- (4) If a warning device is used, the device must automatically deactivate and reset when the low-speed condition is corrected. If the device has an audible warning, it must also be equipped with a means for the pilot to manually silence the audible warning before the low-speed condition is corrected.]

Amdt. 27-14, Eff. 3/1/78

62.2 Performance

FAR 27.45 : General

- (a) Unless otherwise prescribed, the performance requirements of this subpart must be met for still air and a standard atmosphere.
- (b) The performance must correspond to the engine power available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraphs (d) or (e) of this section, as appropriate.
- (c) The available power must correspond to engine power, not exceeding the approved power, less—
 - (1) Installation losses; and
 - (2) The power absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.
- (d) For reciprocating engine-powered rotorcraft, the performance, as affected by engine power, must be based on a relative humidity of 80 percent in a standard atmosphere.
- (e) For turbine engine-powered rotorcraft, the performance, as affected by engine power, must be based on a relative humidity of—
 - (1) 80 percent, at and below standard temperature; and
 - (2) 34 percent, at and above standard temperature plus 50 degrees F. Between these two temperatures, the relative humidity must vary linearly.
- (f) [For turbine-engine-powered rotorcraft, a means must be provided to permit the pilot to determine prior to takeoff that each engine is capable of developing the power necessary to achieve the applicable rotorcraft performance prescribed in this subpart.]

Amdt. 27-21, Eff. 12/6/84

FAR 27.51 : Takeoff

- (a) The takeoff, with takeoff power and r.p.m., and with the extreme forward center of gravity—
 - (1) May not require exceptional piloting skill or exceptionally favorable conditions; and
 - (2) Must be made in such a manner that a landing can be made safely at any point along the flight path if an engine fails.
- (b) Paragraph (a) of this section must be met throughout the ranges of—
 - (1) Altitude, from standard sea level conditions to the maximum altitude capability of the rotorcraft, or 7,000 feet, whichever is less; and
 - (2) Weight, from the maximum weight (at sea level) to each lesser weight selected by the applicant for each altitude covered by subparagraph (1) of this paragraph.

FAR 27.31 : Removable ballast

Removable ballast may be used in showing compliance with the flight requirements of this subpart.

FAR 27.33 : Main rotor speed and pitch limits

- (a) Main rotor speed limits. A range of main rotor speeds must be established that—
- (1) With power on, provides adequate margin to accommodate the variations in rotor speed occurring in any appropriate maneuver, and is consistent with the kind of governor or synchronizer used; and
 - (2) With power off, allows each appropriate autorotative maneuver to be performed throughout the ranges of airspeed and weight for which certification is requested.
- [(b) Normal main rotor pitch limits (power-on). For rotorcraft, except helicopters required to have a main rotor low speed warning under paragraph (e) of this section, it must be shown with power on and without exceeding approved engine maximum limitations, that main rotor speeds substantially less than the minimum approved main rotor speed will not occur under any sustained flight condition. This must be met by—]
- (1) Appropriate setting of the main rotor high pitch stop;
 - (2) Inherent rotorcraft characteristics that make unsafe low main rotor speeds unlikely; or
 - (3) Adequate means to warn the pilot of unsafe main rotor speeds.
- (c) Normal main rotor low pitch limits (power off). It must be shown, with power off, that—
- (1) The normal main rotor low pitch limit provides sufficient rotor speed, in any autorotative condition, under the most critical combinations of weight and airspeed; and
 - (2) It is possible to prevent overspeeding of the rotor without exceptional piloting skill.
- (d) Emergency high pitch. If the main rotor high pitch stop is set to meet paragraph (b)(1) of this section, and if that stop cannot be exceeded inadvertently, additional pitch may be made available for emergency use.
- [(e) Main rotor low speed warning for helicopters. For each single engine helicopter, and each multiengine helicopter that does not have an approved device that automatically increases power on the operating engines when one engine fails, there must be a main rotor low speed warning which meets the following requirements :
- (1) The warning must be furnished to the pilot in all flight conditions, including power-on and power-off flight, when the speed of a main rotor approaches a value that can jeopardize safe flight.
 - (2) The warning may be furnished either through the inherent aerodynamic qualities of the helicopter or by a device.
 - (3) The warning must be clear and distinct under all conditions, and must be clearly distinguishable from all other warnings. A visual device that requires the attention of the crew within the cockpit is not acceptable by itself.

any pilot seated at the controls can monitor the airplane's flight path and these instruments with minimum head and eye movement. The powerplant instruments for these flight conditions are those needed to set power within powerplant limitations.

- (b) For each multiengine airplane, identical powerplant instruments must be located so as to prevent confusion as to which engine each instrument relates.
 - (c) Instrument panel vibration may not damage, or impair the accuracy of, any instrument.
 - (d) [For each airplane, the flight instruments required by Sec. 23.1303, and, as applicable, by the operating rules of this chapter, must be grouped on the instrument panel and centered as nearly as practicable about the vertical plane of each required pilot's forward vision. In addition :]
 - (1) The instrument that most effectively indicates the attitude must be on the panel in the top center position ;
 - (2) The instrument that most effectively indicates airspeed must be adjacent to and directly to the left of the instrument in the top center position ;
 - (3) The instrument that most effectively indicates altitude must be adjacent to and directly to the right of the instrument in the top center position ; and
 - (4) The instrument that most effectively indicates direction of flight, other than the magnetic direction indicator required by Sec. 23.1303(c), must be adjacent to and directly below the instrument in the top center position ; and
 - (5) Electronic display indicators may be used for compliance with paragraphs (d)(1) through (d)(4) of this section when such displays comply with requirements in Sec. 23.1311.
 - (e) If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.
- Amtdt. 23-49, Eff. 03/11/96

FAR 23.1322 : Warning, caution, and advisory lights.

If warning, caution, or advisory lights are installed in the cockpit, they must, unless otherwise approved by the Administrator, be—

- (a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action) ;
 - (b) Amber, for caution lights (lights indicating the possible need for future corrective action) ;
 - (c) Green, for safe operation lights ; and
 - (d) Any other color, including white, for lights not described in paragraphs (a) through (c) of this section, provided the color differs sufficiently from the colors prescribed in paragraphs (a) through (c) of this section to avoid possible confusion.
- (e) [Effective under all probable cockpit lighting conditions.]

Amtdt. 23-43, Eff. 05/10/93

FAR 23.1323 : Airspeed indicating system.

- (a) Each airspeed indicating instrument must be calibrated to indicate true airspeed (at sea level with a standard atmosphere) with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied.
- (b) Each airspeed system must be calibrated in flight to determine the system error. The system error, including position error, but excluding the airspeed indicator instrument calibration error, may not exceed three percent of the calibrated airspeed or five knots, whichever is greater, throughout the following speed ranges :
 - (1) $1.3V_{SI}$ to V_{MO}/M_{MO} or V_{NE} , whichever is appropriate with flaps retracted.
 - (2) $1.3V_{SI}$ to V_{FE} with flaps extended.
- (c) [The design and installation of each airspeed indicating system must provide positive drainage of moisture from the pitot static plumbing.]
- (d) If certification for instrument flight rules or flight in icing conditions is requested, each airspeed system must have a heated pitot tube or an equivalent means of preventing malfunction due to icing.
- (e) In addition, for commuter category airplanes, the airspeed indicating system must be calibrated to determine the system error during the accelerate-takeoff ground run. The ground run calibration must be obtained between 0.8 of the minimum value of V_1 and 1.2 times the maximum value of V_1 , considering the approved ranges of altitude and weight. The ground run calibration must be determined assuming an engine failure at the minimum value of V_1 .
- (f) For commuter category airplanes, where duplicate airspeed indicators are required, their respective pitot tubes must be far enough apart to avoid damage to both tubes in a collision with a bird.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1325 : Static pressure system.

- (a) Each instrument provided with static pressure case connections must be vented so that the influence of airplane speed, the opening and closing of windows, airflow variations, moisture, or other foreign matter will least affect the accuracy of the instruments except as noted in paragraph (b)(3) of this section.
- (b) If a static pressure system is necessary for the functioning of instruments, systems, or devices, it must comply with the provisions of paragraphs (b)(1) through (3) of this section.
 - (1) The design and installation of a static pressure system must be such that—
 - (i) Positive drainage of moisture is provided;
 - (ii) Chafing of the tubing, and excessive distortion or restriction at bends in the tubing, is avoided; and
 - (iii) The materials used are durable, suitable for the purpose intended, and protected against corrosion.
 - (2) A proof test must be conducted to demonstrate the integrity of the static pressure system in the following manner :

- (iii) The lowest weight at which compliance with each applicable flight requirement of this Part is shown.
- (c) [Total weight with jettisonable external load. A total weight for the rotorcraft with a jettisonable external load attached that is greater than the maximum weight established under paragraph (a) of this section may be established for any rotorcraft-load combination if—
 - (1) The rotorcraft-load combination does not include human external cargo,
 - (2) Structural component approval for external load operations under either Sec. 27.865 or under equivalent operational standards is obtained,
 - (3) The portion of the total weight that is greater than the maximum weight established under paragraph (a) of this section is made up only of the weight of all or part of the jettisonable external load.
 - (4) Structural components of the rotorcraft are shown to comply with the applicable structural requirements of this part under the increased loads and stresses caused by the weight increase over that established under paragraph (a) of this section, and
 - (5) Operation of the rotorcraft at a total weight greater than the maximum certificated weight established under paragraph (a) of this section is limited by appropriate operating limitations under Sec. 27.865(a) and (d) of this part.]

Amdt. 27-36, Eff. 10/5/99

FAR 27.27 : Center of gravity limits

- [The extreme forward and aft centers of gravity and, where critical, the extreme lateral centers of gravity must be established for each weight established under Sec. 27.25. Such an extreme may not lie beyond—
- (a) The extremes selected by the applicant;
 - (b) The extremes within which the structure is proven, or
 - (c) The extremes within which compliance with the applicable flight requirements is shown.]

Amdt. 27-2, Eff. 2/25/68

FAR 27.29 : Empty weight and corresponding center of gravity

- (a) The empty weight and corresponding center of gravity must be determined by weighing the rotorcraft without the crew and payload, but with—
 - (1) Fixed ballast ;
 - (2) Unusable fuel ; [and
 - (3) Full operating fluids, including—
 - (i) Oil ;
 - (ii) Hydraulic fluid ; and
 - (iii) Other fluids required for normal operation of rotorcraft systems, except water intended for injection in the engines.]
- (b) The condition of the rotorcraft at the time of determining empty weight must be one that is well defined and can be easily repeated, particularly with respect to the weights of fuel, oil, coolant, and installed equipment.

Amdt. 27-14, Eff. 3/1/78

62.1 General

FAR 27.21 : Proof of compliance

[Each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested. This must be shown—

- (a) By tests upon a rotorcraft of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and
- (b) By systematic investigation of each required combination of weight and center of gravity if compliance cannot be reasonably inferred from combinations investigated.]

Amdt. 27-21, Eff. 12/6/84

FAR 27.25 : Weight limits

- (a) Maximum weight. The maximum weight (the highest weight at which compliance with each applicable requirement of this Part is shown) must be established so that it is—

- (1) Not more than—
 - (i) The highest weight selected by the applicant ;
 - (ii) The design maximum weight (the highest weight at which compliance with each applicable structural loading condition of this Part is shown) ;
 or
- (iii) The highest weight at which compliance with each applicable flight requirement of this Part is shown ; and

- (2) Not less than the sum of—

- (i) The empty weight determined under Sec. 27.29 ;
- (ii) The weight of usable fuel appropriate to the intended operation with full payload ;
- (iii) The weight of full oil capacity ; and
- (iv) For each seat, an occupant weight of 170 pounds or any lower weight for which certification is requested.

- (b) Minimum weight. The minimum weight (the lowest weight at which compliance with each applicable requirement of this Part is shown) must be established so that it is—

- (1) Not more than the sum of—
 - (i) The empty weight determined under Sec. 27.29 ; and
 - (ii) The weight of the minimum crew necessary to operate the rotorcraft, assuming for each crewmember a weight no more than 170 pounds, or any lower weight selected by the applicant or included in the loading instructions ; and
- (2) Not less than—

- (i) The lowest weight selected by the applicant ;
- (ii) The design minimum weight (the lowest weight at which compliance with each applicable structural loading condition of this Part is shown) ; or

- (i) *Unpressurized airplanes.* Evacuate the static pressure system to a pressure differential of approximately 1 inch of mercury or to a reading on the altimeter, 1,000 feet above the aircraft elevation at the time of the test. Without additional pumping for a period of 1 minute, the loss of indicated altitude must not exceed 100 feet on the altimeter.

- (ii) *Pressurized airplanes.* Evacuate the static pressure system until a pressure differential equivalent to the maximum cabin pressure differential for which the airplane is type certificated is achieved. Without additional pumping for a period of 1 minute, the loss of indicated altitude must not exceed 2 percent of the equivalent altitude of the maximum cabin differential pressure or 100 feet, whichever is greater.

- (3) If a static pressure system is provided for any instrument, device, or system required by the operating rules of this chapter, each static pressure port must be designed or located in such manner that the correlation between air pressure in the static pressure system and true ambient atmospheric static pressure is not altered when the aircraft encounters icing conditions. An anti-icing means or an alternate source of static pressure may be used in showing compliance with this requirement. If the reading of the altimeter, when on the alternate static pressure system differs from the reading of the altimeter when on the primary static system by more than 50 feet, a correction card must be provided for the alternate static system.

- (c) Except as provided in paragraph (d) of this section, if the static pressure system incorporates both a primary and an alternate static pressure source, the means for selecting one or the other source must be designed so that—

- (1) When either source is selected, the other is blocked off; and
- (2) Both sources cannot be blocked off simultaneously.

- (d) For unpressurized airplanes, paragraph (c)(1) of this section does not apply if it can be demonstrated that the static pressure system calibration, when either static pressure source is selected, is not changed by the other static pressure source being open or blocked.

- (e) [Each static pressure system must be calibrated in flight to determine the system error. The system error, in indicated pressure altitude, at sea-level, with a standard atmosphere, excluding instrument calibration error, may not exceed ± 30 feet per 100 knot speed for the appropriate configuration in the speed range between $1.3V_{S0}$ with flaps extended, and $1.8V_{S1}$ with flaps retracted. However, the error need not be less than 30 feet.

- (f) [Reserved]

- (g) For airplanes prohibited from flight in instrument meteorological or icing conditions, in accordance with Sec. 23.1559(b) of this part, paragraph (b)(3) of this section does not apply.

Amdt. 23-50, Eff. 03/12/96

FAR 23.1326 : [Pitot heat indication systems.]

[If a flight instrument pitot heating system is installed to meet the requirements specified in Sec. 23.1323(d), an indication system must be provided to indicate to the flight crew when that pitot heating system is not operating. The indication system must comply with the following requirements :

- (a) The indication provided must incorporate an amber light that is in clear view of a flightcrew member.
- (b) The indication provided must be designed to alert the flight crew if either of the following conditions exist :

- (1) The pitot heating system is switched "off"
- (2) The pitot heating system is switched "on" and any pitot tube heating element is inoperative.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1327 : Magnetic direction indicator.

- (a) [Except as provided in paragraph (b) of this section—

- (1) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the airplane's vibration or magnetic fields; and
- (2) The compensated installation may not have a deviation, in level flight, greater than ten degrees on any heading.

- (b) A magnetic nonstabilized direction indicator may deviate more than ten degrees due to the operation of electrically powered systems such as electrically heated windshield if either a magnetic stabilized direction indicator, which does not have a deviation in level flight greater than ten degrees on any heading, or a gyroscopic direction indicator, is installed. Deviations of a magnetic nonstabilized direction indicator of more than 10 degrees must be placarded in accordance with Sec. 23.1547 (e).]

Amdt. 23-20 Eff. 09/01/77

FAR 23.1329 : Automatic pilot system.

- If an automatic pilot system is installed, it must meet the following :

- (a) Each system must be designed so that the automatic pilot can—
 - (1) Be quickly and positively disengaged by the pilots to prevent it from interfering with their control of the airplane; or
 - (2) Be sufficiently overpowered by one pilot to let him control the airplane.

- (b) If the provisions of paragraph (a)(1) of this section are applied, the quick release (emergency) control must be located on the control wheel [both control wheels if the airplane can be operated from either pilot seat]] on the side opposite the throttles, or on the stick control. (both stick controls, if the airplane can be operated from either pilot seat) such that it can be operated without moving the hand from its normal position on the control.

- (c) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.

- (d) Each manually operated control for the system operation must be readily accessible to the pilot. Each control must operate in the same plane and sense of motion as specified in Sec. 23.779 for cockpit controls. The direction of motion must be plainly indicated on or near each control.

Chapitre 62

Subpart B : Flight

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FAR 27.1 : Applicability

- (a) [This part prescribes airworthiness standards for the issue of type certificates, and changes to those certificates, for normal category rotorcraft with maximum weights of 7,000 pounds or less and nine or less passenger seats.]
- (b) Each person who applies under Part 21 for such a certificate or change must show compliance with the applicable requirements of this part.
- (c) Multiengine rotorcraft may be type certificated as Category A provided the requirements referenced in appendix C of this part are met.

Amdt. 27-37, Eff. 10/18/99

FAR 27.2 : Special retroactive requirements

- (a) For each rotorcraft manufactured after September 16, 1992, each applicant must show that each occupant's seat is equipped with a safety belt and shoulder harness that meets the requirements of paragraphs (a), (b), and (c) of this section.
- (1) Each occupant's seat must have a combined safety belt and shoulder harness with a single-point release. Each pilot's combined safety belt and shoulder harness must allow each pilot, when seated with safety belt and shoulder harness fastened, to perform all functions necessary for flight operations. There must be a means to secure belts and harnesses, when not in use, to prevent interference with the operation of the rotorcraft and with rapid egress in an emergency.
- (2) Each occupant must be protected from serious head injury by a safety belt plus a shoulder harness that will prevent the head from contacting any injurious object.
- (3) The safety belt and shoulder harness must meet the static and dynamic strength requirements, if applicable, specified by the rotorcraft type certification basis.
- (4) For purposes of this section, the date of manufacture is either—
- (i) The date the inspection acceptance records, or equivalent, reflect that the rotorcraft is complete and meets the FAA-Approved Type Design Data; or
- (ii) The date the foreign civil airworthiness authority certifies that the rotorcraft is complete and issues an original standard airworthiness certificate, or equivalent, in that country.
- (b) For rotorcraft with a certification basis established prior to October 18, 1999—
- (1) The maximum passenger seat capacity may be increased to eight or nine provided the applicant shows compliance with all the airworthiness requirements of this part in effect on October 18, 1999.
- (2) The maximum weight may be increased to greater than 6,000 pounds provided—
- (i) The number of passenger seats is not increased above the maximum number certificated on October 18, 1999, or
- (ii) The applicant shows compliance with all of the airworthiness requirements of this part in effect on October 18, 1999.

Amdt. 27-37, Eff. 10/18/99

- (e) Each system must be designed and adjusted so that, within the range of adjustment available to the pilot, it cannot produce hazardous loads on the airplane or create hazardous deviations in the flight path, under any flight condition appropriate to its use, either during normal operation or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

- (f) Each system must be designed so that a single malfunction will not produce a hardover signal in more than one control axis. If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, positive interlocks and sequencing of engagement to prevent improper operation are required.

- (g) There must be protection against adverse interaction of integrated components, resulting from a malfunction.

- (h) If the automatic pilot system can be coupled to airborne navigation equipment, means must be provided to indicate to the flight crew the current mode of operation. Selector switch position is not acceptable as a means of indication.

Amdt. 23-49, Eff. 03/11/96

FAR 23.1331 : Instruments using a power [source.]

[For each instrument that uses a power source, the following apply :

- (a) Each instrument must have an integral visual power annunciator or separate power indicator to indicate when power is not adequate to sustain proper instrument performance. If a separate indicator is used, it must be located so that the pilot using the instruments can monitor the indicator with minimum head and eye movement. The power must be sensed at or near the point where it enters the instrument. For electric and vacuum/pressure instruments, the power is considered to be adequate when the voltage or the vacuum/pressure, respectively, is within approved limits.
- (b) The installation and power supply systems must be designed so that—
- (1) The failure of one instrument will not interfere with the proper supply of energy to the remaining instrument ; and
- (2) The failure of the energy supply from one source will not interfere with the proper supply of energy from any other source.
- (c) There must be at least two independent sources of power (not driven by the same engine on multiengine airplanes), and a manual or an automatic means to select each power source.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1335 : Flight director [systems.]

[If a flight director system is installed, means must be provided to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.]

Amdt. 23-20, Eff. 09/01/77

FAR 23.1337 : Powerplant instruments installation.

- (a) *Instruments and instrument lines.*

- (1) Each powerplant and auxiliary power unit instrument line must meet the requirements of Sec. 23.993.
- (2) Each line carrying flammable fluids under pressure must—
 - (i) Have restricting orifices or other safety devices at the source of pressure to prevent the escape of excessive fluid if the line fails; and
 - (ii) Be installed and located so that the escape of fluids would not create a hazard.
- (3) Each powerplant and auxiliary power unit instrument that utilizes flammable fluids must be installed and located so that the escape of fluid would not create a hazard.
- (b) *Fuel quantity indicator.* There must be a means to indicate to the flightcrew members the quantity of usable fuel in each tank during flight. An indicator calibrated in appropriate units and clearly marked to indicate those units must be used. In addition—
 - (1) Each fuel quantity indicator must be calibrated to read "zero" during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under [Sec. 23.956(a)].
 - (2) Each exposed sight gauge used as a fuel quantity indicator must be protected against damage;
 - (3) Each sight gauge that forms a trap in which water can collect and freeze must have means to allow drainage on the ground;
 - (4) There must be a means to indicate the amount of usable fuel in each tank when the airplane is on the ground (such as by a stick gauge);
 - (5) Tanks with interconnected outlets and airspace may be considered as one tank and need not have separate indicators; and
 - (6) No fuel quantity indicator is required for an auxiliary tank that is used only to transfer fuel to other tanks if the relative size of the tank, the rate of fuel transfer, and operating instructions are adequate to—
 - (i) Guard against overflow; and
 - (ii) Give the flight crewmembers prompt warning if transfer is not proceeding as planned.
- (c) *Fuel flowmeter system.* If a fuel flowmeter system is installed, each metering component must have a means to by-pass the fuel supply if malfunctioning of that component severely restricts fuel flow.
- (d) *Oil quantity indicator.* There must be a means to indicate the quantity of oil in each tank—
 - (1) On the ground (such as by a stick gauge); and
 - (2) In flight, to the flight crewmembers, if there is an oil transfer system or a reserve oil supply system.
- (e) [Deleted.]

Amdt. 23-51, EF. 03/12/96

Chapitre 61

Subpart A : General

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33.3 Electrical Systems and Equipment

FAR 23.1351 : General.

- (a) *Electrical system capacity.* Each electrical system must be adequate for the intended use. In addition—
- (1) Electric power sources, their transmission cables, and their associated control and protective devices, must be able to furnish the required power at the proper voltage to each load circuit essential for safe operation; and
 - (2) Compliance with paragraph (a)(1) of this section must be shown as follows—
 - (i) For normal, utility, and acrobatic category airplanes, by an electrical load analysis or by electrical measurements that account for the electrical loads applied to the electrical system in probable combinations and for probable durations; and
 - (ii) For commuter category airplanes, by an electrical load analysis that accounts for the electrical loads applied to the electrical system in probable combinations and for probable durations.
- (b) *Function.* For each electrical system, the following apply :
- (1) Each system, when installed, must be—
 - (i) Free from hazards in itself, in its method of operation, and in its effects on other parts of the airplane;
 - (ii) Protected from fuel, oil, water, other detrimental substances, and mechanical damage; and
 - (iii) So designed that the risk of electrical shock to crew, passengers, and ground personnel is reduced to a minimum.
 - (2) [Electric power sources must function properly when connected in combination or independently.
 - (3) No failure or malfunction of any electric power source may impair the ability of any remaining source to supply load circuits essential for safe operation.
 - (4) In addition, for commuter category airplanes, the following apply :]
 - (i) Each system must be designed so that essential load circuits can be supplied in the event of reasonably probable faults or open circuits including faults in heavy current carrying cables ;
 - (ii) A means must be accessible in flight to the flight crewmembers for the individual and collective disconnection of the electrical power sources from the system ;
 - (iii) The system must be designed so that voltage and frequency, if applicable, at the terminals of all essential load equipment can be maintained within the limits for which the equipment is designed during any probable operating conditions ;
 - (iv) If two independent sources of electrical power for particular equipment or systems are required, their electrical energy supply must be ensured by means such as duplicate electrical equipment, throwover switching, or multichannel or loop circuits separately routed ; and
 - (v) For the purpose of complying with paragraph (b)(5) of this section, the distribution system includes the distribution busses, their associated feeders, and each control and protective device.

- (c) *Generating system.* There must be at least one generator/alternator if the electrical system supplies power to load circuits essential for safe operation. In addition—
- (1) Each generator/alternator must be able to deliver its continuous rated power, or such power as is limited by its regulation system.
 - (2) Generator/alternator voltage control equipment must be able to dependably regulate the generator/alternator output within rated limits;
 - (3) [Automatic means must be provided to prevent damage to any generator/alternator and adverse effects on the airplane electrical system due to reverse current. A means must also be provided to disconnect each generator/alternator from the battery and other generators/alternators.]
 - (4) There must be a means to give immediate warning to the flight crew of a failure of any generator/alternator.
 - (5) Each generator/alternator must have an overvoltage control designed and installed to prevent damage to the electrical system, or to equipment supplied by the electrical system that could result if that generator/alternator were to develop an overvoltage condition.
- (d) *Instruments.* A means must exist to indicate to appropriate flight crewmembers the electric power system quantities essential for safe operation.
- (1) For normal, utility, and acrobatic category airplanes with direct current systems, an ammeter that can be switched into each generator feeder may be used and, if only one generator exists, the ammeter may be in the battery feeder.
 - (2) For commuter category airplanes, the essential electric power system quantities include the voltage and current supplied by each generator.
- (e) *Fire resistance.* Electrical equipment must be so designed and installed that in the event of a fire in the engine compartment, during which the surface of the firewall adjacent to the fire is heated to 2,000° F for 5 minutes or to a lesser temperature substantiated by the applicant, the equipment essential to continued safe operation and located behind the firewall will function satisfactorily and will not create an additional fire hazard.
- (f) *External power.* If provisions are made for connecting external power to the airplane, and that external power can be electrically connected to equipment other than that used for engine starting, means must be provided to ensure that no external power supply having a reverse polarity, or a reverse phase sequence, can supply power to the airplane's electrical system.
- (g) It must be shown by analysis, tests, or both, that the airplane can be operated safely in *VFR* conditions, for a period of not less than five minutes, with the normal electrical power (electrical power sources excluding the battery and any other standby electrical sources) inoperative, with critical type fuel (from the standpoint of flameout and restart capability), and with the airplane initially at the maximum certificated altitude. Parts of the electrical system may remain on if—
- (1) A single malfunction, including a wire bundle or junction box fire, cannot result in loss of the part turned off and the part turned on; and
 - (2) The parts turned on are electrically and mechanically isolated from the parts turned off.

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FAR 23.1353 : Storage battery design and installation.

- (a) Each storage battery must be designed and installed as prescribed in this section.
- (b) Safe cell temperatures and pressures must be maintained during any probable charging and discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge)—
 - (1) At maximum regulated voltage or power ;
 - (2) During a flight of maximum duration ; and
 - (3) Under the most adverse cooling condition likely to occur in service.
- (c) Compliance with paragraph (b) of this section must be shown by tests unless experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.
- (d) No explosive or toxic gases emitted by any battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation, may accumulate in hazardous quantities within the airplane.
- (e) No corrosive fluids or gases that may escape from the battery may damage surrounding structures or adjacent essential equipment.
- (f) Each nickel cadmium battery installation capable of being used to start an engine or auxiliary power unit must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.
- (g) Nickel cadmium battery installations capable of being used to start an engine or auxiliary power unit must have—
 - (1) A system to control the charging rate of the battery automatically so as to prevent battery overheating ;
 - (2) A battery temperature sensing and over-temperature warning system with a means for disconnecting the battery from its charging source in the event of an over-temperature condition ; or
 - (3) A battery failure sensing and warning system with a means for disconnecting the battery from its charging source in the event of battery failure.
- (h) [In the event of a complete loss of the primary electrical power generating system, the battery must be capable of providing at least 30 minutes of electrical power to those loads that are essential to continued safe flight and landing. The 30 minute time period includes the time needed for the pilots to recognize the loss of generated power and take appropriate load shedding action.]

Amndt. 23-49, Eff. 03/11/96

FAR 23.1357 : Circuit protective devices.

- (a) Protective devices, such as fuses or circuit breakers, must be installed in all electrical circuits other than—
 - (1) [Main circuits of starter motors used during starting only ; and]
 - (2) Circuits in which no hazard is presented by their omission.
- (b) A protective device for a circuit essential to flight safety may not be used to protect any other circuit.

- (c) Each resettable circuit protective device ("trip free" device in which the tripping mechanism cannot be overridden by the operating control) must be designed so that—
 - (1) A manual operation is required to restore service after tripping ; and
 - (2) If an overload or circuit fault exists, the device will open the circuit regardless of the position of the operating control.
 - (d) If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be so located and identified that it can be readily reset or replaced in flight.
 - (e) [For fuses identified as replaceable in flight—
 - (1) There must be one spare of each rating or 50 percent spare fuses of each rating, whichever is greater ; and
 - (2) The spare fuse(s) must be readily accessible to any required pilot.]
- Amdt. 23-43, 05/10/93

FAR 23.1359 : [Electrical system fire protection.]

- (a) [Each component of the electrical system must meet the applicable fire protection requirements of Secs. 23.863 and 23.1182.
 - (b) Electrical cables, terminals, and equipment in designated fire zones that are used during emergency procedures must be fire-resistant.
 - (c) Insulation on electrical wire and electrical cable must be self-extinguishing when tested at an angle of 60 degrees in accordance with the applicable portions of Appendix F of this part, or other approved equivalent methods. The average burn length must not exceed 3 inches (76 mm) and the average flame time after removal of the flame source must not exceed 30 seconds. Drippings from the test specimen must not continue to flame for more than an average of 3 seconds after falling.]
- Amdt. 23-49, Eff. 03/11/96

FAR 23.1361 : Master switch arrangement.

- (a) There must be a master switch arrangement to allow ready disconnection of each electric power source from power distribution systems, except as provided in paragraph (b) of this section. The point of disconnection must be adjacent to the sources controlled by the switch arrangement. If separate switches are incorporated into the master switch arrangement, a means must be provided for the switch arrangement to be operated by one hand with a single movement.
- (b) Load circuits may be connected so that they remain energized when the master switch is open, if the circuits are isolated, or physically shielded, to prevent their igniting flammable fluids or vapors that might be liberated by the leakage or rupture of any flammable fluid system ; and
 - (1) The circuits are required for continued operation of the engine ; or
 - (2) The circuits are protected by circuit protective devices with a rating of five amperes or less adjacent to the electric power source.
- (3) In addition, two or more circuits installed in accordance with the requirements of paragraph (b)(2) of this section must not be used to supply a load of more than five amperes.

Septième partie

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- (4) Three life-size dolls, not included as part of the total passenger load, must be carried by passengers to simulate live infants 2 years old or younger.
- (5) Crewmembers, mechanics, and training personnel, who maintain or operate the airplanes in the normal course of their duties, may not be used as passengers.
- (i) No passenger may be assigned a specific seat except as the Administrator may require. Except as required by subparagraph (g) of this paragraph, no employee of the applicant may be seated next to an emergency exit.
- (j) Seat belts and shoulder harnesses (as required) must be fastened.
- (k) Before the start of the demonstration, approximately one-half of the total average amount of carry-on baggage, blankets, pillows, and other similar articles must be distributed at several locations in aisles and emergency exit access ways to create minor obstructions.
- (l) No prior indication may be given to any crewmember or passenger of the particular exits to be used in the demonstration.
- (m) The applicant may not practice, rehearse, or describe the demonstration for the participants nor may any participant have taken part in this type of demonstration within the preceding 6 months.
- (n) The pretakeoff passenger briefing required by Sec. 121.571 may be given. The passengers may also be advised to follow directions of crewmembers but not be instructed on the procedures to be followed in the demonstration.
- (o) If safety equipment as allowed by paragraph (c) of this appendix is provided, either all passenger and cockpit windows must be blacked out or all of the emergency exits must have safety equipment in order to prevent disclosure of the available emergency exits.
- (p) Not more than 50 percent of the emergency exits in the sides of the fuselage of an airplane that meets all of the requirements applicable to required emergency exits for that airplane may be used for the demonstration. Exits that are not to be used in the demonstration must have the exit handle deactivated or must be indicated by red lights, red tape, or other acceptable means placed outside the exits to indicate fire or other reason why they are unusable. The exits to be used must be representative of all the emergency exits on the airplane and must be designated by the applicant, subject to approval by the Administrator. At least one floor level exit must be used.
- (q) [Except as provided in paragraph (c) of this section, all evacuees must leave the airplane by a means provided as part of the airplane's equipment.
- (r) The applicant's approved procedures must be fully utilized, except the flightcrew must take no active role in assisting others inside the cabin during the demonstration.]
- (s) The evacuation time period is completed when the last occupant has evacuated the airplane and is on the ground. Provided that the acceptance rate of the stand or ramp is no greater than the acceptance rate of the means available on the airplane for descent from the wing during an actual crash situation, evacuees using stands or ramps allowed by paragraph (c) of this Appendix are considered to be on the ground when they are on a stand or ramp.

Amdt. 25-79, Eff. 9/27/93

- (c) [The master switch or its controls must be so installed that the switch is easily discernible and accessible to a crewmember.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1365 : Electric cables and equipment.

- (a) Each electric connecting cable must be of adequate capacity.
- (b) [Any equipment that is associated with any electrical cable installation and that would overheat in the event of circuit overload or fault must be flame resistant. That equipment and the electrical cables must not emit dangerous quantities of toxic fumes.]
- (c) Main power cables (including generator cables) in the fuselage must be designed to allow a reasonable degree of deformation and stretching without failure and must—
- (1) Be separated from flammable fluid lines ; or
 - (2) Be shrouded by means of electrically insulated flexible conduit, or equivalent, which is in addition to the normal cable insulation.
- (d) [Means of identification must be provided for electrical cables, terminals, and connectors.
- (e) Electrical cables must be installed such that the risk of mechanical damage and/or damage caused by fluids vapors, or sources of heat, is minimized.
- (f) Where a cable cannot be protected by a circuit protection device or other overload protection, it must not cause a fire hazard under fault conditions.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1367 : Switches.

- Each switch must be—
- (a) Able to carry its rated current ;
 - (b) Constructed with enough distance or insulating material between current carrying parts and the housing so that vibration in flight will not cause shorting ;
 - (c) Accessible to appropriate flight crewmembers ; and
 - (d) Labeled as to operation and the circuit controlled.

33.4 Lights

FAR 23.1381 : Instrument lights.

- The instrument lights must—
- (a) Make each instrument and control easily readable and discernible ;
 - (b) Be installed so that their direct rays, and rays reflected from the windshield or other surface, are shielded from the pilot's eyes ; and
 - (c) Have enough distance or insulating material between current carrying parts and the housing so that vibration in flight will not cause shorting.
- A cabin dome light is not an instrument light.

FAR 23.1383 : [Taxi and landing lights.]

[Each taxi and landing light must be designed and installed so that :

- (a) No dangerous glare is visible to the pilots.
- (b) The pilot is not seriously affected by halation.
- (c) It provides enough light for night operations.
- (d) It does not cause a fire hazard in any configuration.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1385 : Position light system installation.

- (a) General. Each part of each position light system must meet the applicable requirements of this section and each system as a whole must meet the requirements of Secs. 23.1387 through 23.1397.
- (b) [Left and right position lights. Left and right position lights must consist of a red and a green light spaced laterally as far apart as practicable and installed on the airplane such that, with the airplane in the normal flying position, the red light is on the left side and the green light is on the right side.
- (c) Rear position light. The rear position light must be a white light mounted as far aft as practicable on the tail or on each wing tip.
- (d) Light covers and color filters. Each light cover or color filter must be at least flame resistant and may not change color or shape or lose any appreciable light transmission during normal use.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1387 : Position light system dihedral angles.

- (a) [Except as provided in paragraph (e) of this section, each position light must, as installed, show unbroken light within the dihedral angles described in this section.]
- (b) Dihedral angle L (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airplane, and the other at 110° to the left of the first, as viewed when looking forward along the longitudinal axis.
- (c) Dihedral angle R (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airplane, and the other at 110° to the right of the first, as viewed when looking forward along the longitudinal axis.
- (d) Dihedral angle A (aft) is formed by two intersecting vertical planes making angles of 70° to the right and to the left, respectively, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.
- (e) If the rear position light, when mounted as far aft as practicable in accordance with Sec. 23.1385(c), cannot show unbroken light within dihedral angle A (as defined in paragraph (d) of this section), a solid angle or angles of obstructed visibility totaling not more than 0.04 steradians is allowable within that dihedral angle, if such solid angle is within a cone whose apex is at the rear position light and whose elements make an angle of 30° with a vertical line passing through the rear position light.

Amdt. 23-43, Eff. 05/10/93

Chapitre 60

Appendix J

FAR 25.803 : Emergency [Evacuation]

The following test criteria and procedures must be used for showing compliance with Sec. 25.803 :

- (a) The emergency evacuation must be conducted either during the dark of the night or during daylight with the dark of night simulated. If the demonstration is conducted indoors during daylight hours, it must be conducted with each window covered and each door closed to minimize daylight effect. Illumination on the floor or ground may be used, but it must be kept low and shielded against shining into the airplane's windows or doors.
- (b) The airplane must be in a normal attitude with landing gear extended.
- (c) [Unless the airplane is equipped with an off-wing descent means, stands or ramps may be used for descent from the wing to the ground. Safety equipment such as mats or inverted life rafts may be placed on the floor or ground to protect participants. No other equipment that is not part of the emergency evacuation equipment of the airplane may be used to aid the participants in reaching the ground.]
- (d) Except as provided in paragraph (a) of this Appendix, only the airplane's emergency lighting system may provide illumination.
- (e) All emergency equipment required for the planned operation of the airplane must be installed.
- (f) Each external door and exit, and each internal door or curtain, must be in the takeoff configuration.
- (g) [Each crewmember must be seated in the normally assigned seat for takeoff and must remain in the seat until receiving the signal for commencement of the demonstration. Each crewmember must be a person having knowledge of the operation of exits and emergency equipment and, if compliance with Sec. 121.291 is also being demonstrated, each flight attendant must be a member of a regularly scheduled line crew.]
- (h) A representative passenger load of persons in normal health must be used as follows :
 - (1) [At least 40 percent of the passenger load must be female.
 - (2) At least 35 percent of the passenger load must be over 50 years of age.
 - (3) At least 15 percent of the passenger load must be female and over 50 years of age.]

FAR 25.15 : [Installation of an Automatic Takeoff Thrust Control System (ATTCS) Powerplant Controls.]

(a) [In addition to the requirements of Sec. 25.1141, no single failure or malfunction, or probable combination thereof, of the ATTCS, including associated systems, may cause the failure of any powerplant function necessary for safety.

(b) The ATTCS must be designed to :

- (1) Apply thrust or power on the operating engine(s), following any one engine failure during takeoff, to achieve the maximum approved takeoff thrust or power without exceeding engine operating limits ;
- (2) Permit manual decrease or increase in thrust or power up to the maximum takeoff thrust or power approved for the airplane under existing conditions through the use of the power lever. For airplanes equipped with limiters that automatically prevent engine operating limits from being exceeded under existing ambient conditions, other means may be used to increase the thrust or power in the event of an ATTCS failure provided the means is located on or forward of the power levers ; is easily identified and operated under all operating conditions by a single action of either pilot with the hand that is normally used to actuate the power levers ; and meets the requirements of Sec. 25.777(a), (b), and (c) ;
- (3) Provide a means to verify to the flightcrew before takeoff that the ATTCS is in a condition to operate ; and
- (4) Provide a means for the flightcrew to deactivate the automatic function. This means must be designed to prevent inadvertent deactivation.]

Amdt. 25-62, Eff. 12/9/87

FAR 25.16 : [Installation of an Automatic Takeoff Thrust Control System (ATTCS) Powerplant Instruments.]

[In addition to the requirements of Sec. 25.1305 :

- (a) A means must be provided to indicate when the ATTCS is in the armed or ready condition ; and
- (b) If the inherent flight characteristics of the airplane do not provide adequate warning that an engine has failed, a warning system that is independent of the ATTCS must be provided to give the pilot a clear warning of any engine failure during takeoff.]

Amdt. 25-62, Eff. 12/9/87

FAR 23.1389 : Position light distribution and intensities.

(a) General. The intensities prescribed in this section must be provided by new equipment with each light cover and color filter in place. Intensities must be determined with the light source operating at a steady value equal to the average luminous output of the source at the normal operating voltage of the airplane. The light distribution and intensity of each position light must meet the requirements of paragraph (b) of this section.

(b) [Position lights. The light distribution and intensities of position lights must be expressed in terms of minimum intensities in any vertical plane, and maximum intensities in overlapping beams, with dihedral angles L, R, and A, and must meet the following requirements:]

- (1) Intensities in the horizontal plane. Each intensity in the horizontal plane (the plane containing the longitudinal axis of the airplane and perpendicular to the plane of symmetry of the airplane) must equal or exceed the values in Sec. 23.1391.
- (2) Intensities in any vertical plane. Each intensity in any vertical plane (the plane perpendicular to the horizontal plane) must equal or exceed the appropriate value in Sec. 23.1393, where I is the minimum intensity prescribed in Sec. 23.1391 for the corresponding angles in the horizontal plane.
- (3) Intensities in overlaps between adjacent signals. No intensity in any overlap between adjacent signals may exceed the values in Sec. 23.1395, except that higher intensities in overlaps may be used with main beam intensities substantially greater than the minima specified in Secs. 23.1391 and 23.1393, if the overlap intensities in relation to the main beam intensities do not adversely affect signal clarity. When the peak intensity of the [left and right] position lights is more than 100 candelas, the maximum overlap intensities between them may exceed the values in Sec. 23.1395 if the overlap intensity in Area A is not more than 10 percent of peak position light intensity and the overlap intensity in Area B is not more than 2.5 percent of peak position light intensity.
- (c) Rear position light installation. A single rear position light may be installed in a position displaced laterally from the plane of symmetry of an airplane if—
 - (1) The axis of the maximum cone of illumination is parallel to the flight path in level flight ; and
 - (2) There is no obstruction aft of the light and between planes 70° to the right and left of the axis of maximum illumination.

Amdt. 23-43, Eff. 05/10/93

FAR 23.1391 : Minimum intensities in the horizontal plane of [position lights.]

Each position light intensity must equal or exceed the applicable values in the following table :

Dihedral angle (light included)	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity (candelas)
[L and R (red and green).]	0° to 10°	40
	10° to 20°	30
	20° to 110°	5
A (rear white)	110° to 180°	20

Amdt. 23-43, Eff 05/10/93

FAR 23.1393 : Minimum intensities in any vertical plane [of position lights.]

Each position light intensity must equal or exceed the applicable values in the following table :

Angle above or below the horizontal plane	Intensity
0°	1.00 I.
0° to 5°	0.90 I.
5° to 10°	0.80 I.
10° to 15°	0.70 I.
15° to 20°	0.50 I.
20° to 30°	0.30 I.
30° to 40°	0.10 I.
40° to 90°	0.05 I.

Amdt. 23-43, Eff. 05/10/93

FAR 23.1395 : Maximum intensities in overlapping beams of [position lights.]

No position light intensity may exceed the applicable values in the following table, except as provided in Sec. 23.1389(b)(3) :

Overlaps	Maximum intensity	
	Area A (candles)	Area B (candles)
Green in dihedral angle L	10	1
Red in dihedral angle R	10	1
Green in dihedral angle A	5	1
Red in dihedral angle A	5	1
Rear white in dihedral angle L	5	1
Rear white in dihedral angle R	5	1

where

- (a) Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 10° but less than 20° ; and
- (b) Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 20° .

Amdt. 23-43, Eff. 05/10/93

FAR 23.1397: Color specifications.

Each position light color must have the applicable International Commission on Illumination chromaticity coordinates as follows :

- (a) Aviation red—
 $^{**}y^{**}$ is not greater than 0.335; and
 $^{**}z^{**}$ is not greater than 0.002.
- (b) Aviation green—
 $^{**}x^{**}$ is not greater than 0.440-0.320 y;

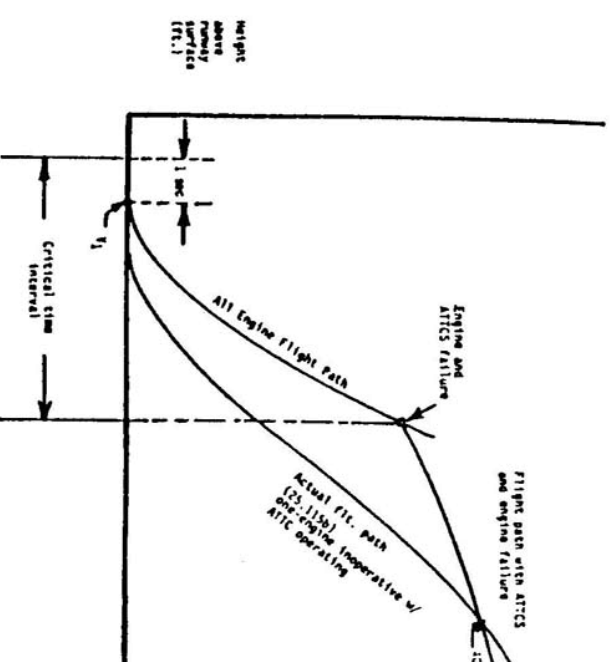


FIG. 59.1 -

FAR 25.14 : [Installation of an Automatic Takeoff Thrust Control System (ATCS) Thrust Setting.]

[The initial takeoff thrust or power setting on each engine at the beginning of the takeoff roll may not be less than any of the following :

- (a) Ninety (90) percent of the thrust or power set by the ATTCs (the maximum takeoff thrust or power approved for the airplane under existing ambient conditions) ;
- (b) That required to permit normal operation of all safety-related systems and equipment dependent upon engine thrust or power lever position ; or
- (c) That shown to be free of hazardous engine response characteristics when thrust or power is advanced from the initial takeoff thrust or power to the maximum approved takeoff thrust or power.]

Amdt. 25-62, Eff. 12/9/87

FAR 25.11 : [Installation of an Automatic Takeoff Thrust Control System (ATTCS) General.]

- (a) [This appendix specifies additional requirements for installation of an engine power control system that automatically resets thrust or power on operating engine(s) in the event of any one engine failure during takeoff.
- (b) With the ATTCS and associated systems functioning normally as designed, all applicable requirements of Part 25, except as provided in this appendix, must be met without requiring any action by the crew to increase thrust or power.]

Amdt. 25-62, Eff. 12/9/87

FAR 25.12 : [Installation of an Automatic Takeoff Thrust Control System (ATTCS) Definitions.]

- (a) [Automatic Takeoff Thrust Control System (ATTCS). An ATTCS is defined as the entire automatic system used on takeoff, including all devices, both mechanical and electrical, that sense engine failure, transmit signals, actuate fuel controls or power levers or increase engine power by other means on operating engines to achieve scheduled thrust or power increases, and furnish cockpit information on system operation.
- (b) Critical Time Interval. When conducting an ATTCS takeoff, the critical time interval is between V1 minus 1 second and a point on the minimum performance, all-engine flight path where, assuming a simultaneous occurrence of an engine and ATTCS failure, the resulting minimum flight path thereafter intersects the Part 25 required actual flight path at no less than 400 feet above the takeoff surface. This time interval is shown in the following illustration :]

Amdt. 25-62, Eff. 12/9/87

FAR 25.13 : [Installation of an Automatic Takeoff Thrust Control System (ATTCS) Performance and System Reliability Requirements]

[The applicant must comply with the performance and ATTCS reliability requirements as follows :

- (a) An ATTCS failure or a combination of failures in the ATTCS during the critical time interval :
- (1) Shall not prevent the insertion of the *maximum approved takeoff* thrust or power, or must be shown to be an improbable event.
 - (2) Shall not result in a significant loss or reduction in thrust or power, or must be shown to be an extremely improbable event.
- (b) The concurrent existence of an ATTCS failure and an engine failure during the critical time interval must be shown to be extremely improbable.
- (c) All applicable performance requirements of Part 25 must be met with an engine failure occurring at the most critical point during takeoff with the ATTCS system functioning.]

Amdt. 25-62, Eff. 12/9/87

(c) [Aviation white—

"x" is not greater than y -0.170; and
 "y" is not less than 0.390-0.170 x.

"x" is not less than 0.300 and not greater than 0.540;

"y" is not less than "x-0.040" or "y0-0.010", whichever is the smaller; and

"y" is not greater than "x+0.020" nor "0.636-0.400 x";

Where "y0" is the "y" coordinate of the Planckian radiator for the value of "x" considered.]

Amdt. 23-11, Eff. 08/11/71

FAR 23.1399 : Riding light.

- (a) Each riding (anchor) light required for a seaplane or amphibian, must be installed so that it can—
- (1) Show a white light for at least two miles at night under clear atmospheric conditions; and
 - (2) Show the maximum unbroken light practicable when the airplane is moored or drifting on the water.
- (b) Externally hung lights may be used.

FAR 23.1401 : Anticollision light system.

- (a) [General. The airplane must have an anticollision light system that—]
- (1) Consists of one or more approved anticollision lights located so that their light will not impair the flight crewmembers' vision or detract from the conspicuity of the position lights; and
 - (2) Meets the requirements of paragraphs (b) through (f) of this section.
- (b) *Field of coverage.* The system must consist of enough lights to illuminate the vital areas around the airplane, considering the physical configuration and flight characteristics of the airplane. The field of coverage must extend in each direction within at least 75° above and 75° below the horizontal plane of the airplane, except that there may be solid angles of obstructed visibility totaling not more than 0.5 steradians.
- (c) *Flashing characteristics.* The arrangement of the system, that is, the number of light sources, beam width, speed of rotation, and other characteristics, must give an effective flash frequency of not less than 40, nor more than 100, cycles per minute. The effective flash frequency is the frequency at which the airplane's complete anticollision light system is observed from a distance, and applies to each sector of light including any overlaps that exist when the system consists of more than one light source. In overlaps, flash frequencies may exceed 100, but not 180, cycles per minute.
- (d) *Color.* Each anticollision light must be either aviation red or aviation white and must meet the applicable requirements of Sec. 23.1397.
- (e) *Light intensity.* The minimum light intensities in any vertical plane, measured with the red filter (if used) and expressed in terms of "effective" intensities, must meet

the requirements of paragraph (f) of this section. The following relation must be assumed :

$$L_e = \frac{\int_{t_1}^{t_2} I(t) dt}{0.2 + (t_2 - t_1)}$$

where :

- L_e : effective intensity (candles).
- $I(t)$: instantaneous intensity as a function of time.
- $t_2 - t_1$: flash time interval (seconds).

Normally, the maximum value of effective intensity is obtained when t2 and t1 are chosen so that the effective intensity is equal to the instantaneous intensity at t2 and t1.

(f) *Minimum effective intensities for anticollision lights.* Each anticollision light effective intensity must equal or exceed the applicable values in the following table.

Angle above or below the horizontal plane :	Effective intensity (candles)
0° to 5°	400
5° to 10°	240
10° to 20°	80
20° to 30°	40
30° to 75°	20

Amdt. 23-49, Eff. 03/11/96

33.5 Safety Equipment

FAR 23.1411 : General.

- (a) Required safety equipment to be used by the flight crew in an emergency, such as automatic liferaft releases, must be readily accessible.
- (b) Stowage provisions for required safety equipment must be furnished and must—
 - (1) Be arranged so that the equipment is directly accessible and its location is obvious; and
 - (2) [Protect the safety equipment from damage caused by being subjected to the inertia loads resulting from the ultimate static load factors specified in Sec. 23.561(b)(3) of this part.]

Amdt. 23-36, Eff. 09/14/88

FAR 23.1413 : [Removed.]

[Removed.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1415 : Ditching equipment.

- (a) Emergency flotation and signaling equipment required by any operating rule in this chapter must be installed so that it is readily available to the crew and passengers.

Chapitre 59
Appendix I

Sommaire

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- (b) Each raft and each life preserver must be approved.
- (c) Each raft released automatically or by the pilot must be attached to the airplane by a line to keep it alongside the airplane. This line must be weak enough to break before submerging the empty raft to which it is attached.
- (d) Each signaling device required by any operating rule in this chapter, must be accessible, function satisfactorily, and must be free of any hazard in its operation.

FAR 23.1416 : [Pneumatic de-icer boot system.]

[If certification with ice protection provisions is desired and a pneumatic de-icer boot system is installed—

- (a) The system must meet the requirements specified in Sec. 23.1419.
- (b) The system and its components must be designed to perform their intended function under any normal system operating temperature or pressure, and
- (c) Means to indicate to the flight crew that the pneumatic de-icer boot system is receiving adequate pressure and is functioning normally must be provided.]

Amdt. 23-23, Eff. 12/01/78

FAR 23.1419 : Ice protection.

[If certification with ice protection provisions is desired, compliance with the requirements of this section and other applicable sections of this part must be shown :

- (a) An analysis must be performed to establish, on the basis of the airplane's operational needs, the adequacy of the ice protection system for the various components of the airplane. In addition, tests of the ice protection system must be conducted to demonstrate that the airplane is capable of operating safely in continuous maximum and intermittent maximum icing conditions as described in Appendix C of part 25 of this chapter. As used in this section, "Capable of operating safely," means that airplane performance, controllability, maneuverability, and stability must not be less than that required in part 23, subpart B.
- (b) Except as provided by paragraph (c) of this section, in addition to the analysis and physical evaluation prescribed in paragraph (a) of this section, the effectiveness of the ice protection system and its components must be shown by flight tests of the airplane or its components in measured natural atmospheric icing conditions and by one or more of the following tests, as found necessary to determine the adequacy of the ice protection system—
 - (1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.
 - (2) Flight dry air tests of the ice protection system as a whole, or its individual components.
 - (3) Flight test of the airplane or its components in measured simulated icing conditions.
- (c) If certification with ice protection has been accomplished on prior type certificated airplanes whose designs include components that are thermodynamically and aerodynamically equivalent to those used on a new airplane design, certification of these equivalent components may be accomplished by reference to previously accomplished tests, required in Sec. 23.1419(a) and (b), provided that the applicant accounts for any differences in installation of these components.

- (d) A means must be identified or provided for determining the formation of ice on the critical parts of the airplane. Adequate lighting must be provided for the use of this means during night operation. Also, when monitoring of the external surfaces of the airplane by the flight crew is required for operation of the ice protection equipment, external lighting must be provided that is adequate to enable the monitoring to be done at night. Any illumination that is used must be of a type that will not cause glare or reflection that would handicap crewmembers in the performance of their duties. The Airplane Flight Manual or other approved manual material must describe the means of determining ice formation and must contain information for the safe operation of the airplane in icing conditions.]

Amtd. 23-43, Eff. 05/10/93

33.6 Miscellaneous Equipment

FAR 23.1431 : Electronic equipment.

- (a) In showing compliance with Sec. 23.1309(b)(1) and (2) with respect to radio and electronic equipment and their installations, critical environmental conditions must be considered.
- (b) Radio and electronic equipment, controls, and wiring must be installed so that operation of any unit or system of units will not adversely affect the simultaneous operation of any other radio or electronic unit, or system of units, required by this chapter.
- (c) [For those airplanes required to have more than one flightcrew member, or whose operation will require more than one flightcrew member, the cockpit must be evaluated to determine if the flightcrew members, when seated at their duty station, can converse without difficulty under the actual cockpit noise conditions when the airplane is being operated. If the airplane design includes provision for the use of communication headsets, the evaluation must also consider conditions where headsets are being used. If the evaluation shows conditions under which it will be difficult to converse, an intercommunication system must be provided.]
- (d) If installed communication equipment includes transmitter "off-on" switching, that switching means must be designed to return from the "transmit" to the "off" position when it is released and ensure that the transmitter will return to the off (non transmitting) state.
- (e) If provisions for the use of communication headsets are provided, it must be demonstrated that the flightcrew members will receive all aural warnings under the actual cockpit noise conditions when the airplane is being operated when any headset is being used.]
- Amtd. 23-49, Eff. 03/11/96

FAR 23.1435 : Hydraulic systems.

- (a) *Design.* Each hydraulic system must be designed as follows :
- (1) Each hydraulic system and its elements must withstand, without yielding, the structural loads expected in addition to hydraulic loads.
- (2) A means to indicate the pressure in each hydraulic system which supplies two or more primary functions must be provided to the flight crew.

must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the airplane.

- (2) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.
- (3) Information describing the order and method of removing and replacing products and parts with any necessary precautions to be taken.
- (4) Other general procedural instructions including procedures for system testing during ground running, symmetry checks, weighing and determining the center of gravity, lifting and shoring, and storage limitations.
- (c) Diagrams of structural access plates and information needed to gain access for inspections when access plates are not provided.
- (d) Details for the application of special inspection techniques including radiographic and ultrasonic testing where such processes are specified.
- (e) Information needed to apply protective treatments to the structure after inspection.
- (f) All data relative to structural fasteners such as identification, discard recommendations, and torque values.
- (g) A list of special tools needed.]
- Amtd. 25-54, Eff. 10/14/80

FAR 25.H4 : Airworthiness Limitations section.

- (a) [The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth—
- (1) Each mandatory replacement time, structural inspection interval, and related structural inspection procedures approved under Sec. 25.571; and
- (2) Each mandatory replacement time, inspection interval, related inspection procedure, and all critical design configuration control limitations approved under Sec. 25.581 for the fuel tank system.
- (b) If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads : "The Airworthiness Limitations section is FAA-approved and specifies maintenance required under Sec. 43.16 and 91.403 of the Federal Aviation Regulations, unless an alternative program has been FAA approved."]
- Amtd. 25-102, Eff. 6/6/2001

FAR 25.H1 : [Airworthiness Limitations section.]

The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, structural inspection interval, and related structural inspection procedure approved under Sec. 25.571. If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads : "The Airworthiness Limitations section is FAA approved and specifies under Secs. 43.16 and [91.403] of the Federal Aviation Regulations unless an alternative program has been FAA approved. Amdt. 25-68, Eff. 8/18/90

FAR 25.H2 : [Format.]

- (a) [The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.]
- (b) The format of the manual or manuals must provide for a practical arrangement.] Amdt. 25-54, Eff. 10/14/80

FAR 25.H3 : [Content.]

[The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following manuals or sections, as appropriate, and information :

- (a) *Airplane maintenance manual or section.*
 - (1) Introduction information that includes an explanation of the airplane's features and data to the extent necessary for maintenance or preventive maintenance.
 - (2) A description of the airplane and its systems and installations including its engines, propellers, and appliances.
 - (3) Basic control and operation information describing how the airplane components and systems are controlled and how they operate, including any special procedures and limitations that apply.
 - (4) Servicing information that covers details regarding servicing points, capacities of tanks, reservoirs, types of fluids to be used, pressures applicable to the various systems, location of access panels for inspection and servicing, locations of lubrication points, lubricants to be used, equipment required for servicing, tow instructions and limitations, mooring, jacking, and leveling information.
- (b) *Maintenance Instructions.*
 - (1) Scheduling information for each part of the airplane and its engines, auxiliary power units, propellers, accessories, instruments, and equipment that provides the recommended periods at which they should be cleaned, inspected, adjusted, tested, and lubricated, and the degree of inspection, the applicable wear tolerances, and work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree of complexity requiring specialized maintenance techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross references to the Airworthiness Limitations section of the manual

- (3) There must be means to ensure that the pressure, including transient (surge) pressure, in any part of the system will not exceed the safe limit above design operating pressure and to prevent excessive pressure resulting from fluid volumetric changes in all lines which are likely to remain closed long enough for such changes to occur.

- (4) The minimum design burst pressure must be 2.5 times the operating pressure.
- (b) *Tests.* Each system must be substantiated by proof pressure tests. When proof tested, no part of any system may fail, malfunction, or experience a permanent set. The proof load of each system must be at least 1.5 times the maximum operating pressure of that system.

- (c) *Accumulators.* A hydraulic accumulator or reservoir may be installed on the engine side of any firewall, if—

- (1) It is an integral part of an engine or propeller system, or
- (2) The reservoir is nonpressurized and the total capacity of all such nonpressurized reservoirs is one quart or less.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1437 : Accessories for multiengine airplanes.

For multiengine airplanes, engine-driven accessories essential to safe operation must be distributed among two or more engines so that the failure of any one engine will not impair safe operation through the malfunctioning of these accessories.

FAR 23.1438 : [Pressurization and pneumatic systems.]

- (a) [Pressurization system elements must be burst pressure tested to 2.0 times, and proof pressure tested to 1.5 times, the maximum normal operating pressure.
- (b) Pneumatic system elements must be burst pressure tested to 3.0 times, and proof pressure tested to 1.5 times, the maximum normal operating pressure.
- (c) An analysis, or a combination of analysis and test, may be substituted for any test required by paragraph (a) or (b) of this section if the Administrator finds it equivalent to the required test.]

Amdt. 23-20, Eff. 09/01/77

FAR 23.1441 : Oxygen equipment and supply.

- (a) [If certification with supplemental oxygen equipment is requested, or the airplane is approved for operations at or above altitudes where oxygen is required to be used by the operating rules, oxygen equipment must meet the requirements of this section and Secs. 23.1443 through 23.1449. Portable oxygen equipment may be used to meet the requirements of this part if the portable equipment is shown to comply with the applicable requirements, is identified in the airplane type design, and its stowage provisions are found to be in compliance with the requirements of Sec. 23.561.]
- (b) The oxygen system must be free from hazards in itself, in its method of operation, and its effect upon other components.
- (c) There must be a means to allow the crew to readily determine, during the flight, the quantity of oxygen available in each source of supply.

- (d) [Each required flight crewmember must be provided with—
- (1) Demand oxygen equipment if the airplane is to be certificated for operation above 25,000 feet.
 - (2) Pressure demand oxygen equipment if the airplane is to be certificated for operation above 40,000 feet.
- (e) There must be a means, readily available to the crew in flight, to turn on and to shut off the oxygen supply at the high pressure source. This shutoff requirement does not apply to chemical oxygen generators.]
- Amdt. 23-43, Eff. 05/10/93

FAR 23.1443 : Minimum mass flow of supplemental oxygen.

- (a) [If continuous flow oxygen equipment is installed, an applicant must show compliance with the requirements of either paragraphs (a)(1) and (a)(2) or paragraph (a)(3) of this section :
- (1) For each passenger, the minimum mass flow of supplemental oxygen required at various cabin pressure altitudes may not be less than the flow required to maintain, during inspiration and while using the oxygen equipment (including masks) provided, the following mean tracheal oxygen partial pressures :
 - (i) At cabin pressure altitudes above 10,000 feet up to and including 18,500 feet, a mean tracheal oxygen partial pressure of 100mm Hg when breathing 15 liters per minute, Body Temperature, Pressure, Saturated (BTPS) and with a tidal volume of 700cc with a constant time interval between respirations.
 - (ii) At cabin pressure altitudes above 18,500 feet up to and including 40,000 feet, a mean tracheal oxygen partial pressure of 83.8mm Hg when breathing 30 liters per minute, BTPS, and with a tidal volume of 1,100cc with a constant time interval between respirations.
 - (2) For each flight crewmember, the minimum mass flow may not be less than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 149mm Hg when breathing 15 liters per minute, BTPS, and with a maximum tidal volume of 700cc with a constant time interval between respirations.
 - (3) The minimum mass flow of supplemental oxygen supplied for each user must be at a rate not less than that shown in the following figure for each altitude up to and including the maximum operating altitude of the airplane.
- (b) If demand equipment is installed for use by flight crewmembers, the minimum mass flow of supplemental oxygen required for each flight crewmember may not be less than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 122mm Hg up to and including a cabin pressure altitude of 35,000 feet, and 95 percent oxygen between cabin pressure altitudes of 35,000 and 40,000 feet, when breathing 20 liters per minutes BTPS. In addition, there must be means to allow the crew to use undiluted oxygen at their discretion.
- (c) If first-aid oxygen equipment is installed, the minimum mass flow of oxygen to each user may not be less than 4 liters per minute, STPD. However, there may be a means to decrease this flow to not less than 2 liters per minute, STPD, at any cabin altitude. The quantity of oxygen required is based upon an average flow rate of 3 liters per minute per person for whom first-aid oxygen is required.

Chapitre 58

Appendix H

Sommaire

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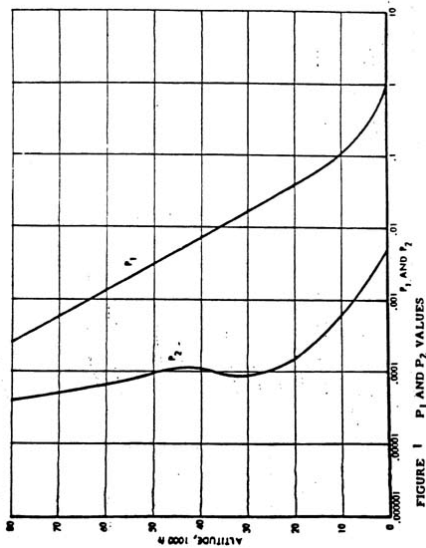


FIG. 57.1 – P_1 and P_2 Values

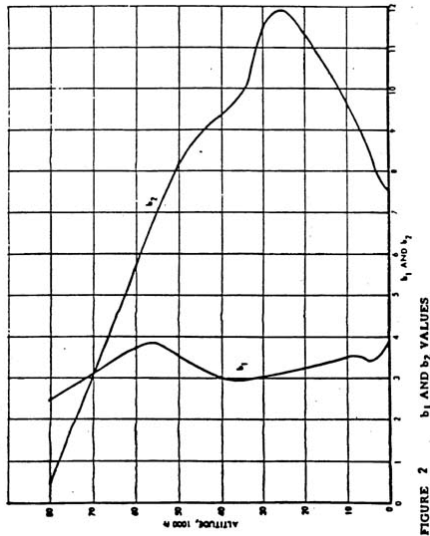


FIG. 57.2 – b_1 and b_2 Values

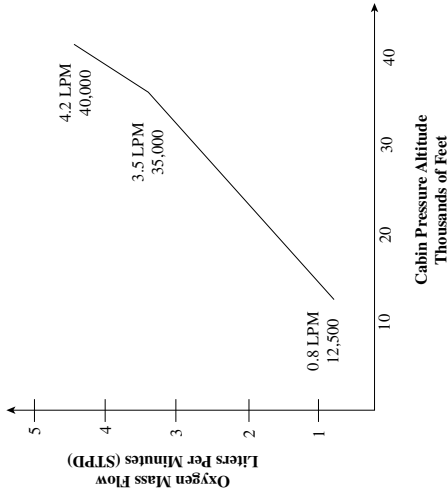


FIG. 33.1 – FAR 23.1443 : Oxygen Mass Flow/Cabin Pressure Altitude.

(d) As used in this section :

- (1) BTPS means Body Temperature, and Pressure, saturated (which is, 37° C, and the ambient pressure to which the body is exposed, minus 47mm Hg, which is the tracheal pressure displaced by water vapor pressure when the breathed air becomes saturated with water vapor at 37° C).
- (2) STPD means Standard, Temperature, and Pressure, Dry (which is, 0° C at 760mm Hg with no water vapor).]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1445 : [Oxygen distribution system.]

- (a) [Except for flexible lines from oxygen outlets to the dispensing units, or where shown to be otherwise suitable to the installation, nonmetallic tubing must not be used for any oxygen line that is normally pressurized during flight.
- (b) Nonmetallic oxygen distribution lines must not be routed where they may be subjected to elevated temperatures, electrical arcing, and released flammable fluids that might result from any probable failure.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.1447 : Equipment standards for oxygen dispensing units.

If oxygen dispensing units are installed, the following apply :

- (a) There must be an individual dispensing unit for each occupant for whom supplemental oxygen is to be supplied. Each dispensing unit must :
- (1) Provide for effective utilization of the oxygen being delivered to the unit.
 - (2) Be capable of being readily placed into position on the face of the user.
 - (3) Be equipped with a suitable means to retain the unit in position on the face.
 - (4) [If radio equipment is installed, the flightcrew oxygen dispensing units must be designed to allow the use of that equipment and to allow communication with any other required crew member while at their assigned duty station.]
- (b) If certification for operation up to and including 18,000 feet (MSL) is requested, each oxygen dispensing unit must :
- (1) Cover the nose and mouth of the user ; or
 - (2) Be a nasal cannula, in which case one oxygen dispensing unit covering both the nose and mouth of the user must be available. In addition, each nasal cannula or its connecting tubing must have permanently affixed—
 - (i) A visible warning against smoking while in use ;
 - (ii) An illustration of the correct method of donning ; and
 - (iii) A visible warning against use with nasal obstructions or head colds with resultant nasal congestion.
- (c) If certification for operation above 18,000 feet (MSL) is requested, each oxygen dispensing unit must cover the nose and mouth of the user.
- (d) [For a pressurized airplane designed to operate at flight altitudes above 25,000 feet (MSL), the dispensing units must meet the following :
- (1) The dispensing units for passengers must be connected to an oxygen supply terminal and be immediately available to each occupant wherever seated.
 - (2) The dispensing units for crewmembers must be automatically presented to each crewmember before the cabin pressure altitude exceeds 15,000 feet, or the units must be of the quick-donning type, connected to an oxygen supply terminal that is immediately available to crewmembers at their station.
- (e) If certification for operation above 30,000 feet is requested, the dispensing units for passengers must be automatically presented to each occupant before the cabin pressure altitude exceeds 15,000 feet.]
- (f) If an automatic dispensing unit (nose and mask, or other unit) system is installed, the crew must be provided with a manual means to make the dispensing units immediately available in the event of failure of the automatic system.
- Amdt. 23-49, EFF. 03/11/96

FAR 23.1449 : [Means for determining use of oxygen.]

[There must be a means to allow the crew to determine whether oxygen is being delivered to the dispensing equipment.]

Amdt. 23-9, EFF. 06/17/70

t : selected time interval.

y : net value of the load or stress.

$y_{one=g}$: value of the load or stress in one-g level flight.

$N(g)$: average number of exceedances of the indicated value of the load or stress in unit time.

$\sum_{N_o, \bar{A}}$: symbol denoting summation over all mission segments.

$\bar{N}_o, \bar{A}$: parameters determined by dynamic analysis as defined in paragraph (c)(2) of this appendix.

P, P_1, b_1, b_2 : parameters defining the probability distributions of root-mean-square gust velocity, to be read from Figures 1 and 2 of this appendix.

The limit gust loads must be read from the frequency of exceedance curves at a frequency of exceedance of $2 \cdot 10^{-5}$ exceedances per hour. Both positive and negative load directions must be considered in determining the limit loads.

- (4) If a stability augmentation system is utilized to reduce the gust loads, consideration must be given to the fraction of flight time that the system may be inoperative. The flight profiles of paragraph (c)(1) of this appendix must include flight with the system inoperative for this fraction of the flight time. When a stability augmentation system is included in the analysis, the effect of system nonlinearities on loads at the limit load level must be conservatively accounted for.

- (d) *Supplementary design envelope analysis.* In addition to the limit loads defined by paragraph (c) of this appendix, limit loads must also be determined in accordance with paragraph (b) of this appendix, except that—

- (1) In paragraph (b)(3)(i) of this appendix, the value of $U_\sigma = 85 \text{ fps}$ true gust velocity is replaced by $U_\sigma = 60 \text{ fps}$ true gust velocity on the interval 0 to 30,000 ft. altitude, and is linearly decreased to 25 fps true gust velocity at 80,000 ft. altitude ; and
- (2) In paragraph (b) of this appendix, the reference to paragraphs (b)(3)(i) through (b)(3)(iii) of this appendix is to be understood as referring to the paragraph as modified by paragraph (d)(1).

Amdt. 25-54, EFF. 10/14/80

linear decrease from that value at 20,000 feet to 30 fps at 80,000 feet. The following factors will be taken into account when assessing comparability to a similar design :

- (1) The transfer function of the new design should exhibit no unusual characteristics as compared to the similar design which will significantly affect response to turbulence ; e.g., coalescence of modal response in the frequency regime which can result in a significant increase of loads.
- (2) The typical mission of the new airplane is substantially equivalent to that of the similar design.
- (3) The similar design should demonstrate the adequacy of the U_σ selected.
- (ii) At speed $V_B : U_\sigma$ is equal to 1.32 times the values obtained under paragraph (b)(3)(i) of this appendix.
- (iii) At speed $V_D : U_\sigma$ is equal to $\frac{1}{2}$ the values obtained under paragraph (b)(3)(i) of this appendix.
- (iv) At speeds between V_B and V_C and between V_C and $V_D : U_\sigma$ is equal to a value obtained by linear interpolation.
- (4) When a stability augmentation system is included in the analysis, the effect of system nonlinearities on loads at the limit load level must be realistically or conservatively accounted for.

(c) *Mission analysis.* Limit loads must be determined in accordance with the following :

- (1) The expected utilization of the airplane must be represented by one or more flight profiles in which the load distribution and the variation with time of speed, altitude, gross weight, and center of gravity position are defined. These profiles must be divided into mission segments or blocks, for analysis, and average or effective values of the pertinent parameters defined for each segment.
- (2) For each of the mission segments defined under paragraph (c)(1) of this appendix, values of A and N_o must be determined by analysis. $\bar{A}$ is defined as the ratio of root-mean-square incremental load to root-mean-square gust velocity and N_o is the radius of gyration of the load power spectral density function about zero frequency. The power spectral density of the atmospheric turbulence must be given by the equation set forth in paragraph (b)(2) of this appendix.
- (3) For each of the load and stress quantities selected, the frequency of exceedance must be determined as a function of load level by means of the equation-

$$N(y) = \sum_i N_o \left(P_1 \exp \left(\frac{|y - y_{one=g}|}{b_1 \bar{A}} \right) + P_2 \exp \left(\frac{|y - y_{one=g}|}{b_2 \bar{A}} \right) \right)$$

where-

FAR 23.1450 : [Chemical oxygen generators.]

- (a) [For the purpose of this section, a chemical oxygen generator is defined as a device which produces oxygen by chemical reaction.
- (b) Each chemical oxygen generator must be designed and installed in accordance with the following requirements :
 - (1) Surface temperature developed by the generator during operation may not create a hazard to the airplane or to its occupants.
 - (2) Means must be provided to relieve any internal pressure that may be hazardous.
 - (c) In addition to meeting the requirements in paragraph (b) of this section, each portable chemical oxygen generator that is capable of sustained operation by successive replacement of a generator element must be placarded to show-
 - (1) The rate of oxygen flow, in liters per minute ;
 - (2) The duration of oxygen flow, in minutes, for the replaceable generator element ; and
 - (3) A warning that the replaceable generator element may be hot, unless the element construction is such that the surface temperature cannot exceed 100 degrees F.]

Amdt. 23-20, Eff. 09/01/77

FAR 23.1451 : [Fire protection for oxygen equipment.]

[Oxygen equipment and lines must :

- (a) Not be installed in any designated fire zones.
- (b) Be protected from heat that may be generated in, or escape from, any designated fire zone.
- (c) Be installed so that escaping oxygen cannot come in contact with and cause ignition of grease, fluid, or vapor accumulations that are present in normal operation or that may result from the failure or malfunction of any other system.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1453 : [Protection of oxygen equipment from rupture.]

- (a) [Each element of the oxygen system must have sufficient strength to withstand the maximum pressure and temperature, in combination with any externally applied loads arising from consideration of limit structural loads, that may be acting on that part of the system.
- (b) Oxygen pressure sources and the lines between the source and the shutoff means must be :
 - (1) Protected from unsafe temperatures ; and
 - (2) Located where the probability and hazard of rupture in a crash landing are minimized.]

Amdt. 23-49, Eff. 03/11/96

FAR 23.1457 : [Cockpit voice recorders.]

- (a) [Each cockpit voice recorder required by the operating rules of this chapter must be approved and must be installed so that it will record the following :
 - (1) Voice communications transmitted from or received in the airplane by radio.
 - (2) Voice communications of flight crewmembers on the flight deck.
 - (3) Voice communications of flight crewmembers on the flight deck, using the airplane's interphone system.
 - (4) Voice or audio signals identifying navigation or approach aids introduced into a headset or speaker.
 - (5) Voice communications of flight crewmembers using the passenger loudspeaker system, if there is such a system and if the fourth channel is available in accordance with the requirements of paragraph (c)(4)(ii) of this section.
- (b) The recording requirements of paragraph (a)(2) of this section must be met by installing a cockpit-mounted area microphone, located in the best position for recording voice communications originating at the first and second pilot stations and voice communications of other crewmembers on the flight deck when directed to those stations. The microphone must be so located and, if necessary, the preamplifiers and filters of the recorder must be so adjusted or supplemented, so that the intelligibility of the recorded communications is as high as practicable when recorded under flight cockpit noise conditions and played back. Repeated aural or visual playback of the record may be used in evaluating intelligibility.
- (c) Each cockpit voice recorder must be installed so that the part of the communication or audio signals specified in paragraph (a) of this section obtained from each of the following sources is recorded on a separate channel :
 - (1) For the first channel, from each boom, mask, or handheld microphone, headset, or speaker used at the first pilot station.
 - (2) For the second channel from each boom, mask, or handheld microphone, headset, or speaker used at the second pilot station.
 - (3) For the third channel—from the cockpit-mounted area microphone.
 - (4) For the fourth channel from—
 - (i) Each boom, mask, or handheld microphone, headset, or speaker used at the station for the third and fourth crewmembers.
 - (ii) If the stations specified in paragraph (c)(4)(i) of this section are not required or if the signal at such a station is picked up by another channel, each microphone on the flight deck that is used with the passenger loudspeaker system, if its signals are not picked up by another channel.
 - (5) And that as far as is practicable all sounds received by the microphone listed in paragraphs (c)(1), (2), and (4) of this section must be recorded without interruption irrespective of the position of the interphone-transmitter key switch. The design shall ensure that sidetone for the flight crew is produced only when the interphone, public address system, or radio transmitters are in use.
- (d) Each cockpit voice recorder must be installed so that :
 - (1) It receives its electric power from the bus that provides the maximum reliability for operation of the cockpit voice recorder without jeopardizing service to essential or emergency loads.

Chapitre 57

Appendix G

FAR 25.G1 : [Appendix G—Continuous Gust Design Criteria]

[The continuous gust design criteria in this appendix must be used in establishing the dynamic response of the airplane to vertical and lateral continuous turbulences unless a more rational criteria is used. The following gust load requirements apply to mission analysis and design envelope analysis :

- (a) The limit gust loads utilizing the continuous turbulence concept must be determined in accordance with the provisions of either paragraph (b) or paragraphs (c) and (d) of this appendix.
- (b) *Design envelope analysis.* The limit loads must be determined in accordance with the following :

- (1) All critical altitudes, weights, and weight distributions, as specified in Sec. 25.321(b), and all critical speeds within the ranges indicated in paragraph (b)(3) of this appendix must be considered.
- (2) Values of $\bar{A}$ (ratio of root-mean-square incremental load root-mean-square gust velocity) must be determined by dynamic analysis. The power spectral density of the atmospheric turbulence must be as given by the equation—

$$Q(\Omega) = \frac{\sigma^2 L}{\pi} \frac{1 + \frac{8}{3} (1.339 L \Omega)^2}{\left(1 + (1.339 L \Omega)^2\right)^{\frac{11}{4}}}$$

where :

Q	: power-spectral density	$(ft./sec.)^2/rad./ft.$
σ	: root-mean-square gust velocity,	$ft./sec.$
Ω	: reduced frequency,	$rad./ft.$

$L = 2,500 ft.$:

- (3) The limit loads must be obtained by multiplying the $\bar{A}$ values determined by the dynamic analysis by the following values of the gust velocity U_σ :
 - (i) At speed V_C : $U_\sigma = 85 fms$ true gust velocity in the interval 0 to 30,000 ft. altitude and is linearly decreased to 30 fms true gust velocity at 80,000 ft. altitude. Where the Administrator finds that a design is comparable to a similar design with extensive satisfactory service experience, it will be acceptable to select U_σ at V_C less than 85 fms, but not less than 75 fms, with

- (2) There is an automatic means to simultaneously stop the recorder and prevent each erasure feature from functioning, within 10 minutes after crash impact ; and
- (3) There is an aural or visual means for preflight checking of the recorder for proper operation.
- (e) The record container must be located and mounted to minimize the probability of rupture of the container as a result of crash impact and consequent heat damage to the record from fire. In meeting this requirement, the record container must be as far aft as practicable, but may not be where aft mounted engines may crush the container during impact. However, it need not be outside of the pressurized compartment.
- (f) If the cockpit voice recorder has a bulk erasure device, the installation must be designed to minimize the probability of inadvertent operations and actuation of the device during crash impact.
- (g) Each recorder container must :
 - (1) Be either bright orange or bright yellow ;
 - (2) Have reflective tape affixed to its external surface to facilitate its location under water ; and
 - (3) Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such manner that they are not likely to be separated during crash impact.]

Amdt. 23-35, Eff. 10/11/88

FAR 23.1459 : [Flight recorders.]

- (a) [Each flight recorder required by the operating rules of this chapter must be installed so that—
 - (1) It is supplied with airspeed, altitude, and directional data obtained from sources that meet the accuracy requirements of Secs. 23.1323, 23.1325, and 23.1327, as appropriate ;
 - (2) The vertical acceleration sensor is rigidly attached, and located longitudinally either within the approved center of gravity limits of the airplane, or at a distance forward or aft of these limits that does not exceed 25 percent of the airplane's mean aerodynamic chord ;
 - (3) It receives its electrical power from the bus that provides the maximum reliability for operation of the flight recorder without jeopardizing service to essential or emergency loads ;
 - (4) There is an aural or visual means for preflight checking of the recorder for proper recording of data in the storage medium.
 - (5) Except for recorders powered solely by the engine-driven electrical generator system, there is an automatic means to simultaneously stop a recorder that has a data erasure feature and prevent each erasure feature from functioning, within 10 minutes after crash impact ; and
- (b) Each nonjectable record container must be located and mounted so as to minimize the probability of container rupture resulting from crash impact and subsequent damage to the record from fire. In meeting this requirement the record container

must be located as far aft as practicable, but need not be aft of the pressurized compartment, and may not be where aft-mounted engines may crush the container upon impact.

- (c) A correlation must be established between the flight recorder readings of airspeed, altitude, and heading and the corresponding readings (taking into account correction factors) of the first pilot's instruments. The correlation must cover the airspeed range over which the airplane is to be operated, the range of altitude to which the airplane is limited, and 360 degrees of heading. Correlation may be established on the ground as appropriate.

- (d) Each recorder container must—

- (1) Be either bright orange or bright yellow ;

- (2) Have reflective tape affixed to its external surface to facilitate its location under water ; and

- (3) Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such a manner that they are not likely to be separated during crash impact.

- (e) Any novel or unique design or operational characteristics of the aircraft shall be evaluated to determine if any dedicated parameters must be recorded on flight recorders in addition to or in place of existing requirements.]

Amdt. 23-35, Eff. 10/11/88

FAR 23.1461 : Equipment containing high energy rotors.

- (a) [Equipment, such as Auxiliary Power Units (APU) and constant speed drive units, containing high energy rotors must meet paragraphs (b), (c), or (d) of this section.]

- (b) High energy rotors contained in equipment must be able to withstand damage caused by malfunctions, vibration, abnormal speeds, and abnormal temperatures. In addition—

- (1) Auxiliary rotor cases must be able to contain damage caused by the failure of high energy rotor blades ; and

- (2) Equipment control devices, systems, and instrumentation must reasonably ensure that no operating limitations affecting the integrity of high energy rotors will be exceeded in service.

- (c) It must be shown by test that equipment containing high energy rotors can contain any failure of a high energy rotor that occurs at the highest speed obtainable with the normal speed control devices inoperative.

- (d) Equipment containing high energy rotors must be located where rotor failure will neither endanger the occupants nor adversely affect continued safe flight.

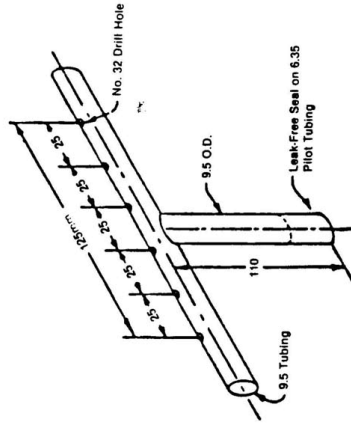
Amdt. 23-49, Eff. 03/11/96

FAR 25.F5 : [Appendix F—Part V—Test Method to Determine the Smoke Emission Characteristics of Cabin Materials]

- (a) [*Summary of Method.* The specimen must be constructed, conditioned, and tested in the flaming mode in accordance with American Society of Testing and Materials (ASTM) Standard Test Method ASTM F814-83.

- (b) *Acceptance Criteria.* The specific optical smoke density (D_s), which is obtained by averaging the reading obtained after 4 minutes with each of the three specimens, shall not exceed 200.]

Amdt. 25-66, Eff. 9/26/88



(Unless denoted otherwise, all dimensions are in millimeters.)
[Figure 4.]

FIG. 56.11 –

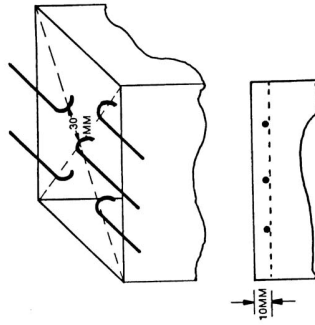


FIG. 56.12 – [Thermocouple Position]

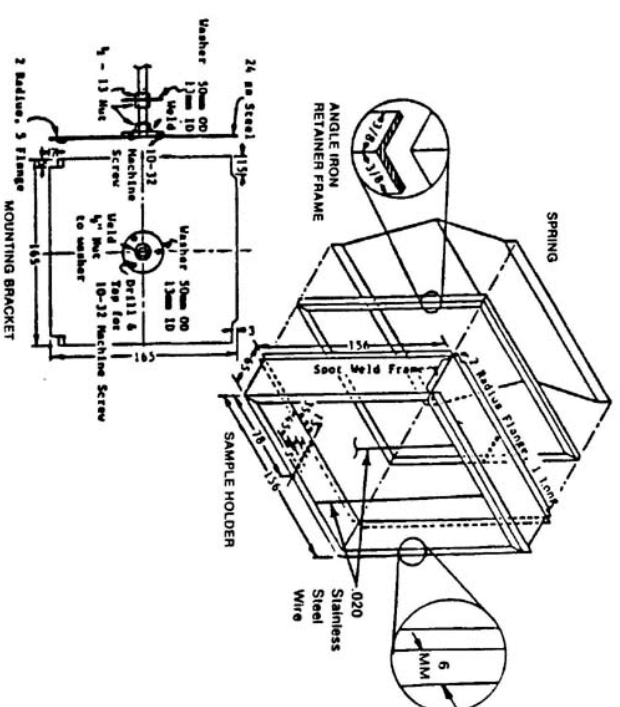
Chapitre 34

Subpart G : Operating Limitations and Information

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(Unless denoted otherwise, all dimensions are in millimeters.)

Figure 3

FIG. 56.10 –

FAR 23.1501 : General.

(a) [Each operating limitation specified in Secs. 23.1505 through 23.1527 and other limitations and information necessary for safe operation must be established.

(b) The operating limitations and other information necessary for safe operation must be made available to the crewmembers as prescribed in Secs. 23.1541 through 23.1589.]

Amdt. 23-21, Eff. 03/01/78

FAR 23.1505 : Airspeed limitations.

(a) The never-exceed speed V_{NE} must be established so that it is—

(1) Not less than 0.9 times the minimum value of V_D allowed under Sec. 23.335; and

(2) Not more than the lesser of—

(i) 0.9 V_D established under Sec. 23.335; or

(ii) 0.9 times the maximum speed shown under Sec. 23.251.

(b) The maximum structural cruising speed V_{NO} must be established so that it is—

(1) Not less than the minimum value of V_C allowed under Sec. 23.335; and

(2) Not more than the lesser of—

(i) V_C established under Sec. 23.335; or

(ii) 0.89 V_{NE} established under paragraph (a) of this section.

(c) [Paragraphs (a) and (b) of this section do not apply to turbine airplanes or the airplanes for which a design diving speed V_D/M_D is established under Sec. 23.335(b)(4). For those airplanes, a maximum operating limit speed (V_{MO}/M_{MO} airspeed or Mach number, whichever is critical at a particular altitude) must be established as a speed that may not be deliberately exceeded in any regime of flight (climb, cruise, or descent) unless a higher speed is authorized for flight test or pilot training operations. V_{MO}/M_{MO} must be established so that it is not greater than the design cruising speed V_C/M_C and so that it is sufficiently below V_D/M_D and the maximum speed shown under Sec. 23.251 to make it highly improbable that the latter speeds will be inadvertently exceeded in operations. The speed margin between V_{MO}/M_{MO} and V_D/M_D or the maximum speed shown under Sec. 23.251 may not be less than the speed margin established between V_C/M_C and V_D/M_D under Sec. 23.335(b), or the speed margin found necessary in the flight tests conducted under Sec. 23.253.]

Amdt. 23-7, Eff. 09/14/69

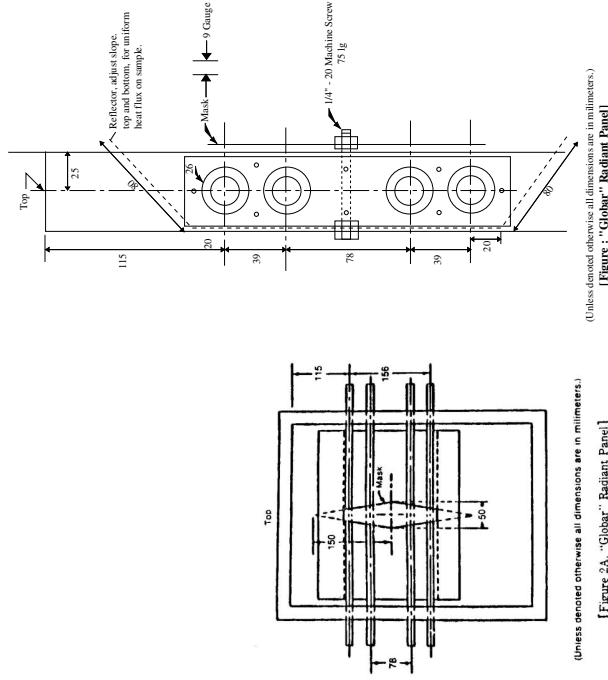
FAR 23.1507 : [Operating] maneuvering speed.

[The maximum operating maneuvering speed, V_O , must be established as an operating limitation. V_O is a selected speed that is not greater than $V_S \sqrt{n_z}$ established in Sec. 23.335(c).]

Amdt. 23-45, Eff. 09/07/93

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(Unless denoted otherwise all dimensions are in millimeters.)
[Figure 2A. "Globar" Radiant Panel]

(a) ["Globar" Radiant Panel]

(b) ["Globar" Radiant Panel]

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FAR 23.1511 : Flap extended speed.

- (a) The flap extended speed V_{FE} must be established so that it is—
 - (1) [Not less than the minimum value of V_F allowed in Sec. 23.345(b) ; and
 - (2) Not more than V_F established under Sec. 23.345(a) ; (c) ; and (d) .]
 - (b) Additional combinations of flap setting, airspeed, and engine power may be established if the structure has been proven for the corresponding design conditions.
- Amdt. 23-50, Eff. 03/11/96

FAR 23.1513 : Minimum control speed.

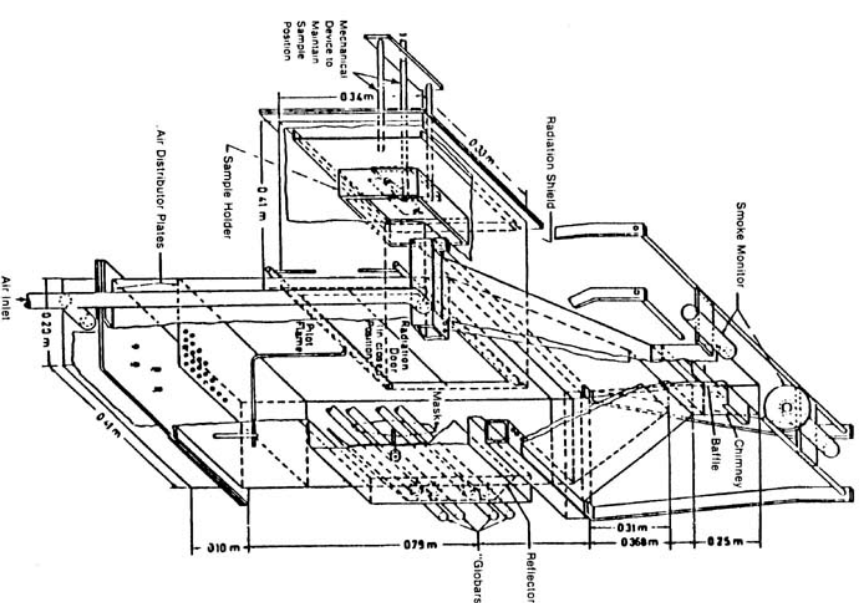
The minimum control speed V_{MC} , determined under Sec. 23.149, must be established as an operating limitation.

FAR 23.1519 : Weight and center of gravity.

The weight and center of gravity limitations determined under Sec. 23.23 must be established as operating limitations.

FAR 23.1521 : Powerplant limitations.

- (a) *General.* The powerplant limitations prescribed in this section must be established so that they do not exceed the corresponding limits for which the engines or propellers are type certificated. In addition, other powerplant limitations used in determining compliance with this part must be established.
 - (b) *Takeoff operation.* The powerplant takeoff operation must be limited by—
 - (1) The maximum rotational speed (rpm) ;
 - (2) The maximum allowable manifold pressure (for reciprocating engines) ;
 - (3) The maximum allowable gas temperature (for turbine engines) ;
 - (4) The time limit for the use of the power or thrust corresponding to the limitations established in paragraphs (b)(1) through (3) of this section ; and
 - (5) [The maximum allowable cylinder head (as applicable) ; liquid coolant and oil temperatures.]
 - (c) *Continuous operation.* The continuous operation must be limited by—
 - (1) The maximum rotational speed ;
 - (2) The maximum allowable manifold pressure (for reciprocating engines) ;
 - (3) The maximum allowable gas temperature (for turbine engines) ; and
 - (4) The maximum allowable cylinder head, oil, and liquid coolant temperatures.
 - (d) *Fuel grade or designation.* The minimum fuel grade (for reciprocating engines) ; or fuel designation (for turbine engines) ; must be established so that it is not less than that required for the operation of the engines within the limitations in paragraphs (b) and (c) of this section.
 - (e) *Ambient temperature.* For all airplanes except reciprocating engine-powered airplanes of 6,000 pounds or less maximum weight, ambient temperature limitations (including limitations for winterization installations if applicable) must be established as the maximum ambient atmospheric temperature at which compliance with the cooling provisions of Secs. 23.1041 through 23.1047 is shown.]
- Amdt. 23-50, Eff. 03/11/96



[Figure 1. Release Rate Apparatus]

FIG. 56.9 – [Release Rate Apparatus]

- (7) [Injection of the specimen and closure of the inner door marks time zero. A record of the thermopile output with at least one data point per second must be made during the time the specimen is in the environmental chamber.]
- (8) The test duration is five minutes.
- (9) A minimum of three specimens must be tested.

(f) *Calculations.*

- (1) The calibration factor is calculated as follows :

$$K_h = \frac{F_1 - F_0}{V_1 - V_0} \frac{mole}{(210.8 - 22)kcal} \frac{273}{T_a} \frac{P - P_v}{760} \frac{moleCH_4STP}{22.41} \frac{WATTmin}{0.01433kcal} \frac{kw}{1000w}$$

F_0 : flow of methane at baseline (lpm)
 F_1 : higher preset flow of methane (lpm)
 V_0 : thermopile voltage at baseline (mv)
 V_1 : Thermopile voltage at higher flow (mv)
 T_a : Ambient temperature (K)
 P : Ambient pressure (mm Hg)
 P_v : Water vapor pressure (mm Hg)

- (2) [Heat release rates may be calculated from the reading of the thermopile output voltage at any instant of time as :

$$HRR = \frac{V_m K_h}{0.02323 m^2}$$

$$HRR : \text{Heat release Rate} \quad kw/m^2$$

$$V_m : \text{measured thermopile voltage} \quad (mv)$$

$$K_h : \text{Calibration Factor} \quad (Kw/mv)$$

- (3) The integral of the heat release rate is the total heat release as a function of time and is calculated by multiplying the rate by the data sampling frequency in minutes and summing the time from zero to two minutes.
- (g) *Criteria.* The total positive heat release over the first two minutes of exposure for each of the three or more samples tested must be averaged, and the peak heat release rate for each of the samples tested must be averaged, and the peak heat release rate for each of the samples tested must be averaged, and the peak heat release rate for each of the samples must be averaged. The average total heat release must not exceed 65 kilowatt-minutes per square meter, and the average peak heat release rate must not exceed 75 kilowatts per square meter.
- (h) *Report.* The test report must include the following for each specimen tested :

- (1) Description of the specimen.
- (2) Radiant heat flux to the specimen, expressed in W/cm^2 .
- (3) Data giving release rates of heat (in kW/m^2) as a function of time, either graphically or tabulated at intervals no greater than 10 seconds. The calibration factor (k_h) must be recorded.
- (4) If melting, sagging, delaminating, or other behavior that affects the exposed surface area or the mode of burning occurs, these behaviors must be reported, together with the time at which such behaviors were observed.
- (5) The peak heat release and the 2-minute integrated heat release rate must be reported.

Amdt. 25-66, Eff. 9/26/88

FAR 23.1522 : [Auxiliary power unit limitations.]

[If an auxiliary power unit is installed, the limitations established for the auxiliary power unit must be specified in the operating limitations for the airplane.]
Amdt. 23-45, Eff. 09/07/93

FAR 23.1523 : Minimum flight crew.

The minimum flight crew must be established so that it is sufficient for safe operation considering—

- (a) [The workload on individual crewmembers and, in addition for commuter category airplanes, each crewmember workload determination must consider the following :
- (1) Flight path control,
 - (2) Collision avoidance,
 - (3) Navigation,
 - (4) Communications,
 - (5) Operation and monitoring of all essential airplane systems,
 - (6) Command decisions, and
 - (7) The accessibility and ease of operation of necessary controls by the appropriate crewmember during all normal and emergency operations when at the crewmember flight station.]
- (b) The accessibility and ease of operation of necessary controls by the appropriate crewmember ; and
- (c) The kinds of operation authorized under Sec. 23.1525.
Amdt. 23-34, Eff. 02/17/87

FAR 23.1524 : [Maximum passenger seating configuration.]

[The maximum passenger seating configuration must be established.]
Amdt. 23-10, Eff. 03/13/71

FAR 23.1525 : Kinds of operation.

[The kinds of operation authorized (e.g., VFR, IFR, day or night) and the meteorological conditions (e.g., icing) to which the operation of the airplane is limited or from which it is prohibited, must be established appropriate to the installed equipment.]
Amdt. 23-45, Eff. 09/07/93

FAR 23.1527 : Maximum operating altitude.

- (a) [The maximum altitude up to which operation is allowed, as limited by flight, structural, powerplant, functional or equipment characteristics, must be established.
- (b) A maximum operating altitude limitation of not more than 25 000 feet must be established for pressurized airplanes unless compliance with Sec. 23.775(e) is shown.]
Amdt. 23-45, Eff. 09/07/93

FAR 23.1529 : [Instructions for Continued Airworthiness.]

[The applicant must prepare Instructions for Continued Airworthiness in accordance with Appendix G 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 airplane or issuance of a standard certificate of airworthiness, whichever occurs later.]

Amdt. 23-26, Eff. 10/14/80

34.1 Markings and Placards

FAR 23.1541 : General.

- (a) The airplane must contain—
 - (1) The markings and placards specified in Secs. 23.1545 through 23.1567; and
 - (2) Any additional information, instrument markings, and placards required for the safe operation if it has unusual design, operating, or handling characteristics.
 - (b) Each marking and placard prescribed in paragraph (a) of this section—
 - (1) Must be displayed in a conspicuous place; and
 - (2) May not be easily erased, disfigured, or obscured.
 - (c) [For airplanes which are to be certificated in more than one category—
 - (1) The applicant must select one category upon which the placards and markings are to be based; and
 - (2) The placards and marking information for all categories in which the airplane is to be certificated must be furnished in the Airplane Flight Manual.
 - (d) [Deleted.]
- Amdt. 23-21, Eff. 03/01/78

FAR 23.1543 : Instrument markings : general.

For each instrument—

- (a) When markings are on the cover glass of the instrument, there must be means to maintain the correct alignment of the glass cover with the face of the dial; and
 - (b) Each arc and line must be wide enough and located to be clearly visible to the pilot.
 - (c) [All related instruments must be calibrated in compatible units.]
- Amdt. 23-50, Eff. 03/11/96

FAR 23.1545 : Airspeed indicator.

- (a) Each airspeed indicator must be marked as specified in paragraph (b) of this section, with the marks located at the corresponding indicated airspeeds.
- (b) The following markings must be made :
 - (1) For the never-exceed speed V_{NE} , a radial red line.
 - (2) For the caution range, a yellow arc extending from the red line specified in paragraph (b)(1) of this section to the upper limit of the green arc specified in paragraph (b)(3) of this section.

1 liter/min is set and increased to higher preset flows of 4, 6, 8, 6, and 4 liters/min. The rate is determined by using a stopwatch to time a complete revolution of the wet test meter for both the baseline and higher flow, with the flow returned to baseline before changing to the next higher flow. The thermopile baseline voltage is measured. The gas flow to the burner must be increased to the higher preset flow and allowed to burn for 2.0 minutes, and the thermopile voltage must be measured. The sequence is repeated until all five values have been determined. The average of the five values must be used as the calibration factor. The procedure must be repeated if the percent relative standard deviation is greater than 5 percent. Calculations are shown in paragraph (f).]

- (2) *Flux Uniformity.* Uniformity of flux over the specimen must be checked periodically and after each heating element change to determine if it is within acceptable limits of plus or minus 5 percent.
- (d) *Sample Preparation.*
 - (1) [The standard size for vertically mounted specimens is 150 X 150 mm with thickness up to 45 mm.]
 - (2) *Conditioning.* Specimens must be conditioned as described in Part 1 of this Appendix.
 - (3) *Mounting.* Only one surface of a specimen will be exposed during a test. A single layer of 0.025mm aluminum foil is wrapped tightly on all exposed sides.
- (e) *Procedure.*
 - (1) The power supply to the radiant panel is set to produce a radiant flux of $3.5W/cm^2$. The flux is measured at the point which the center of the specimen surface will occupy when positioned for test. The radiant flux is measured after the air flow through the equipment is adjusted to the desired rate. The sample should be tested in its end use thickness.
 - (2) The pilot flames are lighted and their position, as described in paragraph (b)(8), is checked.
 - (3) The air flow to the equipment is set at 0.04 plus or minus $0.001m^3/s$ at atmospheric pressure. Proper air flow may be set and monitored by either : (1) An orifice meter designed to produce a pressure drop of at least 200mm of the manometric fluid, or by (2) a rotometer (variable orifice meter) with a scale capable of being read to plus or minus $0.0004m^3/s$. The stop on the vertical specimen holder rod is adjusted so that the exposed surface of the specimen is positioned 100mm from the entrance when injected into environmental chamber.
 - (4) The specimen is placed in the hold chamber with the radiation doors closed. The airtight outer door must be secured, and the recording devices must be started. The specimen must be retained in the hold chamber for 60 seconds, plus or minus 10 seconds, before injection. The thermopile "zero" value must be determined during the last 20 seconds of the hold period
 - (5) When the specimen is to be injected, the radiation doors are opened, the specimen is injected into the environmental chamber, and the radiation doors are closed behind the specimen.
 - (6) [[Reserved].]

The front surface of the specimen shall be 100mm from the closed radiation doors after injection. The specimen holder clips onto the mounted bracket (Figure 3). The mounting bracket is attached to the injection rod by three screws which pass through a wide area washer welded onto a $\frac{1}{2}$ -inch nut. The end of the injection rod is threaded to screw into the nut, and a .020 inch thick wide area washer is held between two $\frac{1}{2}$ -inch nuts which are adjusted to tightly cover the hole in the radiation doors through which the injection rod or calibration calorimeter pass.

- (7) **Calorimeter.** A total-flux flush calorimeter must be mounted in the center of a $\frac{1}{4}$ -inch Kaowool "M" board inserted in the sample holder to measure the total heat flux. The calorimeter must have a view angle of 180 degrees and be calibrated for incident flux. The calorimeter calibration must be acceptable to the Administrator.

- (8) **Pilot-Flame Positions.** Pilot ignition of the specimen must be accomplished by simultaneously exposing the specimen to a lower pilot burner and an upper pilot burner, as described in paragraph (b)(8)(i) and (b)(8)(ii), respectively. The pilot burner must remain lighted for the entire 5-minute duration of the test.

- (i) **Lower Pilot Burner.** The pilot-flame tubing must be 6.3mm O.D., 0.8mm wall, stainless steel tubing. A mixture of 120 cm³/min. of methane and 850cm³/min. of air must be fed to the lower pilot flame burner. The normal position of the end of the pilot burner tubing is 10 mm from and perpendicular to the exposed vertical surface of the specimen. The centerline at the outlet of the burner tubing must intersect the vertical centerline of the sample at a point 5mm above the lower exposed edge of the specimen,]

- (ii) **Upper Pilot Burner.** The pilot burner must be a straight length of 6.3mm O.D., 0.8mm wall, stainless steel tubing is 360mm long. One end of the tubing shall be closed, and three No. 40 drill holes shall be drilled into the tubing, 60mm apart, for gas ports, all radiating in the same direction. The first hole must be 5mm from the closed end of the tubing. The tube is inserted into the environmental chamber through a 6.6mm hole drilled 10mm above the upper edge of the window frame. The tube is supported and positioned by an adjustable "Z" shaped support mounted outside the environmental chamber, above the viewing window. The tube is positioned above and 20mm behind the exposed upper edge of the specimen. The middle hole must be in the vertical plane perpendicular to the exposed surface of the specimen which passes through its vertical centerline and must be pointed toward the radiation source. The gas supplied to the burner must be methane adjusted to produce flame lengths of 25mm.

- (c) **Calibration of Equipment.**

- (1) **Heat Release Rate.** [A burner as shown in Figure 4 must be placed over the end of the lower pilot flame tubing using a gas tight connection. The flow of gas to the pilot flame must be at least 99 percent methane and must be accurately metered. Prior to usage, the wet test meter is properly leveled and filled with distilled water to the tip of the internal pointer while no gas is flowing. Ambient temperature and pressure of the water are based on the internal wet test meter temperature. A baseline flow rate of approximately

- (3) For the normal operating range, a green arc with the lower limit at V_{S1} with maximum weight and with landing gear and wing flaps retracted, and the upper limit at the maximum structural cruising speed V_{NO} established under Sec. 23.1505(b).

- (4) For the flap operating range, a white arc with the lower limit at V_{SO} at the maximum weight, and the upper limit at the flaps-extended speed V_{FE} established under Sec. 23.1511.

- (5) [For reciprocating multiengine-powered airplanes of 6,000 pounds or less maximum weight, for the speed at which compliance has been shown with Sec. 23.69(b) relating to rate of climb at maximum weight and at sea level, a blue radial line.

- (6) For reciprocating multiengine-powered airplanes of 6,000 pounds or less maximum weight, for the maximum value of minimum control speed, V_{MC} , (one-engine-inoperative) determined under Sec. 23.149(b), a red radial line.]

- (c) If V_{NE} or V_{NO} vary with altitude, there must be means to indicate to the pilot the appropriate limitations throughout the operating altitude range.

- (d) Paragraphs (b)(1) through (b)(3) and paragraph (c) of this section do not apply to aircraft for which a maximum operating speed V_{MO}/M_{MO} is established under Sec. 23.1505(c). For those aircraft there must either be a maximum allowable airspeed indication showing the variation of V_{MO}/M_{MO} with altitude or compressibility limitations (as appropriate), or a radial red line marking for V_{MO}/M_{MO} must be made at lowest value of V_{MO}/M_{MO} established for any altitude up to the maximum operating altitude for the airplane.

Amdt. 23-50, Eff. 03/11/96

FAR 23.1547 : Magnetic direction indicator.

- (a) A placard meeting the requirements of this section must be installed on or near the magnetic direction indicator.

- (b) The placard must show the calibration of the instrument in level flight with the engines operating.

- (c) The placard must state whether the calibration was made with radio receivers on or off.

- (d) Each calibration reading must be in terms of magnetic headings in not more than 30° increments.

- (e) [If a magnetic nonstabilized direction indicator can have a deviation of more than 10 degrees caused by the operation of electrical equipment, the placard must state which electrical loads, or combination of loads, would cause a deviation of more than 10 degrees when turned on.]

Amdt. 23-20, Eff. 09/01/77

FAR 23.1549 : Powerplant [and auxiliary power unit instruments.]

[For each required powerplant and auxiliary power unit instrument, as appropriate to the type of instruments—]

- (a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line;

- (b) Each normal operating range must be marked with a green arc or green line, not extending beyond the maximum and minimum safe limits;
- (c) Each takeoff and precautionary range must be marked with a yellow arc or a yellow line; and
- (d) [Each engine, auxiliary power unit, or propeller range that is restricted because of excessive vibration stresses must be marked with red arcs or red lines.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.1551 : Oil quantity indicator.

Each oil quantity indicator must be marked in sufficient increments to indicate readily and accurately the quantity of oil.

FAR 23.1553 : Fuel quantity indicator.

[A red radial line must be marked on each indicator at the calibrated zero reading, as specified in Sec. 23.1337(b)(1).]

Amdt. 23-50, Eff. 03/11/96

FAR 23.1555 : Control markings.

- (a) Each cockpit control, other than primary flight controls and simple push button type starter switches, must be plainly marked as to its function and method of operation.
- (b) Each secondary control must be suitably marked.
- (c) For powerplant fuel controls—
 - (1) Each fuel tank selector control must be marked to indicate the position corresponding to each tank and to each existing cross feed position;
 - (2) If safe operation requires the use of any tanks in a specific sequence, that sequence must be marked on or near the selector for those tanks;
 - (3) The conditions under which the full amount of usable fuel in any restricted usage fuel tank can safely be used must be stated on a placard adjacent to the selector valve for that tank; and
 - (4) Each valve control for any engine of a multiengine airplane must be marked to indicate the position corresponding to each engine controlled.
- (d) Usable fuel capacity must be marked as follows :
 - (1) For fuel systems having no selector controls, the usable fuel capacity of the system must be indicated at the fuel quantity indicator.
 - (2) For fuel systems having selector controls, the usable fuel capacity available at each selector control position must be indicated near the selector control.
- (e) For accessory, auxiliary, and emergency controls—
 - (1) If retractable landing gear is used, the indicator required by Sec. 23.729 must be marked so that the pilot can, at any time, ascertain that the wheels are secured in the extreme positions; and
 - (2) [Each emergency control must be red and must be marked as to method of operation. No control other than an emergency control, or a control that serves an emergency function in addition to its other functions, shall be this color.]

Amdt. 23-50, Eff. 03/11/96

overshoot, as shown in Figure 5A. If an insufficient number of washers is added, or R_1 is too small, the output with square wave input will look like Figure 5B; if too many washers are added and R_1 is too large, the output will look like Figure 5A.

- (iv) Subtract the output of the compensator from the thermopile. The junctions enclosed in the dotted circle of Figure 4 are kept at the same constant temperature by electrically insulating the junctions and placing them on the pipe carrying air to the manifold, then covering them and the pipe with thermal insulation.

- (v) Thermopile hot junctions must be cleared of soot deposits on a daily basis during periods of testing.

- (3) *Radiation Source.* [A radiant heat source for generating a flux up to 100 kW/m², using four silicone carbide elements, Type LJ, 20 inches (50.8 cm) long by $\frac{5}{8}$ inch (1.54 cm) O.D., nominal resistance 1.4 ohms, is shown in Figures 2A and 2B. The silicone carbide elements are mounted in the stainless steel panel box by inserting them through 15.9mm holes in 0.8mm thick ceramic fiber board. Location of the holes in the pads and stainless steel cover plates are shown in Figure 2B. The diamond shaped mask of 24-gauge stainless steel is added to provide uniform heat flux over the area occupied by the 150 by 150mm vertical sample.]

- (4) *Air Distribution System.* The air entering the environmental chamber is distributed by a 6.3 mm thick aluminum plate having eight, No. 4 drill-holes, 51 mm from sides on 102 mm centers, mounted at the base of the environmental chamber. A second plate of 18 gauge steel having 120, evenly spaced, No. 28 drill holes is mounted 150 mm above the aluminum plate. A well-regulated air supply is required. The air supply manifold at the base of the pyramidal section has 48, evenly spaced, No. 26 drill holes located 10 mm from the inner edge of the manifold so that 0.03 m³/second of air flows between the pyramidal sections and 0.01 m³/second flows through the environmental chamber when total air flow to apparatus is controlled at 0.04 m³/second.

- (5) *Exhaust Stack.* An exhaust stack, 133mm by 70mm in cross section, and 254mm long, fabricated from 28 gauge stainless steel, is mounted on the outlet of the pyramidal section. A 25mm by 76mm plate of 31 gauge stainless steel is centered inside the stack, perpendicular to the air flow, 75mm above the base of the stack.

- (6) *Specimen Holders.* The 150 mm x 150 mm specimen is tested in a vertical orientation. The holder (Figure 3) is provided with a specimen holder frame, which touches the specimen (which is wrapped with aluminum foil as required by paragraph (d)(3) of this part) along only the 6 mm perimeter, and a "V" shaped spring to hold the assembly together. A detachable 12 mm X 12 mm X 150 mm drip pan and two .020-inch stainless steel wires (as shown in Figure 3) should be used for testing of materials prone to melting and dripping. The positioning of the spring and frame may be changed to accommodate different specimen thicknesses by inserting the retaining rod in different holes on the specimen holder. Since the radiation shield described in ASTM E-906 is not used, a guide pin is added to the injection mechanism. This fits into a slotted metal plate on the injection mechanism outside of the holding chamber and can be used to provide accurate positioning of the specimen face after injection.

FAR 25.F4 : Appendix F-Part IV-Test Method to Determine the Heat Release Rate From Cabin Materials Exposed to Radiant Heat

(a) Summary of Method.

(1) The specimen to be tested is injected into an environmental chamber through which a constant flow of air passes. The specimen's exposure is determined by a radiant heat source adjusted to produce the desired total heat flux on the specimen of 3.5 W/cm², using a calibrated calorimeter. The specimen is tested so that the exposed surface is vertical. Combustion is initiated by piloted ignition. The combustion products leaving the chamber are monitored in order to calculate the release rate of heat.

(b) *Apparatus.* The Ohio State University (OSU) rate of heat release apparatus as described below, is used. This is a modified version of the rate of heat release apparatus standardized by the American Society of Testing and Materials (ASTM), ASTM E-906.

(1) This apparatus is shown in Figures 1A. All exterior surfaces of the apparatus, except the holding chamber, must be insulated with 25 mm thick, low density, high temperature, fiberglass board insulation. A gasketed door through which the sample injection rod slides forms an airtight closure on the specimen hold chamber.

(2) *Thermopile.* [The temperature difference between the air entering the environmental chamber and that leaving is monitored by a thermopile having five hot and five cold, 24 gauge Chromel-Alumel junctions. The hot junctions are spaced across the top of the exhaust stack, 10mm below the top of the chimney. One thermocouple is located in the geometric center, with the other four located 30mm from the center along the diagonal toward each of the corners (Figure 5). The cold junctions are located in the pan below the lower air distribution plate (see paragraph (b)(4)). Thermopile hot junctions must be cleared of soot deposits as needed to maintain the calibrated sensitivity.]

(i) *Thermal Inertia Compensator.* A compensator tab is made from 0.55mm stainless steel sheet, 10 by 20mm. An 800 length of 24 gauge Chromel-Alumel, glass insulated, duplex thermocouple wire is welded or silver soldered to the tab as shown in Figure 2, and the wire bent back so that it is flush against the metal surface.

(ii) The compensator tab must be mounted on the exhaust stack as shown in Figure 3 using a 6-32 round head machine screw, 23mm long. Add small (approximately 4.5mm O.D., 9mm O.D.) washers between the head of the machine screw and the compensator tab to give the best response to a square wave input. (One or two washers should be adequate.) The "sharpness" of the square wave can be increased by changing the ratio of the output from the thermopile and compensator thermocouple which is fed to the recorder. The ratio is changed by adjusting the 1-K ohm variable resistor (R_1) of the thermopile bleeder shown in Figure 4. When adjusting compensation, keep R_1 as small as possible. Adjustment of the compensator must be made during calibration (see paragraph (c)(1)) at a heat release rate of 7.0 plus or minus 0.5 kW.

(iii) Adjust the washers and the variable resistor (R_1) so that 90 percent of full scale response is obtained in 8 to 10 seconds. There must be no

FAR 23.1557 : Miscellaneous markings and placards.

(a) *Baggage and cargo compartments, and ballast location.* Each baggage and cargo compartment, and each ballast location, must have a placard stating any limitations on contents, including weight, that are necessary under the loading requirements.

(b) *Seats.* If the maximum allowable weight to be carried in a seat is less than 170 pounds, a placard stating the lesser weight must be permanently attached to the seat structure.

(c) *Fuel and oil filler openings.* The following apply :

(1) [Fuel filler openings must be marked at or near the filler cover with—

(i) For reciprocating engine-powered airplanes—

(A) The word "Avgas"; and

(B) The minimum fuel grade.

(ii) For turbine engine-powered airplanes—

(A) The words "Jet Fuel"; and

(B) The permissible fuel designations, or references to the Airplane Flight Manual (AFM) for permissible fuel designations.

(iii) For pressure fueling systems, the maximum permissible fueling supply pressure and the maximum permissible defueling pressure.

(2) Oil filler openings must be marked at or near the filler cover with the word "Oil" and the permissible oil designations, or references to the Airplane Flight Manual (AFM) for permissible oil designations.

(3) Coolant filler openings must be marked at or near the filler cover with the word "Coolant".

(d) *Emergency exit placards.* Each placard and operating control for each emergency exit must be red. A placard must be near each emergency exit control and must clearly indicate the location of that exit and its method of operation.

(e) The system voltage of each direct current installation must be clearly marked adjacent to its external power connection.

(f) [Removed.]

Amdt. 23-45, Eff. 09/07/93

FAR 23.1559 : Operating limitations placard.

(a) [There must be a placard in clear view of the pilot stating—

(1) That the airplane must be operated in accordance with the Airplane Flight Manual ; and

(2) The certification category of the airplane to which the placards apply.

(b) For airplanes certificated in more than one category, there must be a placard in clear view of the pilot stating that other limitations are contained in the Airplane Flight Manual.

(c) There must be a placard in clear view of the pilot that specifies the kind of operations to which the operation of the airplane is limited or from which it is prohibited under Sec. 23.1525.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.1561 : Safety equipment.

- (a) Safety equipment must be plainly marked as to method of operation.
- (b) Stowage provisions for required safety equipment must be marked for the benefit of occupants.

FAR 23.1563 : Airspeed placards.

There must be an airspeed placard in clear view of the pilot and as close as practicable to the airspeed indicator. This placard must list—

- (a) The operating maneuvering speed V_O ; and
- (b) The maximum landing gear operating speed V_{LO} .
- (c) [For reciprocating multiengine-powered airplanes of more than 6,000 pounds maximum weight, and turbine engine-powered airplanes, the maximum value of the minimum control speed, V_{MC} (one-engine-inoperative) determined under Sec. 23.149(b).]

Amtd. 23-50, Eff. 03/11/96

FAR 23.1567 : Flight maneuver placard.

- (a) For normal category airplanes, there must be a placard in front of and in clear view of the pilot stating : "No acrobatic maneuvers, including spins, approved."
- (b) For utility category airplanes, there must be—
 - (1) A placard in clear view of the pilot stating : "Acrobatic maneuvers are limited to the following -----" (list approved maneuvers and the recommended entry speed for each) ; and
 - (2) For those airplanes that do not meet the spin requirements for acrobatic category airplanes, an additional placard in clear view of the pilot stating : "Spins Prohibited."
- (c) For acrobatic category airplanes, there must be a placard in clear view of the pilot listing the approved acrobatic maneuvers and the recommended entry airspeed for each. If inverted flight maneuvers are not approved, the placard must bear a notation to this effect.
- (d) [For acrobatic category airplanes and utility category airplanes approved for spinning, there must be a placard in clear view of the pilot—
 - (1) Listing the control action for recovery from spinning maneuvers ; and
 - (2) Stating that recovery must be initiated when spiral characteristics appear, or after not more than six turns or not more than any greater number of turns for which the airplane has been certificated.]

Amtd. 23-50, Eff. 03/11/96

34.2 Airplane Flight Manual and Approved Manual Material

FAR 23.1581 : General.

- (a) *Furnishing information.* An Airplane Flight Manual must be furnished with each airplane, and it must contain the following :

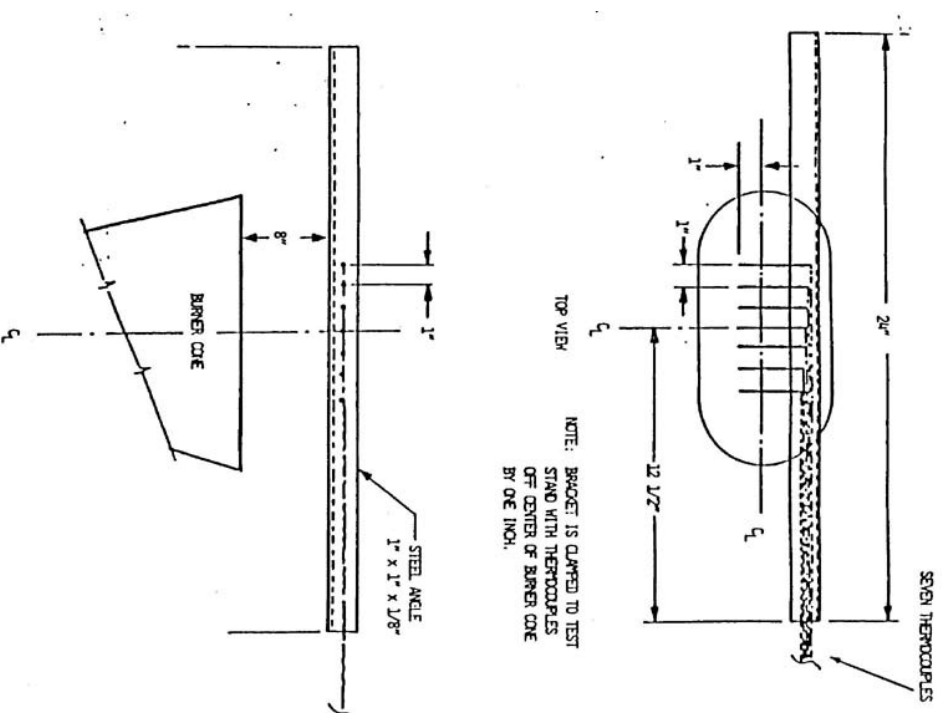


FIGURE 3. THERMOCOUPLE RAKE BRACKET

FIG. 56.8 – Thermocouple Rake Bracket

- (1) Information required by Secs. 23.1583 through 23.1589.
 - (2) Other information that is necessary for safe operation because of design, operating, or handling characteristics.
 - (3) [Further information necessary to comply with the relevant operating rules.]
- (b) *Approved information.*
- (1) Except as provided in paragraph (b)(2) of this section, each part of the Airplane Flight Manual containing information prescribed in Secs. 23.1583 through 23.1589 must be approved, segregated, identified and clearly distinguished from each unapproved part of that Airplane Flight Manual.
 - (2) [The requirements of paragraph (b)(1) of this section do not apply to reciprocating engine-powered airplanes of 6,000 pounds or less maximum weight, if the following is met :]
 - (i) Each part of the Airplane Flight Manual containing information prescribed in Sec. 23.1583 must be limited to such information, and must be approved, identified, and clearly distinguished from each other part of the Airplane Flight Manual.
 - (ii) The information prescribed in Secs. 23.1585 through 23.1589 must be determined in accordance with the applicable requirements of this part and presented in its entirety in a manner acceptable to the Administrator.
 - (3) Each page of the Airplane Flight Manual containing information prescribed in this section must be of a type that is not easily erased, disfigured, or misplaced, and is capable of being inserted in a manual provided by the applicant, or in a folder, or in any other permanent binder.
 - (c) [The units used in the Airplane Flight Manual must be the same as those marked on the appropriate instruments and placards.
 - (d) All Airplane Flight Manual operational airspeeds, unless otherwise specified, must be presented as indicated airspeeds.]
 - (e) Provisions must be made for stowing the Airplane Flight Manual in a suitable fixed container which is readily accessible to the pilot.
 - (f) *Revisions and amendments.* Each Airplane Flight Manual (AFM) must contain a means for recording the incorporation of revisions and amendments.
- Amdt. 23-50, Eff. 03/11/96

FAR 23.1583 : Operating limitations.

[The Airplane Flight Manual must contain operating limitations determined under this part 23, including the following—]

- (a) *Airspeed limitations.* The following information must be furnished :

- (1) Information necessary for the marking of the airspeed limits on the indicator as required in Sec. 23.1545, and the significance of each of those limits and of the color coding used on the indicator.
- (2) The speeds V_{MC} , V_O , V_{LE} , and V_{LO} , if established, and their significance.
- (3) [In addition, for turbine powered commuter category airplanes—]

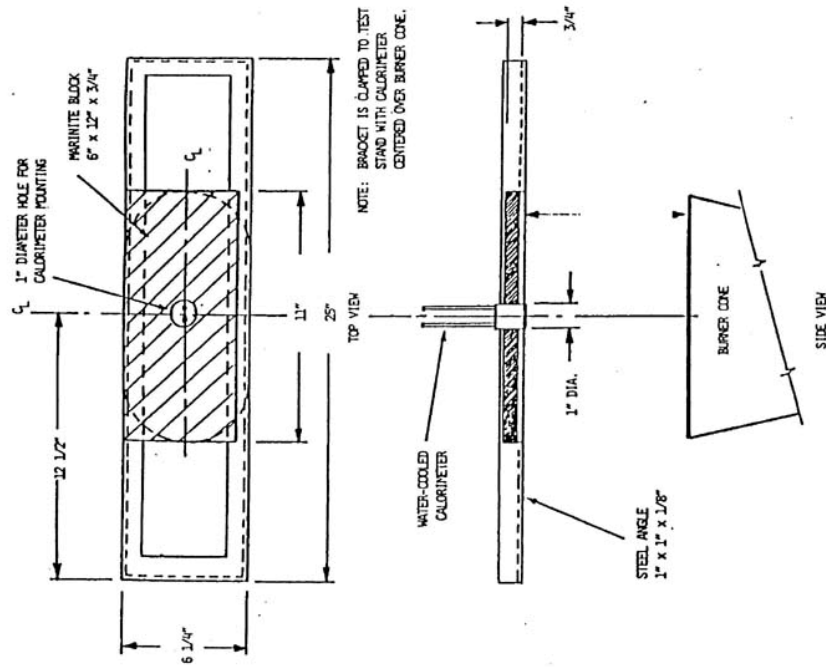


FIGURE 2. CALORIMETER BRACKET

FIG. 56.7 – Calorimeter Bracket

- (i) The maximum operating limit speed, V_{MO}/M_{MO} and a statement that this speed must not be deliberately exceeded in any regime of flight (climb, cruise, or descent) unless a higher speed is authorized for flight test or pilot training; ¹
 - (ii) If an airspeed limitation is based upon compressibility effects, a statement to this effect and information as to any symptoms, the probable behavior of the airplane, and the recommended recovery procedures; and
 - (iii) The airspeed limits must be shown in terms of V_{MO}/M_{MO} instead of V_{NO} and V_{NE} .
- (b) Powerplant limitations.** The following information must be furnished:
- (1) Limitations required by Sec. 23.1521.
 - (2) Explanation of the limitations, when appropriate.
 - (3) Information necessary for marking the instruments required by Secs. 23.1549 through Sec. 23.1553.
- (c) Weight.** The airplane flight manual must include—
- (1) The maximum weight; and
 - (2) The maximum landing weight, if the design landing weight selected by the applicant is less than the maximum weight.
- (3)** For normal, utility, and acrobatic category reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight and for turbine engine-powered airplanes in the normal, utility, and acrobatic category, performance operating limitations as follows—
- (i) The maximum takeoff weight for each airport altitude and ambient temperature within the range selected by the applicant at which the airplane complies with the climb requirements of Sec. 23.63(c)(1).
 - (ii) The maximum landing weight for each airport altitude and ambient temperature within the range selected by the applicant at which the airplane complies with the climb requirements of Sec. 23.63(c)(2).
- (4)** For commuter category airplanes, the maximum takeoff weight for each airport altitude and ambient temperature within the range selected by the applicant at which—
- (i) The airplane complies with the climb requirements of Sec. 23.63(d)(1); and
 - (ii) The accelerate-stop distance determined under Sec. 23.55 is equal to the available runway length plus the length of any stopway, if utilized; and either:
- (iii) The takeoff distance determined under Sec. 23.59(a) is equal to the available runway length; or
 - (iv) At the option of the applicant, the takeoff distance determined under Sec. 23.59(a) is equal to the available runway length plus the length of any clearway and the takeoff run determined under Sec. 23.59(b) is equal to the available runway length.
- (5)** For commuter category airplanes, the maximum landing weight for each airport altitude within the range selected by the applicant at which—

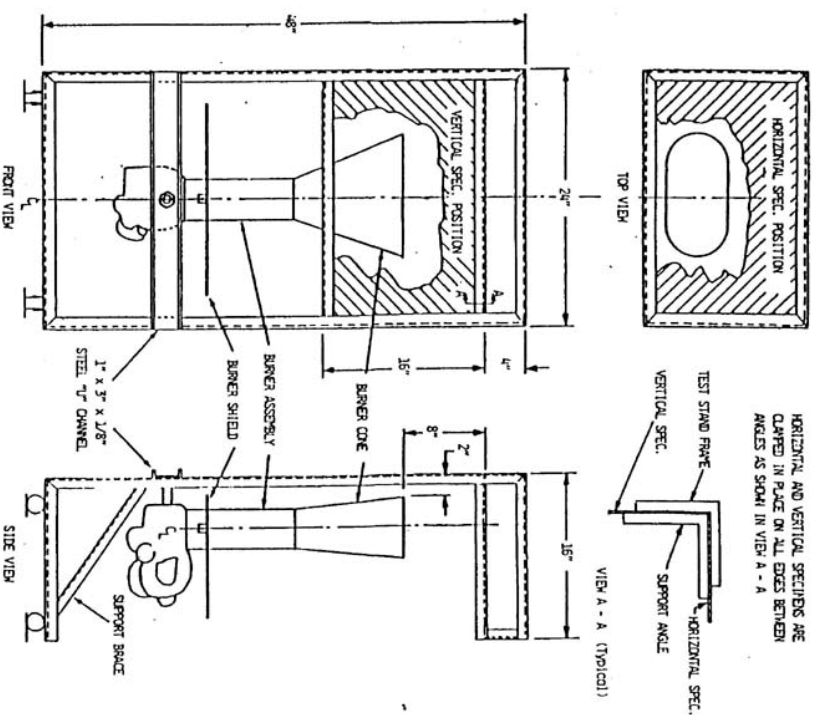


FIG. 56.6 – *Test Apparatus for Horizontal and Vertical Mounting*

- (5) Turn on the burner and ensure that each of the seven thermocouples reads $1700^{\circ}\text{F.} \pm 100^{\circ}\text{F.}$ ($927^{\circ}\text{C.} \pm 38^{\circ}\text{C.}$) to ensure steady state conditions have been achieved. If the temperature is out of this range, repeat steps 2 through 5 until proper readings are obtained.
- (6) Turn off the burner and remove the thermocouple rake.
- (7) Repeat (1) to ensure that the burner is in the correct range.

(g) *Test Procedure.*

- (1) Mount a thermocouple of the same type as that used for calibration at a distance of 4 inches (101 mm) above the horizontal (ceiling) test specimen. The thermocouple should be centered over the burner cone.
 - (2) Mount the test specimen on the test stand shown in Figure 1 in either the horizontal or vertical position. Mount the insulating material in the other position.
 - (3) Position the burner so that flame will not impinge on the specimen, turn the burner on, and allow it to run for 2 minutes. Rotate the burner to apply the flame to the specimen and simultaneously start the timing device.
 - (4) Expose the test specimen to the flame for 5 minutes and then turn off the burner. The test may be terminated earlier if flame penetration is observed.
 - (5) When testing ceiling liner panels, record the peak temperature measured 4 inches above the sample.
 - (6) Record the time at which flame penetration occurs if applicable.
- (h) *Test Report.* The test report must include the following :
- (1) A complete description of the materials tested including type, manufacturer, thickness, and other appropriate data.
 - (2) Observations of the behavior of the test specimens during flame exposure such as delamination, resin ignition, smoke, etc., including the time of such occurrence.
 - (3) The time at which flame penetration occurs, if applicable, for each of three specimens tested.
 - (4) Panel orientation (ceiling or sidewall.)

Amdt. 25-60, Eff. 6/16/86

- (i) The airplane complies with the climb requirements of Sec. 23.63(d)(2) for ambient temperatures within the range selected by the applicant ; and
- (ii) The landing distance determined under Sec. 23.75 for standard temperatures is equal to the available runway length.
- (6) The maximum zero wing fuel weight, where relevant, as established in accordance with Sec. 23.343.
- (d) *Center of gravity.* The established center of gravity limits.
- (e) *Maneuvers.* The following authorized maneuvers, appropriate airspeed limitations, and unauthorized maneuvers, as prescribed in this section.
 - (1) *Normal category airplanes.* No acrobatic maneuvers, including spins, are authorized.
 - (2) *Utility category airplanes.* A list of authorized maneuvers demonstrated in the type flight tests, together with recommended entry speeds and any other associated limitations. No other maneuver is authorized.
 - (3) *Acrobatic category airplanes.* A list of approved flight maneuvers demonstrated in the type flight tests, together with recommended entry speeds and any other associated limitations.
 - (4) *Acrobatic category airplanes and utility category airplanes approved for spinning.* Spin recovery procedure established to show compliance with Sec. 23.221(c).
 - (5) *Commuter category airplanes.* Maneuvers are limited to any maneuver incident to normal flying, stalls, (except whip stalls) and steep turns in which the angle of bank is not more than 60 degrees.
 - (f) *Maneuver load factor.* The positive limit load factors in g's, and, in addition, the negative limit load factor for acrobatic category airplanes.
 - (g) *Minimum flight crew.* The number and functions of the minimum flight crew determined under Sec. 23.1523.]
 - (h) *Kinds of operation.* A list of the kinds of operation to which the airplane is limited or from which it is prohibited under Sec. 23.1525, and also a list of installed equipment that affects any operating limitation and identification as to the equipment's required operational status for the kinds of operation for which approval has been given.
 - (i) *Maximum operating altitude.* The maximum altitude established under Sec. 23.1527.
 - (j) *Maximum passenger seating configuration.* The maximum passenger seating configuration.
 - (k) *Allowable lateral fuel loading.* The maximum allowable lateral fuel loading differential, if less than the maximum possible.
 - (l) *Baggage and cargo loading.* The following information for each baggage and cargo compartment or zone—
 - (1) The maximum allowable load ; and
 - (2) The maximum intensity of loading.
 - (m) *Systems.* Any limitations on the use of airplane systems and equipment.
 - (n) *Ambient temperatures.* Where appropriate, maximum and minimum ambient air temperatures for operation.

- (c) *Smoking.* Any restrictions on smoking in the airplane.
 - (b) *Types of surface.* A statement of the types of surface on which operations may be conducted. (See Sec. 23.45(g) and Sec. 23.1587(a)(4), (c)(2), and (d)(4).)
- Amdt. 23-50, Eff. 03/11/96

FAR 23.1585 : Operating procedures.

- (a) [For all airplanes, information concerning normal, abnormal (if applicable), and emergency procedures and other pertinent information necessary for safe operation and the achievement of the scheduled performance must be furnished, including—
- (1) An explanation of significant or unusual flight or ground handling characteristics;
- (2) The maximum demonstrated values of crosswind for takeoff and landing, and procedures and information pertinent to operations in crosswinds;
- (3) A recommended speed for flight in rough air. This speed must be chosen to protect against the occurrence, as a result of gusts, of structural damage to the airplane and loss of control (for example, stalling);
- (4) Procedures for restarting any turbine engine in flight, including the effects of altitude; and
- (5) Procedures, speeds, and configuration(s) for making a normal approach and landing, in accordance with Secs. 23.73 and 23.75, and a transition to the balked landing condition.
- (6) For seaplanes and amphibians, water handling procedures and the demonstrated wave height.
- (b) In addition to paragraph (a) of this section, for all single-engine airplanes, the procedures, speeds, and configuration(s) for a glide following engine failure, in accordance with Sec. 23.71 and the subsequent forced landing, must be furnished.
- (c) In addition to paragraph (a) of this section, for all multiengine airplanes, the following information must be furnished :
 - (1) Procedures, speeds, and configuration(s) for making and approach and landing with one engine inoperative;
 - (2) Procedures, speeds, and configuration(s) for making a balked landing with one engine inoperative and the conditions under which a balked landing can be performed safely, or a warning against attempting a balked landing;
 - (3) The V_{SSE} determined in Sec. 23.149; and
 - (4) Procedures for restarting any engine in flight including the effects of altitude.
- (d) In addition to paragraphs (a) and either (b) or (c) of this section, as appropriate, for all normal, utility, and acrobatic category airplanes, the following information must be furnished :
 - (1) Procedures, speeds, and configuration(s) for making a normal takeoff, in accordance with Sec. 23.51(a) and (b), and Sec. 23.53(a) and (b), and the subsequent climb, in accordance with Sec. 23.65 and Sec. 23.69(a).
 - (2) Procedures for abandoning a takeoff due to engine failure or other cause.
- (e) In addition to paragraphs (a), (c), and (d) of this section, for all normal, utility, and acrobatic category multiengine airplanes, the information must include the following :

(3) *Calorimeter.*

- (i) The calorimeter to be used in testing must be a total heat flux Foil Type Gardon Gage of an appropriate range (approximately 0 to 15.0 British thermal unit (BTU) per $ft^2 \cdot sec$, 0-17.0 $watts/cm^2$). The calorimeter must be mounted in a 6 inch by 12 inch (152 by 305 mm) by $\frac{3}{4}$ inch (19 mm) thick insulating block which is attached to a steel angle bracket for placement in the test stand during burner calibration as shown in Figure 2 of the Part of this Appendix.
- (ii) The insulating block must be monitored for deterioration and the mounting shimmied as necessary to ensure that the calorimeter face is parallel to the exit plane of the test burner cone.
- (4) *Thermocouples.* The seven thermocouples to be used for testing must be $\frac{1}{16}$ inch ceramic sheathed, type K, grounded thermocouples with a nominal 30 American wire gage (AWG) size conductor. The seven thermocouples must be attached to a steel angle bracket to form a thermocouple rake for placement in the stand during burner calibration as shown in Figure 3 of this Part of this Appendix.
- (5) *Apparatus Arrangement.* The test burner must be mounted on a suitable stand to position the exit of the burner cone a distance of 8 inches from the ceiling liner panel and 2 inches from the sidewall liner panel. The burner stand should have the capability of allowing the burner to be swung away from the test specimen during warm-up periods.
- (6) *Instrumentation.* A recording potentiometer or other suitable instrument with an appropriate range must be used to measure and record the outputs of the calorimeter and the thermocouples.
- (7) *Timing Device.* A stopwatch or other device must be used to measure the time of flame application and the time of flame penetration, if it occurs.
- (e) *Preparation of Apparatus.* Before calibration, all equipment must be turned on and allowed to stabilize, and the burner fuel flow must be adjusted as specified in paragraph (d)(2).
- (f) *Calibration.* To ensure the proper thermal output of the burner the following test must be made :
 - (1) Remove the burner extension from the end of the draft tube. Turn on the blower portion of the burner without turning the fuel or igniters on. Measure the air velocity using a hot wire anemometer in the center of the draft tube across the face of the opening. Adjust the damper such that the air velocity is in the range of 1530 to 1800 ft./min. If tabs are being used at the exit of the draft tube, they must be removed prior to this measurement. Reinstall the draft tube extension cone.
 - (2) Place the calorimeter on the test stand as shown in Figure 2 at a distance of 8 inches (203 mm) from the exit of the burner cone to simulate the position of the horizontal test specimen.
 - (3) Turn on the burner, allow it to run for 2 minutes for warm-up, and adjust the damper to produce a calorimeter reading of 8.0 ± 0.5 BTU per $ft^2 \cdot sec$. ($9.1 \pm 0.6Watts/cm^2$).
 - (4) Replace the calorimeter with the thermocouples rake (see Figure 3).

FAR 25.F3 : [Appendix F-Part III-Test Method to Determine Flame Penetration Resistance of Cargo Compartment Liners.]

(a) [Criteria for Acceptance.

- (1) At least three specimens of cargo compartment sidewall or ceiling liner panels must be tested.
 - (2) Each specimen tested must stimulate the cargo compartment sidewall or ceiling liner panel, including any design features, such as joints, lamp assemblies, etc., the failure of which would affect the capability of the liner to safety contains a fire.
 - (3) There must be no flame penetration of any specimen within 5 minutes after application of the flame source, and the peak temperature measured at 4 inches above the upper surface of the horizontal test sample must not exceed 400° F.
- (b) Summary of Method.** This method provides a laboratory test procedure for measuring the capability of cargo compartment lining materials to resist flame penetration with a 2 gallon per hour (GPH) #2 Grade kerosene or equivalent burner fire source. Ceiling and sidewall liner panels may be tested individually provided a baffle is used to simulate the missing panel. Any specimen that passes the test as a ceiling liner panel may be used as a sidewall liner panel.

(c) Test Specimens.

- (1) The specimen to be tested must measure $16 \pm \frac{1}{8}$ inches ($406 \pm 3mm$) by $24 \pm \frac{1}{8}$ inches ($610 \pm mm$).
- (2) The specimens must be conditioned at 70° F. $\pm$ 5° F. (21° C. $\pm$ 2° C.) and 55% $\pm$ 5% humidity for at least 24 hours before testing.

- (d) **Test Apparatus.** The arrangement of the test apparatus, which is shown in Figure 3 of Part II and Figure 1 through 3 of this Part of Appendix F, must include the components described in this section. Minor details of the apparatus may vary, depending on the model of the burner used.

- (1) **Specimen Mounting Stand.** The mounting stand for the test specimens consists of steel angles as shown in Figure 1.

- (2) **Test Burner.** The burner to be used in testing must—

- (i) Be a modified gun type.
- (ii) Use a suitable nozzle and maintain fuel pressure to yield a 2 GPH fuel flow. For example : an 80 degree nozzle nominally rated at 2.25 GPH and operated at 85 pounds per square inch (PSI) gage to deliver 2.03 GPH.
- (iii) Have a 12 inch (305 mm) burner extension installed at the end of the draft tube with an opening 6 inches (152 mm) high and 11 inches (280 mm) wide as shown in Figure 3 of Part II of this Appendix.
- (iv) Have a burner fuel pressure regulator that is adjusted to deliver a nominal 2.0 GPH of #2 Grade kerosene or equivalent.

Burner models which have been used successfully in testing are the Lenox Model OB-32, Carlin Model 200 CRD and park Model DPL. The basic burner is described in FAA Powerplant Engineering Report No. 3A, Standard Fire Test Apparatus and Procedures for Flexible Hose Assemblies, dated March 1978; however, the test setting specified in this Appendix differ in some instances from those specified in the report.

- (1) Procedures and speeds for continuing a takeoff following engine failure and the conditions under which takeoff can safely be continued, or a warning against attempting to continue the takeoff.
- (2) Procedures, speeds, and configurations for continuing a climb following engine failure, after takeoff, in accordance with Sec. 23.67, or enroute, in accordance with Sec. 23.69(b).
- (f) In addition to paragraphs (a) and (c) of this section, for commuter category airplanes, the information must include the following :
 - (1) Procedures, speeds, and configuration(s) for making a normal takeoff.
 - (2) Procedures and speeds for carrying out an accelerate-stop in accordance with Sec. 23.55.
 - (3) Procedures and speeds for continuing a takeoff following engine failure in accordance with Sec. 23.59(a)(1) and for following the flight path determined under Sec. 23.57 and Sec. 23.61(a).
- (g) For multiengine airplanes, information identifying each operating condition in which the fuel system independence prescribed in Sec. 23.953 is necessary for safety must be furnished, together with instructions for placing the fuel system in a configuration used to show compliance with that section.
- (h) For each airplane showing compliance with Sec. 23.1353(g)(2) or (g)(3), the operating procedures for disconnecting the battery from its charging source must be furnished.
- (i) Information on the total quantity of usable fuel for each fuel tank, and the effect on the usable fuel quantity, as a result of a failure of any pump, must be furnished.
- (j) Procedures for the safe operation of the airplane's systems and equipment, both in normal use and in the event of malfunction, must be furnished.]

Amdt. 23-50, Eff. 03/11/96

FAR 23.1587 : Performance information.

[Unless otherwise prescribed, performance information must be provided over the altitude and temperature ranges required by Sec. 23.45(b).

- (a) For all airplanes, the following information must be furnished—
 - (1) The stalling speeds V_{S0} and V_{S1} with the landing gear and wing flaps retracted, determined at maximum weight under Sec. 23.49, and the effect on these stalling speeds of angles of bank up to 60 degrees;
 - (2) The steady rate and gradient of climb with all engines operating, determined under Sec. 23.69(a) ;
 - (3) The landing distance, determined under Sec. 23.75 for each airport altitude and standard temperature, and the type of surface for which it is valid ;
 - (4) The effect on landing distances of operation on other than smooth hard surfaces, when dry, determined under Sec. 23.45(g) ; and
 - (5) The effect on landing distances of runway slope and 50 percent of the headwind component and 150 percent of the tailwind component.
- (b) In addition to paragraph (a) of this section, for all normal, utility, and acrobatic category reciprocating engine-powered airplanes of 6,000 pounds or less maximum weight, the steady angle of climb/descent, determined under Sec. 23.77(a), must be furnished.

- (c) In addition to paragraphs (a) and (b) of this section, if appropriate, for normal, utility, and acrobatic category airplanes, the following must be furnished—
- (1) The takeoff distance, determined under Sec. 23.53 and the type of surface for which it is valid.
 - (2) The effect on takeoff distance of operation on other than smooth hard surfaces, when dry, determined under Sec. 23.45(g);
 - (3) The effect on takeoff distance of runway slope and 50 percent of the headwind component and 150 percent of the tailwind component;
 - (4) For multiengine reciprocating engine-powered airplanes of more than 6,000 pounds maximum weight and multiengine turbine powered airplanes, the one-engine-inoperative takeoff climb/descent gradient, determined under Sec. 23.66;
 - (5) For multiengine airplanes, the enroute rate and gradient of climb/descent with one engine inoperative, determined under Sec. 23.69(b); and
 - (6) For single-engine airplanes, the glide performance determined under Sec. 23.71.
- (d) In addition to paragraph (a) of this section, for commuter category airplanes, the following information must be furnished—
- (1) The accelerate-stop distance determined under Sec. 23.55;
 - (2) The takeoff distance determined under Sec. 23.59(a);
 - (3) At the option of the applicant, the takeoff run determined under Sec. 23.59(b);
 - (4) The effect on accelerate-stop distance, takeoff distance and, if determined, takeoff run, of operation on other than smooth hard surfaces, when dry, determined under Sec. 23.45(g);
 - (5) The effect on accelerate-stop distance, takeoff distance, and if determined, takeoff run, of runway slope and 50 percent of the headwind component and 150 percent of the tailwind component;
 - (6) The net takeoff flight path determined under Sec. 23.61(b);
 - (7) The enroute gradient of climb/descent with one engine inoperative, determined under Sec. 23.69(b);
 - (8) The effect, on the net takeoff flight path and on the enroute gradient of climb/descent with one engine inoperative, of 50 percent of the headwind component and 150 percent of the tailwind component;
 - (9) Overweight landing performance information (determined by extrapolation and computed for the range of weights between the maximum landing and maximum takeoff weights) as follows—
 - (i) The maximum weight for each airport altitude and ambient temperature at which the airplane complies with the climb requirements of Sec. 23.63(d)(2); and
 - (ii) The landing distance determined under Sec. 23.75 for each airport altitude and standard temperature.
 - (10) The relationship between IAS and CAS determined in accordance with Sec. 23.1323(b) and (c).
 - (11) The altimeter system calibration required by Sec. 23.1325(e).
- Amdt. 23-50, Eff. 03/11/96

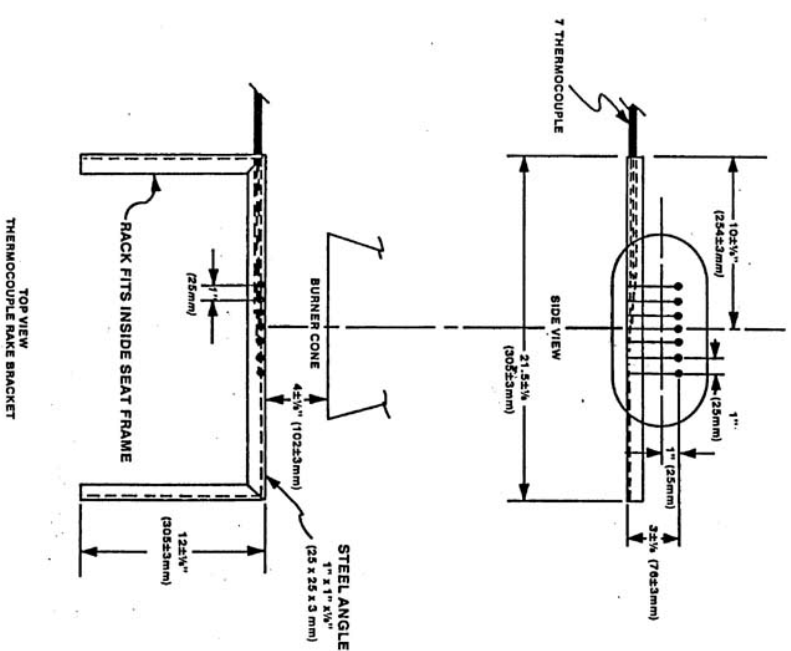


FIGURE 5

FIG. 56.5 -

FAR 23.1589 : Loading information.

The following loading information must be furnished :

- (a) The weight and location of each item of equipment that can be easily removed, relocated, or replaced and that is installed when the airplane was weighed under the requirement of Sec. 23.25.

- (b) [Appropriate loading instructions for each possible loading condition between the maximum and minimum weights established under Sec. 23.25, to facilitate the center of gravity remaining within the limits established under Sec. 23.23.]

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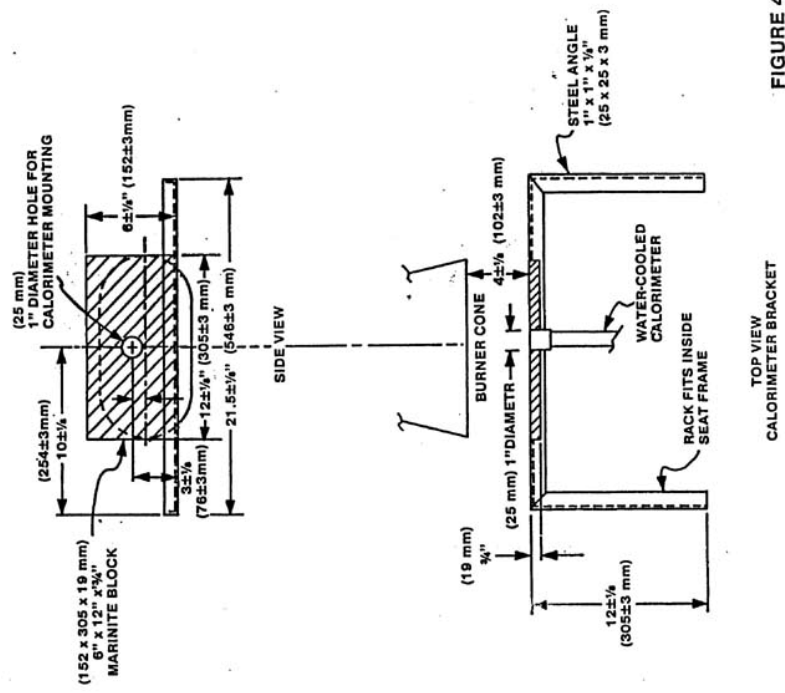


FIG. 56.4 –

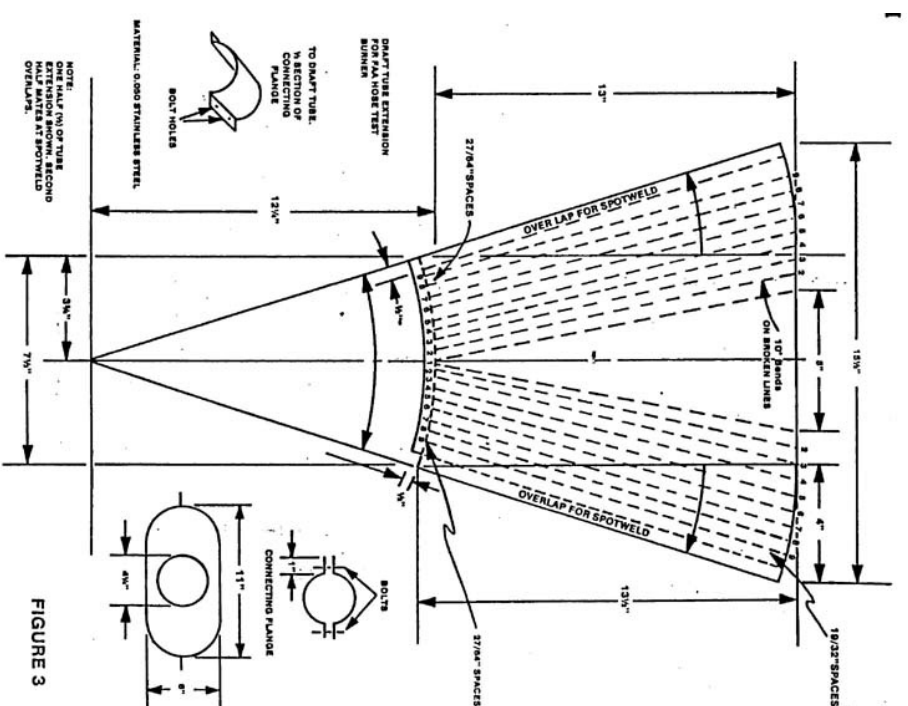


FIG. 56.3 –

Chapitre 35

Appendix A : Simplified Design Load Criteria

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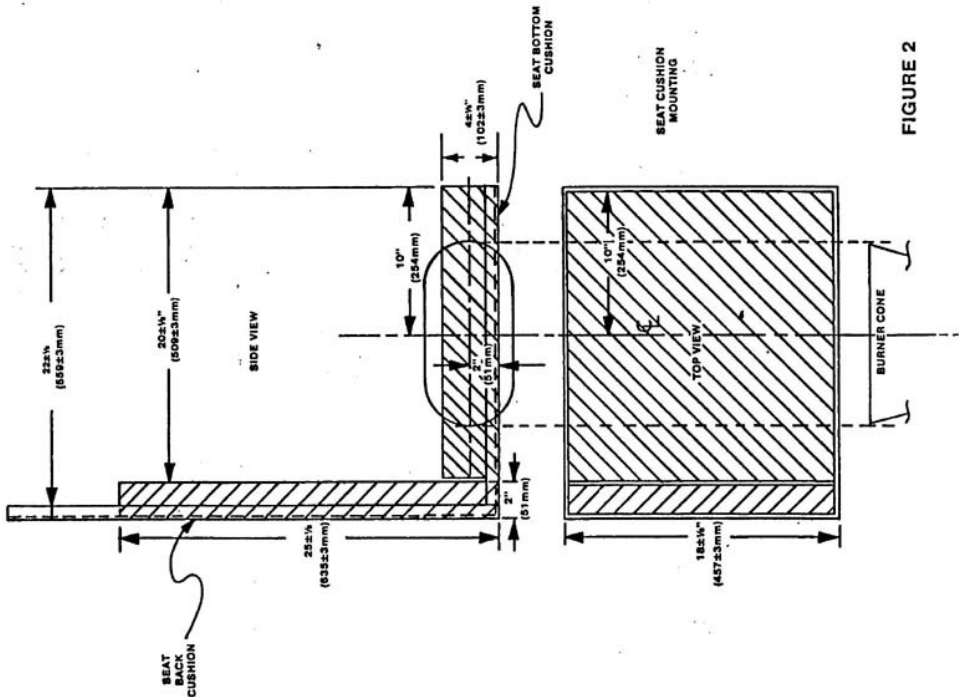


FIG. 56.2 -

FAR 23.A1 : General.

- (a) [The design load criteria in this appendix are an approved equivalent of those in Secs. 23.321 through 23.459 of this subchapter for an airplane having a maximum weight of 6,000 pounds or less and the following configuration :
- (1) A single engine excluding turbine powerplants ;
 - (2) A main wing located closer to the airplane's center of gravity than to the aft, fuselage-mounted, empennage ;
 - (3) A main wing that contains a quarter-chord sweep angle of not more than 15 degrees fore or aft ;
 - (4) A main wing that is equipped with trailing-edge controls (ailerons or flaps, or both) ;
 - (5) A main wing aspect ratio not greater than 7 ;
 - (6) A horizontal tail aspect ratio not greater than 4 ;
 - (7) A horizontal tail volume coefficient not less than 0.34 ;
 - (8) A vertical tail aspect ratio not greater than 2 ;
 - (9) A vertical tail platform area not greater than 10 percent of the wing platform area ; and
 - (10) Symmetrical airfoils must be used in both the horizontal and vertical tail designs.
- (b) Appendix A criteria may not be used on any airplane configuration that contains any of the following design features :
- (1) Canard, tandem-wing, close-coupled, or tailless arrangements of the lifting surfaces ;
 - (2) Biplane or multiplane wing arrangements ;
 - (3) T-tail, V-tail, or cruciform-tail (+) arrangements ;
 - (4) Highly-swept wing platform (more than 15-degrees of sweep at the quarter-chord), delta planforms, or slatted lifting surfaces ; or
 - (5) Winglets or other wing tip devices, or outboard fins.]
- Amdt. 23-48, Eff. 03/11/96

FAR 23.A3 : Special symbols.

- n_1 :Airplane Positive Maneuvering Limit Load Factor.
- n_2 :Airplane Negative Maneuvering Limit Load Factor.
- n_3 :Airplane Positive Gust Limit Load Factor at V_C .
- n_4 :Airplane Negative Gust Limit Load Factor at V_C .
- n_{flap} :Airplane Positive Limit Load Factor with Flaps Fully Extended at V_F .
- $[*V_{rmin}]$:Minimum Design Flap Speed = $11.0\sqrt{n_1 \frac{W}{S}}$ kts.
- $*V_{Amin}$:Minimum Design Maneuvering Speed = $15.0\sqrt{n_1 \frac{W}{S}}$ kts.
- $*V_{Cmin}$:Minimum Design Cruising Speed = $17.0\sqrt{n_1 \frac{W}{S}}$ kts.
- $*V_{Dmin}$:Minimum Design Dive Speed = $24.0\sqrt{n_1 \frac{W}{S}}$ kts.]
- $*$:Also see paragraph A23.7(e)(2) of this Appendix.

Amdt. 23-28, Eff. 04/28/82

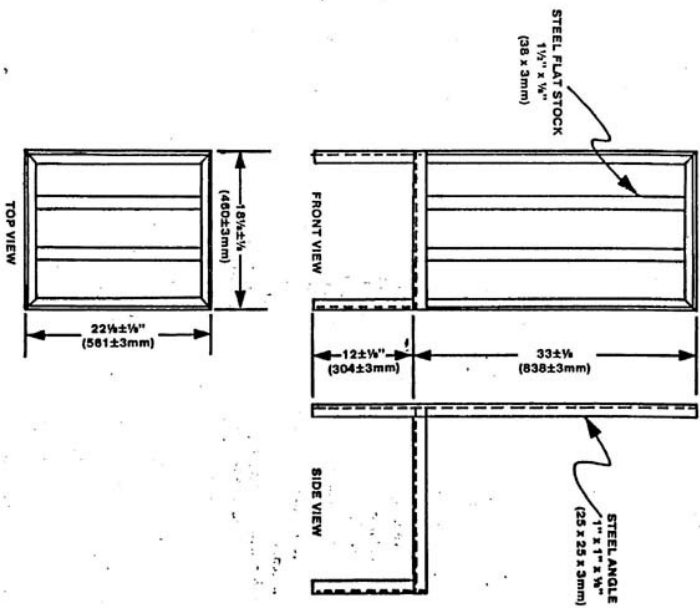


FIGURE 1

FIG. 56.1 -

from one side of the specimen mounting stand. The burner stand should have the capability of allowing the burner to be swung away from the specimen mounting stand during warmup periods.

(6) *Data Recording.* A recording potentiometer or other suitable calibrated instrument with an appropriate range must be used to measure and record the outputs of the calorimeter and the thermocouples.

(7) *Weight Scale.* Weighing Device-A device must be used that with proper procedures may determine the before and after test weights of each set of seat cushion specimens within 0.02 pound (9 grams). A continuous weighing system is preferred.

(8) *Timing Device.* A stopwatch or other device (calibrated to ± 1 second) must be used to measure the time of application of the burner flame and self-extinguishing time or test duration.

Amdt. 25-94, Eff. 3/25/98

FAR 23.A5 : Certification in more than one category.

The criteria in this appendix may be used for certification in the normal, utility, and acrobatic categories, or in any combination of these categories. If certification in more than one category is desired, the design category weights must be selected to make the term " $n_1 W$ " constant for all categories or greater for one desired category than for others. The wings and control surfaces (including wing flaps and tabs) need only be investigated for the maximum value of " $n_1 W$ ", or for the category corresponding to the maximum design weight, where " $n_1 W$ " is constant. If the acrobatic category is selected, a special unsymmetrical flight load investigation in accordance with subparagraphs A23.9(c)(2) and A23.11(c)(2) of this appendix must be completed. The wing, wing carrythrough, and the horizontal tail structures must be checked for this condition. The basic fuselage structure need only be investigated for the highest load factor design category selected. The local supporting structure for dead weight items need only be designed for the highest load factor imposed when the particular items are installed in the airplane. The engine mount, however, must be designed for a higher side load factor, if certification in the acrobatic category is desired, than that required for certification in the normal and utility categories. When designing for landing loads, the landing gear and the airplane as a whole need only be investigated for the category corresponding to the maximum design weight. These simplifications apply to single-engine aircraft of conventional types for which experience is available, and the Administrator may require additional investigations for aircraft with unusual design features.

FAR 23.A7 : Flight loads.

- (a) Each flight load may be considered independent of altitude and, except for the local supporting structure for dead weight items, only the maximum design weight conditions must be investigated.
- (b) Table 1 and figures 3 and 4 of this appendix must be used to determine values of n_1 , n_2 , n_3 , and n_4 , corresponding to the maximum design weights in the desired categories.
- (c) Figures 1 and 2 of this appendix must be used to determine values of n_3 and n_4 corresponding to the minimum flying weights in the desired categories; and, if these load factors are greater than the load factors at the design weight, the supporting structure for dead weight items must be substantiated for the resulting higher load factors.
- (d) Each specified wing and tail loading is independent of the center of gravity range. The applicant, however, must select a c.g. range, and the basic fuselage structure must be investigated for the most adverse dead weight loading conditions for the c.g. range selected.
- (e) The following loads and loading conditions are the minimums for which strength must be provided in the structure :
 - (1) *Airplane equilibrium.* The aerodynamic wing loads may be considered to act normal to the relative wind, and to have a magnitude of 1.05 times the airplane normal loads (as determined from paragraphs A23.9(b) and (c) of this appendix) for the positive flight conditions and a magnitude equal to the airplane normal loads for the negative conditions. Each chordwise and normal component of this wing load must be considered.

- (2) *Minimum design airspeeds.* The minimum design airspeeds may be chosen by the applicant except that they may not be less than the minimum speeds found by using figure 3 of this appendix. In addition, $V_{c_{min}}$ need not exceed values of $0.9 V_H$ actually obtained at sea level for the lowest design weight category for which certification is desired. In computing these minimum design airspeeds, n_1 may not be less than 3.8.
- (3) *Flight load factor.* The limit flight load factors specified in Table 1 of this appendix represent the ratio of the aerodynamic force component (acting normal to the assumed longitudinal axis of the airplane) to the weight of the airplane. A positive flight load factor is an aerodynamic force acting upward, with respect to the airplane.

FAR 23.A9 : Flight conditions.

- (a) *General.* Each design condition in paragraphs (b) and (c) of this section must be used to assure sufficient strength for each condition of speed and load factor on or within the boundary of a $V - n$ diagram for the airplane similar to the diagram in (Figure 35.6, p. 453) of this appendix. This diagram must also be used to determine the airplane structural operating limitations as specified in Secs. 23.1501(c) through 23.1513 and 23.1519.
- (b) *Symmetrical flight conditions.* The airplane must be designed for symmetrical flight conditions as follows :
- (1) The airplane must be designed for at least the four basic flight conditions, "A", "D", "E", and "G" as noted on the flight envelope of (Figure 35.6, p. 453) of this appendix. In addition, the following requirements apply :
- (i) The design limit flight load factors corresponding to conditions "D" and "E" of (Figure 35.6, p. 453) must be at least as great as those specified in (Table 35.1, p. 450) and (Figure 35.6, p. 453) of this Appendix, and the design speed for these conditions must be at least equal to the value of V_D found from (Figure 35.5, p. 453) of this appendix.
- (ii) For conditions "A" and "G" of (Figure 35.6, p. 453), the load factors must correspond to those specified in (Table 35.1, p. 450) of this Appendix, and the design speeds must be computed using these load factors with the maximum static lift coefficient C_{NA} determined by the applicant. However, in the absence of more precise computations, these latter conditions may be based on a value of $C_{NA} = \pm 1.35$ and the design speed for condition "A" may be less than $V_{A_{min}}$.
- (iii) Conditions "C" and "F" of (Figure 35.6, p. 453) need only be investigated when $n_3 \frac{W}{S}$ or $n_4 \frac{W}{S}$ are greater than $n_1 \frac{W}{S}$ or $n_2 \frac{W}{S}$ of this appendix, respectively.
- (2) If flaps or other high lift devices intended for use at the relatively low airspeed of approach, landing, and takeoff, are installed, the airplane must be designed for the two flight conditions corresponding to the values of limit flap-down factors specified in (Table 35.1, p. 450) of this appendix with the flaps fully extended at not less than the design flap speed $V_{r_{min}}$ from (Figure 35.5, p. 453) of this appendix.
- (c) *Unsymmetrical flight conditions.* Each affected structure must be designed for unsymmetrical loadings as follows :

- (4) The specimens must be conditioned at $70 \pm 5^\circ \text{F}$ ($21 \pm 2^\circ \text{C}$) $55\% \pm 10\%$ relative humidity for at least 24 hours before testing.
- (d) *Test Apparatus.* The arrangement of the test apparatus is shown in Figures 1 through 5 and must include the components described in this section. Minor details of the apparatus may vary, depending on the model burner used.
- (1) *Specimen Mounting Stand.* The mounting stand for the test specimens consists of steel angles, as shown in Figure 1. The length of the mounting stand legs is $12 \pm 1/8$ inches (305 ± 3 mm). The mounting stand must be used for mounting the test specimen seat bottom and seat back, as shown in Figure 2. The mounting stand should also include a suitable drip pan lined with aluminum foil, dull side up.
- (2) *Test Burner.* The burner to be used in testing must—
- (i) Be a modified gun type;
- (ii) Have an 80-degree spray angle nozzle nominally rated for 2.25 gallons/hour at 100 psi;
- (iii) Have a 12-inch (305 mm) burner cone installed at the end of the draft tube, with an opening 6 inches (152 mm) high and 11 inches (280 mm) wide, as shown in Figure 3; and
- (iv) Have a burner fuel pressure regulator that is adjusted to deliver a nominal 2.0 gallon/hour of #2 Grade kerosene or equivalent required for the test. Burner models which have been used successfully in testing are the Lenox Model OB-32, Carlin Model 200 CRD, and Park Model DPL 3400. FAA published reports pertinent to this type of burner are : (1) Powerplant Engineering Report No. 3A, Standard Fire Test Apparatus and Procedure for Flexible Hose Assemblies, dated March 1978; and (2) Report No. DOT/FAA/RD/76/213, Reevaluation of Burner Characteristics for Fire Resistance tests, dated January 1977.
- (3) *Calorimeter.*
- (i) The calorimeter to be used in testing must be a (0-15.0 BTU/#2-sec. 0-17.0 W/cm2) calorimeter, accurate $\pm 3\%$, mounted in a 6-inch by 12-inch (152 by 305 mm) by 3/4-inch (19 mm) thick calcium silicate insulating board which is attached to a steel angle bracket for placement in the test stand during burner calibration, as shown in figure 4.
- (ii) Because crumbling of the insulating board with service can result in misalignment of the calorimeter, the calorimeter must be monitored and the mounting shimmed, as necessary, to ensure that the calorimeter face is flush with the exposed plane of the insulating board in a plane parallel to the exit of the test burner cone.
- (4) *Thermocouples.* The seven thermocouples to be used for testing must be 1/16 to 1/8-inch metal sheathed, ceramic packed, type K, grounded thermocouples with a nominal 22 to 30 American wire gage (AWG)-size conductor. The seven thermocouples must be attached to a steel angle bracket to form a thermocouple rake for placement in the test stand during burner calibration, as shown in Figure 5.
- (5) *Apparatus Arrangement.* The test burner must be mounted on a suitable stand to position the exit of the burner cone a distance of $4 \pm 1/8$ inches (102 ± 3 mm)

FAR 25.F2 : Appendix F-Part II-Flammability of Seat Cushions.**(a) Criteria for Acceptance.** Each seat cushion must meet the following criteria :

- (1) At least three sets of seat bottom and seat back cushion specimens must be tested.
- (2) If the cushion is constructed with a fire blocking material, the fire blocking material must completely enclose the cushion foam core material.
- (3) Each specimen tested must be fabricated using the principal components (i.e., foam core, flotation material, fire blocking material, if used, and dress covering) and assembly processes (representative seams and closures) intended for use in the production articles. If a different material combination is used for the back cushion than for the bottom cushion, both material combinations must be tested as complete specimen sets, each set consisting of a back cushion specimen and a bottom cushion specimen. If a cushion, including outer dress covering, is demonstrated to meet the requirements, of this Appendix using the oil burner test, the dress covering of that cushion may be replaced with a similar dress covering provided the burn length of the replacement covering, as determined by the test specified in [Sec. 25.853(c)], does not exceed the corresponding burn length of the dress covering used on the cushion subjected to the oil burner test.
- (4) For at least two-thirds of the total number of specimen sets tested, the burn length from the burner must not reach the side of the cushion opposite the burner. The burn length must not exceed 17 inches. Burn length is the perpendicular distance from the inside edge of the seat frame closest to the burner to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring, or embrittlement, but not including areas sooted, stained, warped, or discolored, or areas where material has shrunk or melted away from the heat source.
- (5) The average percentage weight loss must not exceed 10 percent. Also, at least two-thirds of the total number of specimen sets tested must not exceed 10 percent weight loss. All droppings falling from the cushions and mounting stand are to be discarded before the after-test weight is determined. The percentage weight loss for a specimen set is the weight of the specimen set before testing less the weight of the specimen set after testing expressed as the percentage of the weight before testing.

- (b) *Test Conditions.* Vertical air velocity should average $25 \text{ fpm} \pm 10 \text{ fpm}$ at the top of the back seat cushion. Horizontal air velocity should be below 10 fpm just above the bottom seat cushion. Air velocities should be measured with the ventilation hood operating and the burner motor off.

(c) Test Specimens.

- (1) For each test, one set of cushion specimens representing a seat bottom and seat back cushion must be used.
- (2) The seat bottom cushion specimen must be $18 \pm 1/8$ inches ($457 \pm 3 \text{ mm}$) wide by $20 \pm 1/8$ inches ($508 \pm 3 \text{ mm}$) deep by $4 \pm 1/8$ inches ($102 \pm 3 \text{ mm}$) thick, exclusive of fabric closures and seam overlap.
- (3) The seat back cushion specimen must be $18 \pm 1/8$ inches ($432 \pm 3 \text{ mm}$) wide by $25 \pm 1/8$ inches ($635 \pm 3 \text{ mm}$) high by $2 \pm 1/8$ inches ($51 \pm 3 \text{ mm}$) thick, exclusive of fabric closures and seam overlap.

- (1) The aft fuselage-to-wing attachment must be designed for the critical vertical surface load determined in accordance with subparagraphs A23.11(c)(1) and (2) of this Appendix.

- (2) The wing and wing carry-through structures must be designed for 100 percent of condition "A" loading on one side of the plane of symmetry and 70 percent on the opposite side for certification in the normal and utility categories, or 60 percent on the opposite side for certification in the acrobatic category.

- (3) The wing and wing carry-through structures must be designed for the loads resulting from a combination of 75 percent of the positive maneuvering wing loading on both sides of the plane of symmetry and the maximum wing torsion resulting from aileron displacement. The effect of aileron displacement on wing torsion at V_C or V_A using the basic airfoil moment coefficient modified over the aileron portion of the span, must be computed as follows :

- (i) $C_m = C_m + 0.01 \delta_a$ (up aileron side) wing basic airfoil.
- (ii) $C_m = C_m - 0.01 \delta_d$ (down aileron side) wing basic airfoil, where δ_a is the up aileron deflection and δ_d is the down aileron deflection.

- (4) Δ critical, which is the sum of $\delta_a + \delta_d$, must be computed as follows :

- (i) Compute Δ_a and Δ_b from the formulas :

$$\Delta_a = \frac{V_A}{V_C} \Delta_p, \quad \text{and}$$

$$\Delta_b = 0.5 \frac{V_A}{V_D} \Delta_p$$

where Δ_p = the maximum total deflection (sum of both aileron deflections) at V_A with V_A , V_C , and V_D described in subparagraph (2) of Sec. 23.7(c) of this appendix.

- (ii) Compute K from the formula :

$$K = \frac{(C_m - 0.01 \delta_b) V_D^2}{(C_m - 0.01 \delta_a) V_C^2}$$

where δ_a is the down aileron deflection corresponding to Δ_a , and δ_b is the down aileron deflection corresponding to Δ_b as computed in step (i).

- (iii) If K is less than 1.0, Δ_a is Δ critical and must be used to determine δ_a and δ_d . In this case, V_C is the critical speed which must be used in computing the wing torsion loads over the aileron span.

- (iv) If K is equal to or greater than 1.0, Δ_b is Δ critical and must be used to determine δ_a and δ_d . In this case, V_D is the critical speed which must be used in computing the wing torsion loads over the aileron span.

- (d) *Supplementary conditions ; rear lift truss ; engine torque ; side load on engine mount.* Each of the following supplementary conditions must be investigated :

- (1) In designing the rear lift truss, the special condition specified in Sec. 23.369 may be investigated instead of condition "G" of (Figure 35.6, p. 453) of this appendix. If this is done, and if certification in more than one category is desired, the value of $\frac{W}{S}$ used in the formula appearing in Sec. 23.369 must be that for the category corresponding to the maximum gross weight.

- (2) Each engine mount and its supporting structures must be designed for the maximum limit torque corresponding to METO power and propeller speed acting simultaneously with the limit loads resulting from the maximum positive maneuvering flight load factor n_1 . The limit torque must be obtained by multiplying the mean torque by a factor of 1.33 for engines with five or more cylinders. For 4, 3, and 2 cylinder engines, the factor must be 2, 3, and 4, respectively.
- (3) Each engine mount and its supporting structure must be designed for the loads resulting from a lateral limit load factor of not less than 1.47 for the normal and utility categories, or 2.0 for the acrobatic category.

FAR 23.A11 : Control surface loads.

- (a) *General.* Each control surface load must be determined using the criteria of paragraph (b) of this section and must lie within the simplified loadings of paragraph (c) of this section.
- (b) *Limit pilot forces.* In each control surface loading condition described in paragraphs (c) through (e) of this section, the airloads on the movable surfaces and the corresponding deflections need not exceed those which could be obtained in flight by employing the maximum limit pilot forces specified in the table in Sec. 23.397(b). If the surface loads are limited by these maximum limit pilot forces, the tabs must either be considered to be deflected to their maximum travel in the direction which would assist the pilot or the deflection must correspond to the maximum degree of "out of trim" expected at the speed for the condition under consideration. The tab load, however, need not exceed the value specified in Table 2 of this appendix.
- (c) *Surface loading conditions.* Each surface loading condition must be investigated as follows :
- (1) [Simplified limit surface loadings for the horizontal tail, vertical tail, aileron, wing flaps, and trim tabs are specified in figures 5 and 6 of this appendix.
 - (i) The distribution of load along the span of the surface, irrespective of the chordwise load distribution, must be assumed proportional to the total chord, except on horn balanced surfaces.
 - (ii) The load on the stabilizer and elevator, and the load on fin and rudder, must be distributed chordwise as shown in figure 7 of this appendix.
 - (iii) In order to ensure adequate torsional strength and to account for maneuvers and gusts, the most severe loads must be considered in association with every center of pressure position between the leading edge and the half chord of the mean chord of the surface (stabilizer and elevator, or fin and rudder).
 - (iv) To ensure adequate strength under high leading edge loads, the most severe stabilizer and fin loads must be further considered as being increased by 50 percent over the leading 10 percent of the chord with the loads aft of this appropriately decreased to retain the same total load.
 - (v) The most severe elevator and rudder loads should be further considered as being distributed parabolically from three times the mean loading of the surface (stabilizer and elevator, or fin and rudder) at the leading edge of the elevator and rudder, respectively, to zero at the trailing edge according

must be applied for 15 seconds and then removed. A minimum of 10 inches of specimen must be used for timing purposes, approximately $1\frac{1}{2}$ inches must burn before the burning front reaches the timing zone, and the average burn rate must be recorded.

- (6) *Forty-five degree test.* A minimum of three specimens must be tested and the results averaged. The specimens must be supported at an angle of 45° to a horizontal surface. The exposed surface when installed in the aircraft must be face down for the test. The specimens must be exposed to a Bunsen or Tirrill burner with a nominal $3/8$ inch I.D. tube adjusted to give a flame of $1\frac{1}{2}$ inches in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550° F. Suitable precautions must be taken to avoid drafts. The flame must be applied for 30 seconds with one-third contacting the material at the center of the specimen and then removed. Flame time, glow time, and whether the flame penetrates (passes through) the specimen must be recorded.

- (7) *Sixty degree test.* A minimum of three specimens of each wire specification (make and size) must be tested. The specimen of wire or cable (including insulation) must be placed at an angle of 60° with the horizontal in the cabinet specified in subparagraph (3) of this paragraph with the cabinet door open during the test, or must be placed within a chamber approximately 2 feet high by 1 foot by 1 foot, open at the top and at one vertical side (front), and which allows sufficient flow of air for complete combustion, but which is free from drafts. The specimen must be parallel to and approximately 6 inches from the front of the chamber. The lower end of the specimen must be held rigidly clamped. The upper end of the specimen must pass over a pulley or rod and must have an appropriate weight attached to it so that the specimen is held tautly throughout the flammability test. The test specimen span between lower clamp and upper pulley or rod must be 24 inches and must be marked 8 inches from the lower end to indicate the central point for flame application. A flame from a Bunsen or Tirrill burner must be applied for 30 seconds at the test mark. The burner must be mounted underneath the test mark on the specimen, perpendicular to the specimen and at an angle of 30° to the vertical plane of the specimen. The burner must have a nominal bore of $3/8$ -inch, and must be adjusted to provide a 3-inch high flame with an inner cone approximately one-third of the flame height. The minimum temperature of the hottest portion of the flame, as measured with a calibrated thermocouple pyrometer, may not be less than 1750° F. The burner must be positioned so that the hottest portion of the flame is applied to the test mark on the wire. Flame time, burn length, and flaming time of drippings, if any, must be recorded. The burn length determined in accordance with paragraph (8) of this paragraph must be measured to the nearest tenth of an inch. Breaking of the wire specimens is not considered a failure.

- (8) *Burn length.* Burn length is the distance from the original edge to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring, or embrittlement, but not including areas sooted, stained, warped, or discolored, nor areas where material has shrunk or melted away from the heat source.]

Amdt. 25-72, Eff. 8/20/90

thick foam parts, such as seat cushions, must be $\frac{1}{2}$ -inch in thickness. Test specimens of materials that must meet the requirements of paragraph (a)(1)(v) of Part I of this Appendix must be no more than 1/8-inch in thickness. Electrical wire and cable specimens must be the same size as used in the airplane. In the case of fabrics, both the warp and fill direction of the weave must be tested to determine the most critical flammability condition. Specimens must be mounted in a metal frame so that the two long edges and the upper edge are held securely during the vertical test prescribed in subparagraph (4) of this paragraph and the two long edges and the edge away from the flame are held securely during the horizontal test prescribed in subparagraph (5) of this paragraph. The exposed area of the specimen must be at least 2 inches wide and 12 inches long, unless the actual size used in the airplane is smaller. The edge to which the burner flame is applied must not consist of the finished or protected edge of the specimen but must be representative of the actual cross-section of the material or part as installed in the airplane. The specimen must be mounted in a metal frame so that all four edges are held securely and the exposed area of the specimen is at least 8 inches by 8 inches during the 45° test prescribed in subparagraph (6) of this paragraph.

(3) *Apparatus* : Except as provided in subparagraph (7) of this paragraph, tests must be conducted in a draft-free cabinet in accordance with Federal Test Method Standard 191 Model 5903 (revised Method 5902) for the vertical test, or Method 5906 for horizontal test (available from the General Services Administration, Business Service Center, Region 3, Seventh & D Streets, SW., Washington, D.C. 20407). Specimens which are too large for the cabinet must be tested in similar draft-free conditions.

(4) *Vertical test* : A minimum of three specimens must be tested and results averaged. For fabrics, the direction of weave corresponding to the most critical flammability conditions must be parallel to the longest dimension. Each specimen must be supported vertically. The specimen must be exposed to a Bunsen or Tirrill burner with a nominal 3/8-inch I.D. tube adjusted to give a flame of 1 $\frac{1}{2}$ inches in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550° F. The lower edge of the specimen must be $\frac{3}{8}$ -inch above the top edge of the burner. The flame must be applied to the center line of the lower edge of the specimen. For materials covered by paragraph (a)(1)(i) of Part I of this Appendix, the flame must be applied for 60 seconds and then removed. For materials covered by paragraph (a)(1)(ii) of Part I of this Appendix, the flame must be applied for 12 seconds and then removed. Flame time, burn length, and flaming time of drippings, if any, may be recorded. The burn length determined in accordance with subparagraph (7) of this paragraph must be measured to the nearest tenth of an inch.

(5) *Horizontal test*. A minimum of three specimens must be tested and the results averaged. Each specimen must be supported horizontally. The exposed surface, when installed in the aircraft, must be face down for the test. The specimen must be exposed to a Bunsen or Tirrill burner with a nominal 3/8 inch I.D. tube adjusted to give a flame of 1 $\frac{1}{2}$ inches in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550° F. The specimen must be positioned so that the edge being tested is centered $\frac{3}{8}$ -inch above the top of the burner. The flame

to the equation :

$$P(x) = 3(\bar{w}) \frac{(c-x)^2}{c_f^2}$$

where—

Leading edge of elevator and rudder, respectively

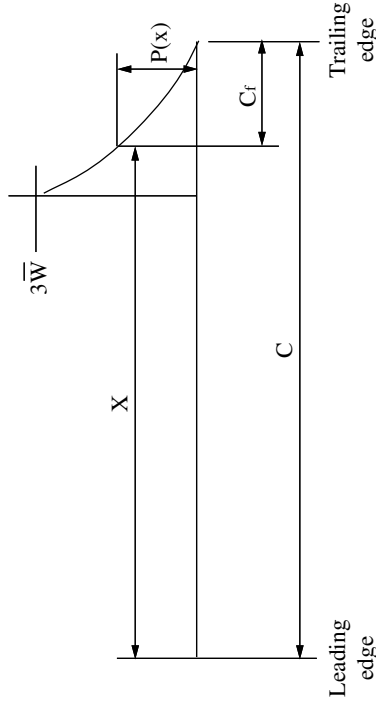


FIG. 35.1 – *Leading Edge of Elevator and Rudder, Respectively*

$P(x)$: local pressure at the chordwise stations x ,

c : chord length of the tail surface,

c_f : chord length of the elevator and rudder respectively, and

$\bar{w}$: average surface loading as specified in Figure A5.

(vi) The chordwise loading distribution for ailerons, wing flaps, and trim tabs are specified in Table 2 of this appendix.]

(2) If certification in the acrobatic category is desired, the horizontal tail must be investigated for an unsymmetrical load of 100 percent $\bar{w}$ on one side of the airplane centerline and 50 percent on the other side of the airplane centerline.

(d) *Outboard fins*. Outboard fins must meet the requirements of Sec. 23.445.]

(e) *Special devices*. Special devices must meet the requirements of Sec. 23.459.

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FAR 23.A13 : Control system loads.

(a) *Primary flight controls and systems*. Each primary flight control and system must be designed as follows :

(1) The flight control system and its supporting structure must be designed for loads corresponding to 125 percent of the computed hinge moments of the movable control surface in the conditions prescribed in A23.11 of this appendix. In addition—

- (i) The system limit loads need not exceed those that could be produced by the pilot and automatic devices operating the controls; and
 - (ii) The design must provide a rugged system for service use, including jamming, ground gusts, taxiing downwind, control inertia, and friction.
- (2) Acceptable maximum and minimum limit pilot forces for elevator, aileron, and rudder controls are shown in the table in Sec. 23.397(b). These pilot loads must be assumed to act at the appropriate control grips or pads as they would under flight conditions, and to be reacted at the attachments of the control system to the control surface horn.
- (b) *Dual controls.* If there are dual controls, the systems must be designed for pilots operating in opposition, using individual pilot loads equal to 75 percent of those obtained in accordance with paragraph (a) of this section, except that individual pilot loads may not be less than the minimum limit pilot forces shown in the table in Sec. 23.397(b).
- (c) *Ground gust conditions.* Ground gust conditions must meet the requirements of Sec. 23.415.
- (d) *Secondary controls and systems.* Secondary controls and systems must meet the requirements of Sec. 23.405.

Limit flight load factors		
Flight load factors	Normal category	Acrobatic category
Flaps Up		
n_1	3.8	6.0
n_2	$-0.5\ n_1$	
n_3	Find n_3 from (Figure 35.3, p. 452).	
n_4	Find n_4 from (Figure 35.4, p. 452).	
Flaps down		
n_{flap}	$0.5\ n_1$	
	Zero°	

* Vertical wing load may be assumed equal to zero and only the flap part of the wing need be checked for this condition.

Tab. 35.1 – Limit Flight Load Factors

- (2) *Cargo and baggage compartments not occupied by crew or passengers* :
- (i) Thermal and acoustic insulation (including coverings) used in each cargo and baggage compartment must be constructed of materials that meet the requirements set forth in paragraph (a)(1)(ii) of Part I of this Appendix.
- (ii) A cargo or baggage compartment defined in Sec. 25.857 as Class B or E must have a liner constructed of materials that meet the requirements of paragraph (a)(1)(ii) of Part I of this Appendix and separated from the airplane structure (except for attachments). In addition, such liners must be subjected to the 45 degree angle test. The flame may not penetrate (pass through) the material during application of the flame or subsequent to its removal. The average flame time after removal of the flame source may not exceed 15 seconds, and the average glow time may not exceed 10 seconds.
- (iii) A cargo or baggage compartment defined in Sec. 25.857 as Class B, C, D, or E must have floor panels constructed of materials which meet the requirements of paragraph (a)(1)(ii) of Part I of this Appendix and which are separated from the airplane structure (except for attachments). Such panels must be subjected to the 45 degree angle test. The flame may not penetrate (pass through) the material during application of the flame or subsequent to its removal. The average flame time after removal of the flame source may not exceed 15 seconds, and the average glow time may not exceed 10 seconds.
- (iv) Insulation blankets and covers used to protect cargo must be constructed of materials that meet the requirements of paragraph (a)(1)(ii) of Part I of this Appendix. Tiedown equipment (including containers, bins, and pallets) used in each cargo and baggage compartment must be constructed of materials that meet the requirements of paragraph (a)(1)(v) of Part I of this Appendix.
- (3) *Electrical system components* : Insulation on electrical wire or cable installed in any area of the fuselage must be self-extinguishing when subjected to the 60 degree test specified in Part I of this Appendix. The average burn length may not exceed 3 inches, and the average flame time after removal of the flame source may not exceed 30 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling.
- b) *Test Procedures* :
- (1) *Conditioning* : Specimens must be conditioned to $70 \pm 5F$, and at 50 percent ± 5 percent relative humidity until moisture equilibrium is reached or for 24 hours. Each specimen must remain in the conditioning environment until it is subjected to the flame.
- (2) *Specimen configuration*. Except for small parts and electrical wire and cable insulation, materials must be tested either as a section cut from a fabricated part as installed in the airplane or as a specimen simulating a cut section, such as a specimen cut from a flat sheet of the material or a model of the fabricated part. The specimen may be cut from any location in a fabricated part; however, fabricated units, such as sandwich panels, may not be separated for test. Except as noted below, the specimen thickness must be no thicker than the minimum thickness to be qualified for use in the airplane. Test specimens of

FAR 25.F1 : Appendix F-Part I-[Test Criteria and Procedures for Showing Compliance with Sec. 25.853 or Sec. 25.855.]

(a) [Material test criteria :

(1) Interior compartments occupied by crew or passengers :

(i) Interior ceiling panels, interior wall panels, partitions, galley structure, large cabinet walls, structural flooring, and materials used in the construction of stowage compartments (other than underseat stowage compartments and compartments for stowing small items such as magazines and maps) must be self-extinguishing when tested vertically in accordance with the applicable portions of Part I of this Appendix. The average burn length may not exceed 6 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling.

(ii) Floor covering, textiles (including draperies and upholstery), seat cushions, padding, decorative and nondecorative coated fabrics, leather, trays and galley furnishings, electrical conduit, thermal and acoustical insulation and insulation covering, air ducting, joint and edge covering, liners of Class B and E cargo or baggage compartments, floor panels of Class B, C, D, or E cargo or baggage compartments, insulation blankets, cargo covers and transparencies, molded and thermoformed parts, air ducting joints, and trim strips (decorative and chafing), that are constructed of materials not covered in subparagraph (iv) below, must be self-extinguishing when tested vertically in accordance with the applicable portions of Part I of this Appendix or other approved equivalent means. The average burn length may not exceed 8 inches, and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 5 seconds after falling.

(iii) Motion picture film must be safety film meeting the Standard Specifications for Safety Photographic Film PHL25 (available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018). If the film travels through ducts, the ducts must meet the requirements of subparagraph (ii) of this paragraph.

(iv) Clear plastic windows and signs, parts constructed in whole or in part of elastomeric materials, edge lighted instrument assemblies consisting of two or more instruments in a common housing, seat belts, shoulder harnesses, and cargo and baggage tie-down equipment, including containers, bins, pallets, etc., used in passenger or crew compartments, may not have an average burn rate greater than 2.5 inches per minute when tested horizontally in accordance with the applicable portions of this Appendix.

(v) Except for small parts (such as knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys, and small electrical parts) that would not contribute significantly to the propagation of a fire and for electrical wire and cable insulation, materials in items not specified in paragraphs (a)(1)(i), (ii), (iii), or (iv) of Part I of this Appendix may not have a burn rate greater than 4.0 inches per minute when tested horizontally in accordance with the applicable portions of this Appendix.

Average limit control surface loading			
Surface	Direction of loading	magnitude of loading	chordwise distribution
Horizontal	a) up and down	(Figure 35.7, p. 454)	
Tail I	b) Unsymmetrical loading	100% $\bar{w}$ on one side of	see (Figure 35.9, p. 455)
	(up and down)	airplane $\nless$ 65% $\bar{w}$ on other side of airplane $\nless$ for normal and utility categories. For acrobatic category see A23.11(c)	
Vertical	Right and left	(Figure 35.7, p. 454)	Same as above
Tail II		curve (1)	
Aileron III	a) up and down	(Figure 35.8, p. 454)	(C)
Wing flap IV	a) up	(Figure 35.8, p. 454)	(D)
	b) down	curve (4)	
Trim Tab V	a) up and down	.25 $\times$ up load (a)	
		(Figure 35.8, p. 454)	same as (D) above
Note : The surface loading I, II, III, and IV above are based on speeds V_A min and V_C min. The loading of IV is based on V_F min. If values of speed greater than these minimums are selected for design, the appropriate surface loadings must be multiplied by the ratio $\left(\frac{V_{selected}}{V_{min}}\right)^2$. For conditions I, II, III, and V the multiplying factor used must be the higher of $\left(\frac{V_A sel.}{V_A min.}\right)^2$ or $\left(\frac{V_C sel.}{V_C min.}\right)^2$.			

TAB. 35.2 - [Average limit control surface loading.]

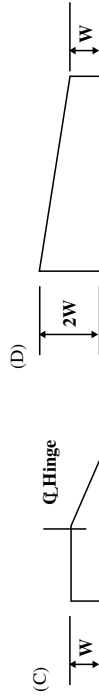


FIG. 35.2 - (Table 35.2, p. 451)

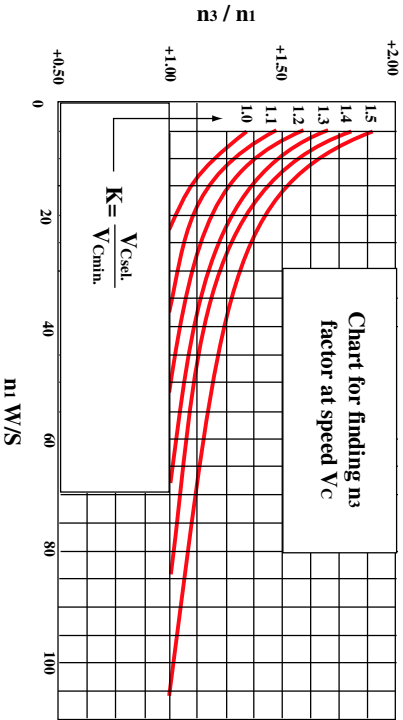


FIG. 35.3 – Chart for finding n_3 factor at speed V_c . ($V_{Cmin.}$ is found from (Figure 35.5, p. 453))

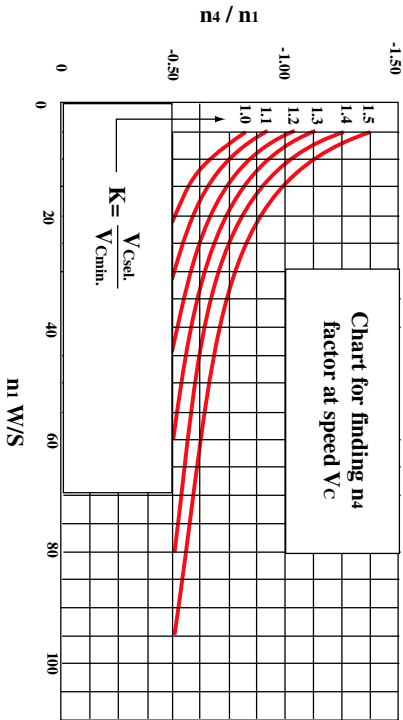


FIG. 35.4 – Chart for finding n_4 factor at speed V_c . ($V_{Cmin.}$ is found from (Figure 35.5, p. 453))

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Appendix F

Sommaire

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be applied and must not exceed that established in compliance with paragraph (b) of this section.

- (b) The flight path, with the engines operating at the power or thrust, or both, appropriate to the airplane configuration and with standby power in use, must lie above the flight path without standby power in use at the maximum weight at which all of the applicable airworthiness requirements are met. In addition, the flight paths must comply with subparagraphs (i) and (ii) of this paragraph.

(i) The flight paths must be established without changing the appropriate airplane configuration.

(ii) The flight paths must be carried out for a minimum height of 400 feet above the point where standby power is actuated.

- (6) *Airplane configuration, speed, and power and thrust; general.* Any change in the airplane's configuration, speed, and power or thrust, or both, must be made in accordance with the procedures established by the applicant for the operation of the airplane in service and must comply with paragraphs (a) through (c) of this section. In addition, procedures must be established for the execution of balked landings and missed approaches.

(a) The Administrator must find that the procedure can be consistently executed in service by crews of average skill.

(b) The procedure may not involve methods or the use of devices which have not been proven to be safe and reliable.

(c) Allowances must be made for such time delays in the execution of the procedures as may be reasonably expected to occur during service.

- (7) *Installation and operation; standby power.* The standby power unit and its installation must comply with paragraphs (a) and (b) of this section.

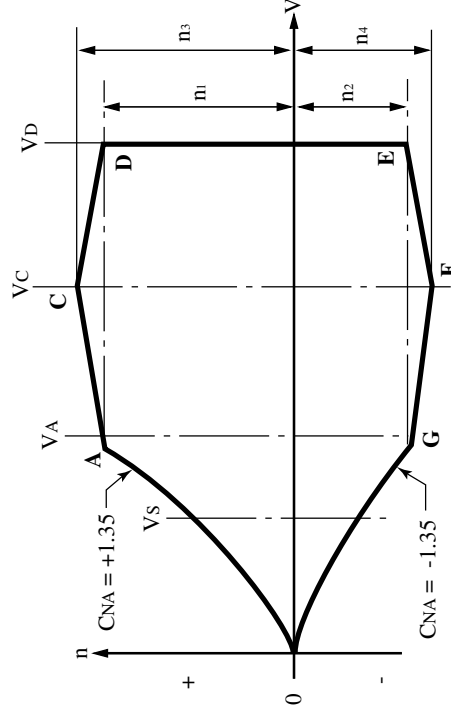
(a) The standby power unit and its installation must not adversely affect the safety of the airplane.

(b) The operation of the standby power unit and its control must have proven to be safe and reliable.]

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$$\begin{aligned}
 V_{Dmin} &= 24.0 \sqrt{n_1 \frac{W}{S}} && \text{but not exceed } 1.4 \sqrt{\frac{W}{S}} V_{Cmin} \\
 V_{Cmin} &= 17.0 \sqrt{n_1 \frac{W}{S}} && \text{but not exceed } 0.9 V_H \\
 V_{Amin} &= 15.0 \sqrt{n_1 \frac{W}{S}} && \text{but not exceed } V_C \text{ used in design.} \\
 V_{Fmin} &= 11.0 \sqrt{n_1 \frac{W}{S}}
 \end{aligned}$$

FIG. 35.5 – Determination of minimum design speeds - equations. [Speeds are in knots.]



1. Conditions "C" or "F" need only be investigated when $n_3 \frac{W}{S}$ or $n_4 \frac{W}{S}$ is greater than $n_1 \frac{W}{S}$ or $n_2 \frac{W}{S}$, respectively.
2. Condition "G" need not be investigated when the supplementary condition specified in FAR 23.369 is investigated.

FIG. 35.6 – Flight envelope.

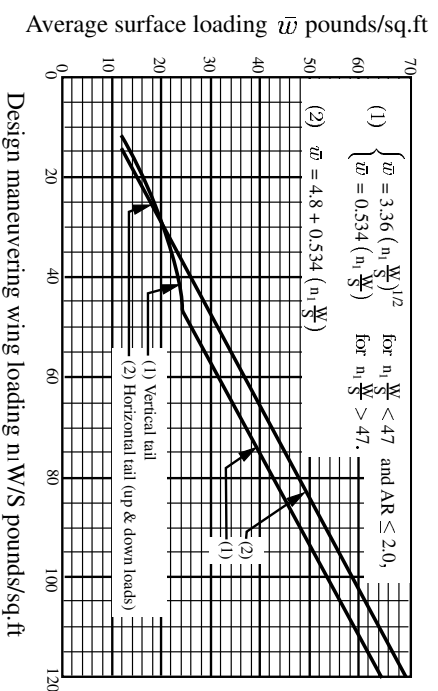


FIG. 35.7 – Average limit control surface loading.

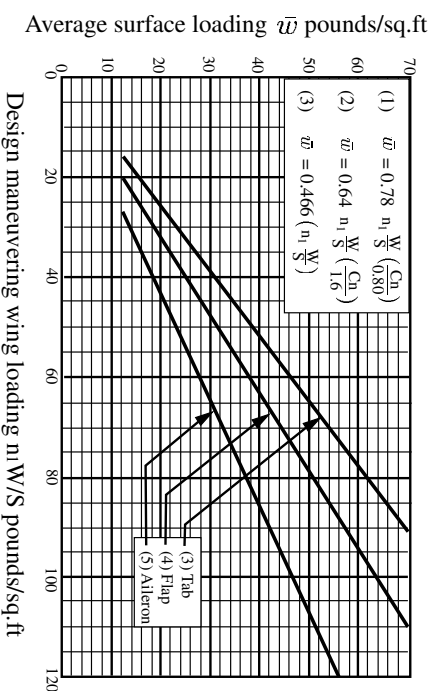


FIG. 35.8 – Average limit control surface loading.

(2) Takeoff path.

- (a) The one-engine-inoperative takeoff path with standby power in use must be determined in accordance with the performance requirements of the applicable airworthiness regulations.
- (b) The one-engine-inoperative takeoff path (excluding that part where the airplane is on or just above the takeoff surface) determined in accordance with paragraph (a) of this section must lie above the one-engine-inoperative takeoff path without standby power at the maximum takeoff weight at which all of the applicable airworthiness requirements are met. For the purpose of this comparison, the flight path is considered to extend to at least a height of 400 feet above the takeoff surface.
- (c) The takeoff path with all engines operating, but without the use of standby power, must reflect a conservatively greater overall level of performance than the one-engine-inoperative takeoff path established in accordance with paragraph (a) of this section. The margin must be established by the Administrator to insure safe day-to-day operations, but in no case may it be less than 15 percent. The all-engines-operating takeoff path must be determined by a procedure consistent with that established in complying with paragraph (a) of this section.
- (d) For reciprocating-engine-powered airplanes, the takeoff path to be scheduled in the Airplane Flight Manual must represent the one-engine-inoperative takeoff path determined in accordance with paragraph (a) of this section and modified to reflect the procedure (see paragraph (6)) established by the applicant for flap retraction and attainment of the en route speed. The scheduled takeoff path must have a positive slope at all points of the airborne portion and at no point must it be above the takeoff path specified in paragraph (a) of this section.
- (3) **Takeoff distance.** The takeoff distance must be the horizontal distance along the one-engine-inoperative take off path determined in accordance with paragraph (2)(a) from the start of the takeoff to the point where the airplane attains a height of 50 feet above the takeoff surface for reciprocating-engine-powered airplanes and a height of 35 feet above the takeoff surface for turbine-powered airplanes.
- (4) **Maximum certificated takeoff weights.** The maximum certificated takeoff weights must be determined at all altitudes, and at ambient temperatures, if applicable, at which performance credit is to be applied and may not exceed the weights established in compliance with paragraphs (a) and (b) of this section.
- (a) The conditions of paragraphs (2) (b) through (d) must be met at the maximum certificated takeoff weight.
- (b) Without the use of standby power, the airplane must meet all of the en route requirements of the applicable airworthiness regulations under which the airplane was originally certificated. In addition, turbine-powered airplanes without the use of standby power must meet the final takeoff climb requirements prescribed in the applicable airworthiness regulations.
- (5) **Maximum certificated landing weights.**
 - (a) The maximum certificated landing weights (one-engine-inoperative approach and all-engine-operating landing climb) must be determined at all altitudes, and at ambient temperatures if applicable, at which performance credit is to

FAR 25.E1 : [Appendix E, I—Limited Weight Credit For Airplanes Equipped With Standby Power]

(a) [Each applicant for an increase in the maximum certificated takeoff and landing weights of an airplane equipped with a type-certificated standby power rocket engine may obtain an increase as specified in paragraph (b) if—

- (1) The installation of the rocket engine has been approved and it has been established by flight test that the rocket engine and its controls can be operated safely and reliably at the increase in maximum weight; and
- (2) The Airplane Flight Manual, or the placard, markings or manuals required in place thereof, set forth in addition to any other operating limitations the Administrator may require, the increased weight approved under this regulation and a prohibition against the operation of the airplane at the approved increased weight when—

- (i) The installed standby power rocket engines have been stored or installed in excess of the time limit established by the manufacturer of the rocket engine (usually stenciled on the engine casing); or
 - (ii) The rocket engine fuel has been expended or discharged.
- (b) The currently approved maximum takeoff and landing weights at which an airplane is certificated without a standby power rocket engine installation may be increased by an amount that does not exceed any of the following :
- (1) An amount equal in pounds to 0.014 IN, where I is the maximum usable impulse in pounds-seconds available from each standby power rocket engine and N is the number of rocket engines installed.
 - (2) An amount equal to 5 percent of the maximum certificated weight approved in accordance with the applicable airworthiness regulations without standby power rocket engines installed.
 - (3) An amount equal to the weight of the rocket engine installation.
 - (4) An amount that, together with the currently approved maximum weight, would equal the maximum structural weight established for the airplane without standby rocket engines installed.]

Amdt. 25-6, Eff. 8/1/65

FAR 25.E2 : [Appendix E, II—Performance Credit for Transport Category Airplanes Equipped With Standby Power.]

[The Administrator may grant performance credit for the use of standby power on transport category airplanes. However, the performance credit applies only to the maximum certificated takeoff and landing weights, the takeoff distance, and the takeoff path, and may not exceed that found by the Administrator to result in an overall level of safety in the takeoff, approach, and landing regimes of flight equivalent to that prescribed in the regulations under which the airplane was originally certificated without standby power. For the purposes of this Appendix, "standby power" is power or thrust, or both, obtained from rocket engines for a relatively short period and actuated only in cases of emergency. The following provisions apply :

- (1) *Takeoff ; general.* The takeoff data prescribed in paragraphs (2) and (3) must be determined at all weights and altitudes, and at ambient temperatures if applicable, at which performance credit is to be applied.

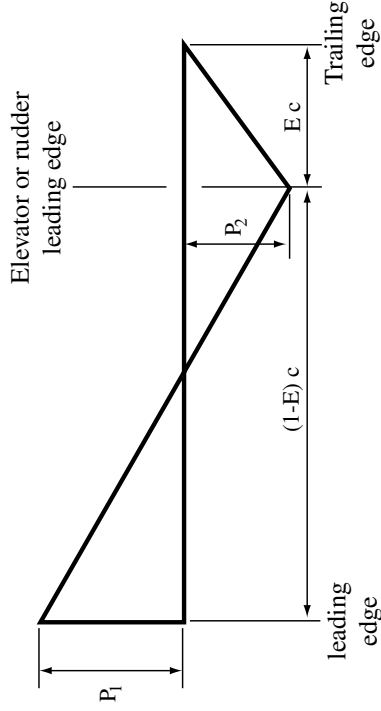


FIG. 35.9— [Chordwise load distribution for stabilizer and elevator or fin and rudder.]

[

$$P_1 = 2 \bar{w} \frac{2 - E - 3d'}{1 - E}$$

$$P_2 = 2 \bar{w} (3d' + E - 1)$$

where —

- $\bar{w}$ average surface loading (as specified in (Figure 35.7, p. 454))
- E Ratio of elevator (or rudder) chord to total stabilizer and elevator (or fin and rudder) chord
- d' Ratio of distance of center of pressure of unit spanwise length of combined stabilizer and elevator (or fin and rudder) measured from stabilizer (or fin) leading edge to the local chord. Sign convention is positive when center of pressure is behind leading edge.
- c Local chord

NOTE : Positive values of $\bar{w}$, P_1 and P_2 are all measured in the same direction.] [Amdt. 23-48, Eff. 03/11/96]

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Appendix E

Sommaire

FAR 25.E1 : [Appendix E, I—Limited Weight Credit For Airplanes Equipped With Standby Power]	726
FAR 25.E2 : [Appendix E, II—Performance Credit for Transport Category Airplanes Equipped With Standby Power]	726

- (6) The actions requiring a crewmember to be unavailable at his assigned duty station, including : observation of systems, emergency operation of any control, and emergencies in any compartment.
- (7) The degree of automation provided in the aircraft systems to afford (after failures or malfunctions) automatic crossover or isolation of difficulties to minimize the need for flight crew action to guard against loss of hydraulic or electric power to flight controls or to other essential systems.
- (8) The communications and navigation workload.
- (9) The possibility of increased workload associated with any emergency that may lead to other emergencies.
- (10) Incapacitation of a flight crewmember whenever the applicable operating rule requires a minimum flight crew of at least two pilots.
- (c) *Kind of operation authorized.* The determination of the kind of operation authorized requires consideration of the operating rules under which the airplane will be operated. Unless an applicant desires approval for a more limited kind of operation, it is assumed that each airplane certificated under this Part will operate under IFR conditions.]

Amdt. 25-3, Eff. 5/28/65

Chapitre 36

Appendix B : Control Surface Loadings

Sommaire

FAR 23.B1 : [Reserved.]	458
FAR 23.B11 : [Reserved.]	458

FAR 23.B1 : [Reserved.]

[Reserved.]

Amdt. 23-42, Eff. 02/04/91

FAR 23.B11 : [Reserved.]

[Reserved.]

Amdt. 23-42, Eff. 02/04/91

Chapitre 54

Appendix D

FAR 25.D1 : [Appendix D.]

[*Criteria for determining minimum flight crew.* The following are considered by the Agency in determining the minimum flight crew under Sec. 25.1523 :

- (a) *Basic workload functions.* The following basic workload functions are considered :
 - (1) Flight path control.
 - (2) Collision avoidance.
 - (3) Navigation.
 - (4) Communications.
 - (5) Operation and monitoring of aircraft engines and systems.
 - (6) Command decisions.
- (b) *Workload factors.* The following workload factors are considered significant when analyzing and demonstrating workload for minimum flight crew determination :
 - (1) The accessibility, ease, and simplicity of operation of all necessary flight, power, and equipment controls, including emergency fuel shutoff valves, electrical controls, electronic controls, pressurization system controls, and engine controls.
 - (2) The accessibility and conspicuity of all necessary instruments and failure warning devices such as fire warning, electrical system malfunction, and other failure or caution indicators. The extent to which such instruments or devices direct the proper corrective action is also considered.
 - (3) The number, urgency, and complexity of operating procedures with particular consideration given to the specific fuel management schedule imposed by center of gravity, structural or other considerations of an airworthiness nature, and to the ability of each engine to operate at all times from a single tank or source which is automatically replenished if fuel is also stored in other tanks.
 - (4) The degree and duration of concentrated mental and physical effort involved in normal operation and in diagnosing and coping with malfunctions and emergencies.
 - (5) The extent of required monitoring of the fuel, hydraulic, pressurization, electrical, electronic, deicing, and other systems while en route.

Chapitre 37

Appendix C : Basic Landing Conditions

Sommaire

FAR 23 C.1 : Basic landing conditions 460

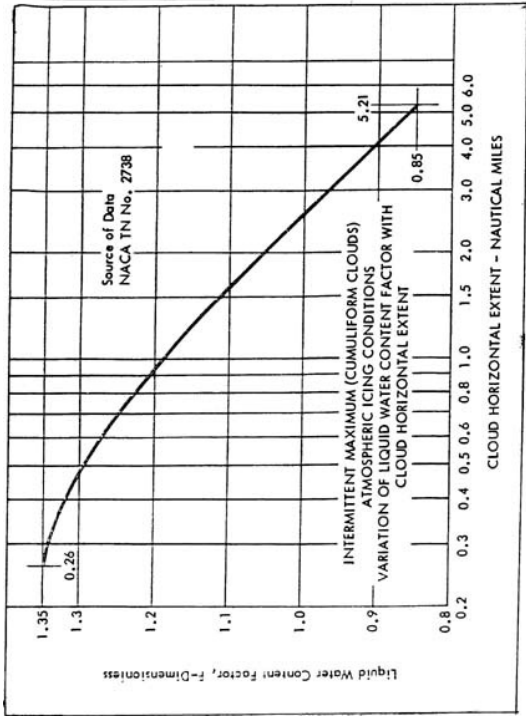


FIG. 53.6 – Intermittent Maximum (Cumuliform Clouds). Atmospheric Icing Conditions. Variation of Liquid Water Content Factor with Cloud Horizontal Extent

FAR 23.C.1 : Basic landing conditions.

Condition	Tail wheel type		Nose wheel type			
	Level landing	Tail-down landing	Level landing with nose reactions	Level landing with wheel just clear of ground	Level landing	Tail-down landing
Reference section	23.479(a)(1)	23.481(a)(1)	23.479(a)(2)(i)	23.479(a)(2)(ii)	23.481(a)(2)	23.481(a)(2) and (b)
Vertical component at c.g.	nW	nW	nW	nW	nW	nW
Fore and aft component at c.g.	KnW	0	KnW	KnW	0	0
Lateral component in either direction at c.g.	0	0	0	0	0	0
Shock absorber extension (hydraulic shock absorber)	Note (2)	Note (2)	Note (2)	Note (2)	Note (2)	Note (2)
Shock absorber deflection (rubber or spring shock absorber)	100%	100%	100%	100%	100%	100%
Main wheel loads (both wheels)- $\begin{cases} V_{\gamma} \\ D_{\gamma} \end{cases}$	Static (n-L)W	Static (n-L)Wb/d	Static (n-L)Wa/d ⁱ	Static (n-L)W	Static (n-L)W	Static (n-L)W
Tail (nose) wheel loads- $\begin{cases} V_{\gamma} \\ D_{\gamma} \end{cases}$	0	0	KnWa/d ⁱ	KnW	0	0
Notes	0 (1), (3), and (4)	0 (4)	KnWb/d ⁱ (1)	0 (1), (3), and (4)	0 (3) and (4)	0 (3) and (4)

Note (1) . K may be determined as follows : $K = 0.25$ for $W = 3,000$ pounds or less; $K = 0.33$ for $W = 6,000$ pounds or greater, with linear variation of K between these weights.

Note (2) . For the purpose of design, the maximum load factor is assumed to occur throughout the shock absorber stroke from 25 percent deflection to 100 percent deflection unless otherwise shown and the load factor must be used with whatever shock absorber extension is most critical for each element of the landing gear.

Note (3) . Unbalanced moments must be balanced by a rational or conservative method.

Note (4) . L is defined in Sec. 23.725(b).

Note (1) [n is the limit inertia load factor, at the c.g. of the airplane, selected under 23.473(d), (f), and (g).]

Amdt. 23-7, Eff. 09/14/69

APPENDIX C
FIGURE 5

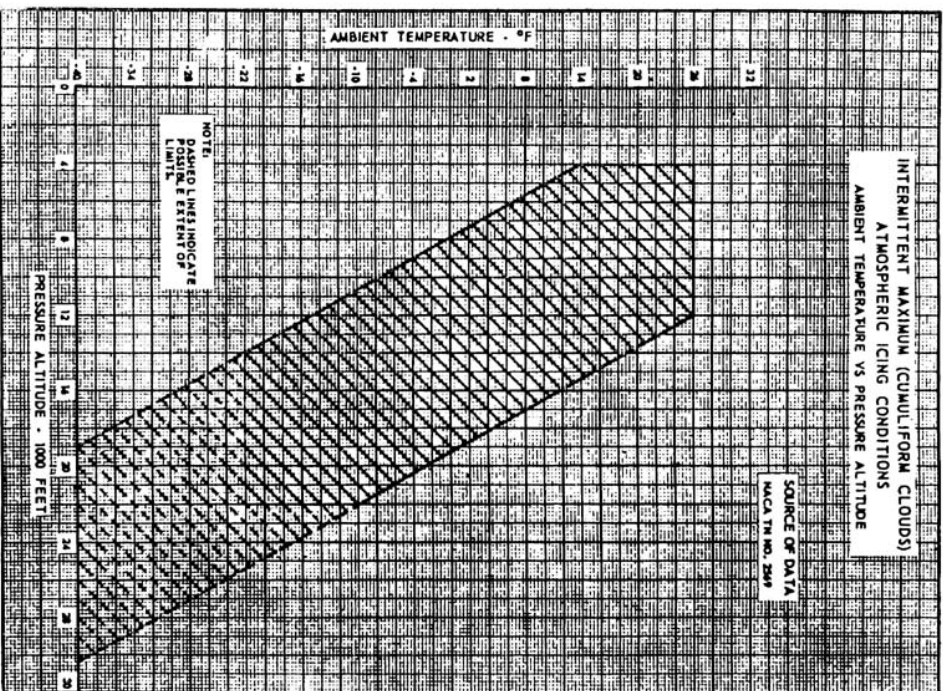


FIG. 53.5 – Intermittent Maximum (Cumuliform Clouds) Atmospheric Icing Conditions. Ambient Temperature vs. Pressure Altitude

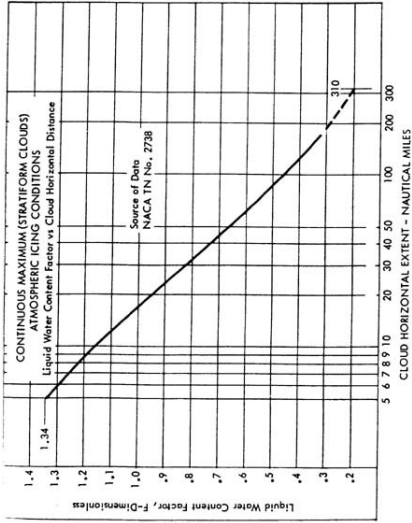


FIG. 53.3 – Continuous Maximum (Stratiform Clouds). Atmospheric Icing Conditions. Liquid Water Content Factor vs. Cloud Horizontal Distance

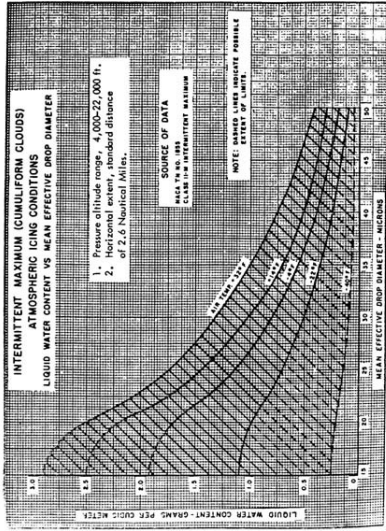


FIG. 53.4 – Intermittent Maximum (Cumuliform Clouds). Atmospheric Icing Conditions. Liquid Water Content vs. Mean Effective Drop Diameter

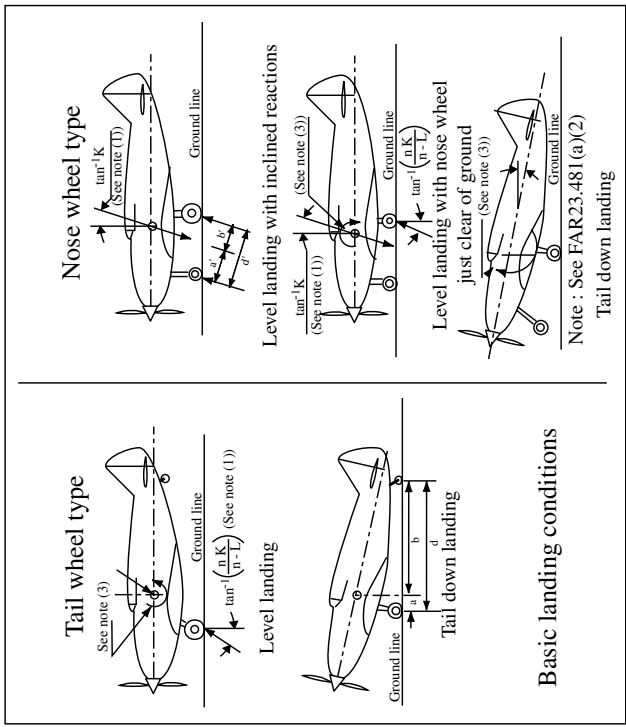


FIG. 37.1 – Basic Landing Conditions

APPENDIX C
FIGURE 2

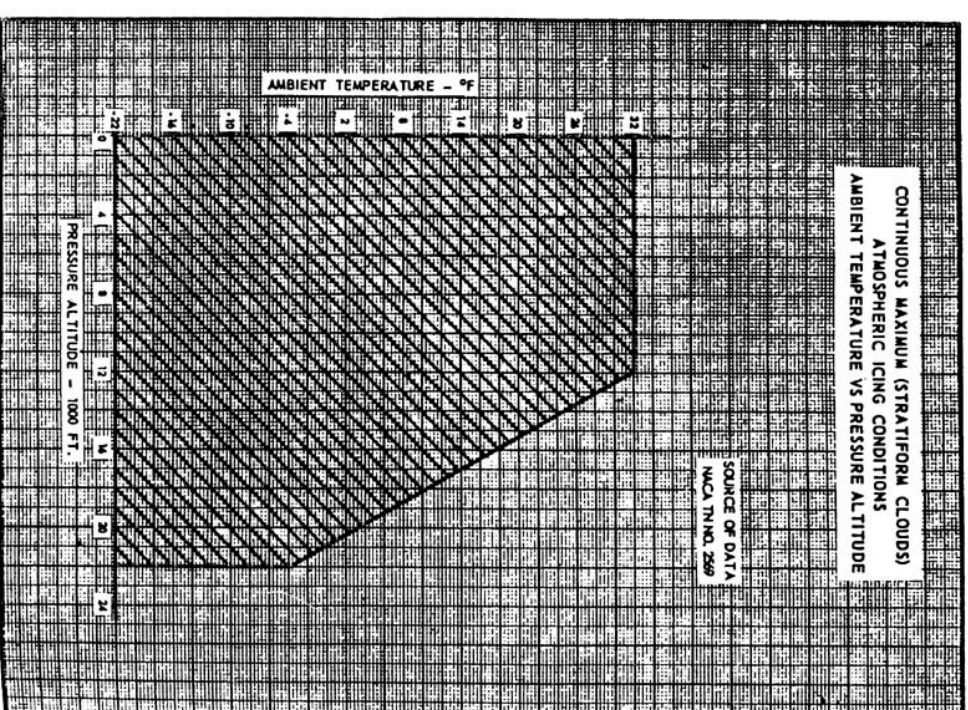


FIG. 53.2 – Continuous Maximum (Stratiform Clouds). Atmospheric Icing Conditions. Ambient Temperature vs. Pressure Altitude

Chapitre 38

Appendix D : [Wheel Spin-Up and Spring-Back Loads]

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FAR 23.D1 : Wheel spin-up loads. 464

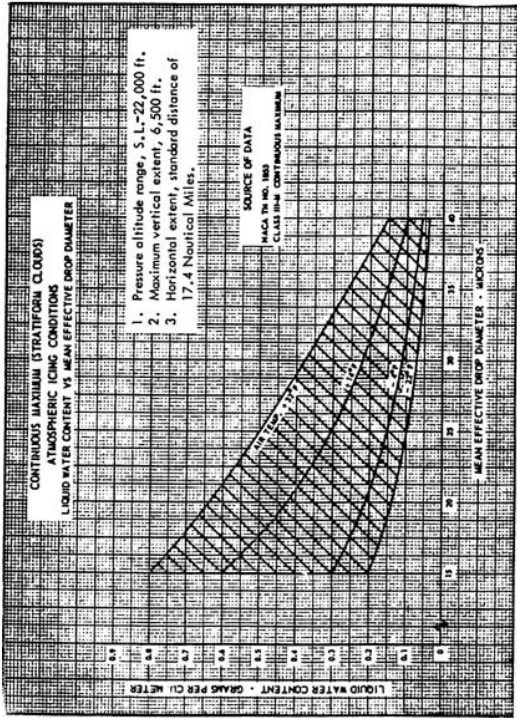


FIG. 53.1 – Continuous Maximum (Stratiform Clouds). Atmospheric Icing Conditions. Liquid Water Content vs. Mean Effective Drop Diameter

FAR 23.D1 : Wheel spin-up loads.

- (a) The following method for determining wheel spin-up loads for landing conditions is based on NACA T.N. 863. However, the drag component used for design may not be less than the drag load prescribed in Sec. 23.479(b).

$$F_{Hmax} = \frac{1}{r_e} \sqrt{\frac{2 L_w (V_H - V_C) n F_{Vmax}}{t_z}}$$

where—

F_{Hmax}	:maximum rearward horizontal force acting on the wheel	(in pounds) ;
r_e	:effective rolling radius of wheel under impact based on recommended operating tire pressure (which may be assumed to be equal to the rolling radius under a static load of $\eta_j W_c$)	in feet ;
L_w	:rotational mass moment of inertia of rolling assembly	(in slug feet) ;
V_H	:linear velocity of airplane parallel to ground at instant of contact (assumed to be $1.2 V_{S0}$)	in feet per second) ;
V_C	:peripheral speed of tire, if pre-rotation is used (there must be a positive means of pre-rotation before pre-rotation may be considered)	(in feet per second) ;
n	:effective coefficient of friction (0.80 may be used) ;	
F_{Vmax}	:maximum vertical force on wheel = $\eta_j W_c$, where W_c and η_j are defined in Sec. 23.725	(pounds) ;
t_z	:time interval between ground contact and attainment of maximum vertical force on wheel. (However, if the value of F_{Vmax} from the above equation exceeds $0.8 F_{Vmax}$, the latter value must be used for F_{Hmax})	(seconds)

- (b) This equation assumes a linear variation of load factor with time until the peak load is reached and under this assumption, the equation determines the drag force at the time that the wheel peripheral velocity at radius r_e equals the airplane velocity. Most shock absorbers do not exactly follow a linear variation of load factor with time. Therefore, rational or conservative allowances must be made to compensate for these variations. On most landing gears, the time for wheel spin-up will be less than the time required to develop maximum vertical load factor for the specified rate of descent and forward velocity. For exceptionally large wheels, a wheel peripheral velocity equal to the ground speed may not have been attained at the time of maximum vertical gear load. However, as stated above, the drag spin-up load need not exceed 0.8 of the maximum vertical loads.
- (c) [Dynamic spring-back of the landing gear and adjacent structure at the instant just after the wheels come up to speed may result in dynamic forward acting loads of considerable magnitude. This effect must be determined, in the level landing condition, by assuming that the wheel spin-up loads calculated by the methods of this appendix are reversed. Dynamic spring-back is likely to become critical for landing gear units having wheels of large mass or high landing speeds.]

Amdt. 23-45, Eff. 09/07/93

Chapitre 53

Appendix C

FAR 25.C1 : Appendix C.

- (a) *Continuous maximum icing.* The maximum continuous intensity of atmospheric icing conditions (continuous maximum icing) is defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the inter-relationship of these three variables as shown in (Figure 53.1, p. 718) of this appendix. The limiting icing envelope in terms of altitude and temperature is given in (Figure 53.2, p. 719) of this appendix. The inter-relationship of cloud liquid water content with drop diameter and altitude is determined from (Figure 53.1, p. 718) and (Figure 53.2, p. 719). The cloud liquid water content for continuous maximum icing conditions of a horizontal extent, other than 17.4 nautical miles, is determined by the value of liquid water content of (Figure 53.1, p. 718), multiplied by the appropriate factor from (Figure 53.3, p. 720) of this appendix.
- (b) *Intermittent maximum icing.* The intermittent maximum intensity of atmospheric icing conditions (intermittent maximum icing) is defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the interrelationship of these three variables as shown in (Figure 53.4, p. 720) of this appendix. The limiting icing envelope in terms of altitude and temperature is given in (Figure 53.5, p. 721) of this appendix. The inter-relationship of cloud liquid water content with drop diameter and altitude is determined from (Figure 53.4, p. 720) and (Figure 53.5, p. 721). The cloud liquid water content for intermittent maximum icing conditions of a horizontal extent, other than 2.6 nautical miles, is determined by the value of cloud liquid water content of (Figure 53.4, p. 720) multiplied by the appropriate factor in (Figure 53.6, p. 722) of this appendix.

Chapitre 39

Appendix E : Limited Weight Credit For Airplanes Equipped with Standby Power

Sommaire

FAR 23.E : [Removed and Reserved]	466

FAR 23.E : [Removed and Reserved.]

[Removed and Reserved.]

Amdt. 23-50, Eff. 03/11/96

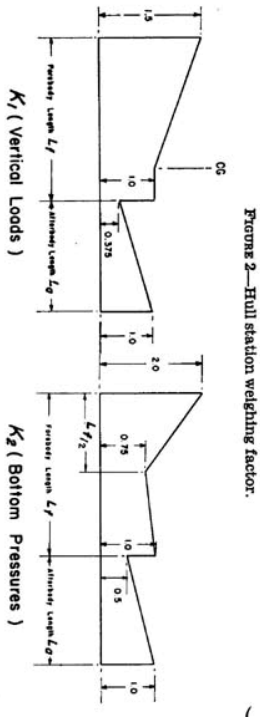


FIG. 52.2 – Hull station weighing factor.

FIGURE 3—Transverse pressure distributions.

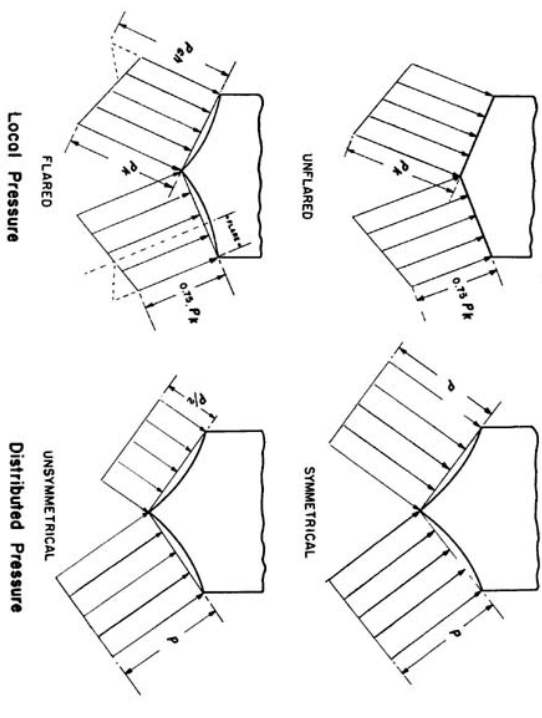


FIG. 52.3 – Transverse pressure distributions.

FAR 25.B1 : Appendix B.

FIGURE 1—Pictorial definition of angles, dimensions, and directions on a seaplane.

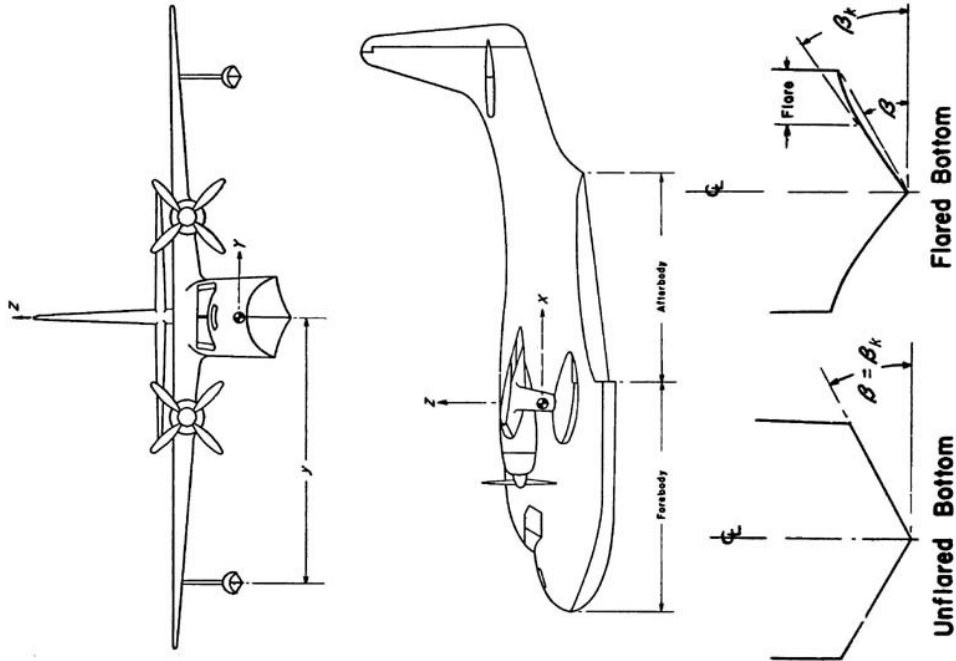


FIG. 52.1 – Pictorial definition of angles, dimensions, and directions on a seaplane.

Chapitre 40

Appendix F : [Test Procedure]

Sommaire

FAR 23.F : [Acceptable test procedure for self-extinguishing materials for showing compliance with Secs. 23.853, 23.855 and 23.1359]	468

FAR 23.F : [Acceptable test procedure for self-extinguishing materials for showing compliance with Secs. 23.853, 23.855 and 23.1359.]

- (a) *Conditioning.* Specimens must be conditioned to 70° F. $\pm$ 5°, and at 50 percent $\pm$ 5 percent relative humidity until moisture equilibrium is reached or for 24 hours. Only one specimen at a time may be removed from the conditioning environment immediately before subjecting it to the flame.
- (b) *[Specimen configuration.* Except as provided for materials used in electrical wire and cable insulation and in small parts, materials must be tested either as a section cut from a fabricated part as installed in the airplane or as a specimen simulating a cut section, such as : a specimen cut from a flat sheet of the material or a model of the fabricated part. The specimen may be cut from any location in a fabricated part ; however, fabricated units, such as sandwich panels, may not be separated for a test. The specimen thickness must be no thicker than the minimum thickness to be qualified for use in the airplane, except that : (1) Thick foam parts, such as seat cushions, must be tested in $\frac{1}{2}$ inch thickness ; (2) when showing compliance with Sec. 23.853(d)(3)(v) for materials used in small parts that must be tested, the materials must be tested in no more than $\frac{1}{8}$ inch thickness ; (3) when showing compliance with Sec. 23.1359(c) for materials used in electrical wire and cable insulation, the wire and cable specimens must be the same size as used in the airplane. In the case of fabrics, both the warp and fill direction of the weave must be tested to determine the most critical flammability conditions. When performing the tests prescribed in paragraphs (d) and (e) of this appendix, the specimen must be mounted in a metal frame so that : (1) in the vertical tests of paragraph (d) of this appendix, the two long edges and the upper edge are held securely ; (2) in the horizontal test of paragraph (e) of this appendix, the two long edges and the edge away from the flame are held securely ; (3) the exposed area of the specimen is at least 2 inches wide and 12 inches long, unless the actual size used in the airplane is smaller ; and (4) the edge to which the burner flame is applied must not consist of the finished or protected edge of the specimen but must be representative of the actual cross section of the material or part installed in the airplane. When performing the test prescribed in paragraph (f) of this appendix, the specimen must be mounted in metal frame so that all four edges are held securely and the exposed area of the specimen is at least 8 inches by 8 inches.
- (c) *Apparatus.* Except as provided in paragraph (g) of this appendix, tests must be conducted in a draft-free cabinet in accordance with Federal Test Method Standard 191 Method 5903 (revised Method 5902) which is available from the General Services Administration, Business Service Center, Region 3, Seventh and D Streets SW., Washington, D.C. 20407, or with some other approved equivalent method. Specimens which are too large for the cabinet must be tested in similar draft free conditions.
- (d) *Vertical test.* A minimum of three specimens must be tested and the results averaged. For fabrics, the direction of weave corresponding to the most critical flammability conditions must be parallel to the longest dimension. Each specimen must be supported vertically. The specimen must be exposed to a Bunsen or Tirrill burner with a nominal $\frac{3}{8}$ inch I.D. tube adjusted to give a flame of 1.5 inches in height. The minimum flame temperature measured by a calibrated thermo-couple pyrometer in the center of the flame must be 1,550° F. The lower edge of the specimen must be three-fourths inch above the top edge of the burner. The flame must be applied to the center line of the lower edge of the specimen. For materials covered by Secs.

Chapitre 52

Appendix B

23.853(d)(3)(i) and 23.853(f), the flame must be applied for 60 seconds and then removed. For materials covered by Sec. 23.853(d)(3)(ii), the flame must be applied for 12 seconds and then removed. Flame time, burn length, and flaming time of drippings, if any, must be recorded. The burn length determined in accordance with paragraph (h) of this appendix must be measured to the nearest one-tenth inch.]

- (e) *Horizontal test.* A minimum of three specimens must be tested and the results averaged. Each specimen must be supported horizontally. The exposed surface when installed in the airplane must be face down for the test. The specimen must be exposed to a Bunsen burner or Tirrill burner with a nominal $\frac{3}{8}$ inch I.D. tube adjusted to give a flame of 1.5 inches in height. The minimum flame temperature, measured by a calibrated thermo-couple pyrometer in the center of the flame must be 1,550° F. The specimen must be positioned so that the edge being tested is three-fourths of an inch above the top of, and on the center line of, the burner. The flame must be applied for 15 seconds and then removed. A minimum of 10 inches of the specimen must be used for timing purposes, approximately 1.5 inches must burn before the burning front reaches the timing zone, and the average burn rate must be recorded.

- (f) *Forty-five degree test.* A minimum of three specimens must be tested and the results averaged. The specimens must be supported at an angle of 45 degrees to a horizontal surface. The exposed surface when installed in the aircraft must be face down for the test. The specimens must be exposed to a Bunsen or Tirrill burner with a nominal $\frac{3}{8}$ inch I.D. tube adjusted to give a flame of 1 $\frac{1}{4}$ inches in height. The minimum flame temperature, measured by a calibrated thermo-couple pyrometer in the center of the flame must be 1,550° F. Suitable precautions must be taken to avoid drafts. The flame must be applied for 30 seconds with one-third contacting the material at the center of the specimen and then removed. Flame time, glow time, and whether the flame penetrates (passes through) the specimen must be recorded.

- (g) *Sixty-degree test.* A minimum of three specimens of each wire specification (make and size) must be tested. The specimen of wire or cable (including insulation) must be placed at an angle of 60 degrees with the horizontal in the cabinet specified in paragraph (c) of this appendix, with the cabinet door open during the test or placed within a chamber approximately 2 feet high x 1 foot x 1 foot, open at the top and at one vertical side (front), that allows sufficient flow of air for complete combustion but is free from drafts. The specimen must be parallel to and approximately 6 inches from the front of the chamber. The lower end of the specimen must be held rigidly clamped. The upper end of the specimen must pass over a pulley or rod and must have an appropriate weight attached to it so that the specimen is held tautly throughout the flammability test. The test specimen span between lower clamp and upper pulley or rod must be 24 inches and must be marked 8 inches from the lower end to indicate the central point for flame application. A flame from a Bunsen or Tirrill burner must be applied for 30 seconds at the test mark. The burner must be mounted underneath the test mark on the specimen, perpendicular to the specimen and at an angle of 30 degrees to the vertical plane of the specimen. The burner must have a nominal bore of three-eighths inch, and must be adjusted to provide a three-inch-high flame with an inner cone approximately one-third of the flame height. The minimum temperature of the hottest portion of the flame, as measured with a calibrated thermocouple pyrometer, may not be less than 1,750° F. The burner must be positioned so that the hottest portion of the flame is applied to the test mark on the wire. Flame time, burn length, and flaming time of drippings,

if any, must be recorded. The burn length determined in accordance with paragraph (1) of this appendix must be measured to the nearest one-tenth inch. Breaking of the wire specimen is not considered a failure.

- (1b) *Burn length.* Burn length is the distance from the original edge to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring, or embrittlement, but not including areas sooted, stained, warped, or discolored, nor areas where material has shrunk or melted away from the heat source.]

Amdd. 23-49, EF. 03/11/96

FIGURE 8—Pivoting, nose or tail wheel type.

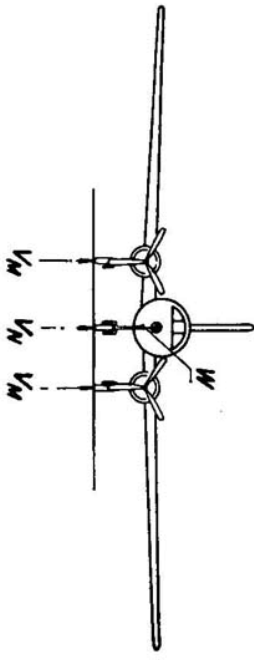
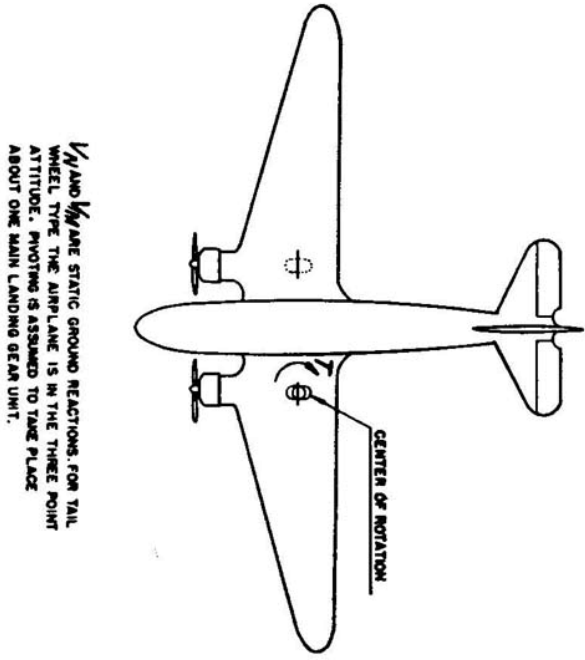


FIG. 51.8 – Pivoting, nose or tail wheel type.

Chapitre 41

Appendix G : Instructions for Continued Airworthiness

FIGURE 7—Ground turning.

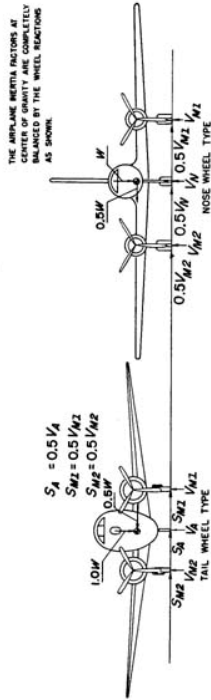


FIG. 51.7 — Ground turning.

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FAR 23.G1 : [General.]

- (a) [This appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by Sec. 23.1529.
 - (b) The Instructions for Continued Airworthiness for each airplane must include the Instructions for Continued Airworthiness for each engine and propeller (hereinafter designated 'products'), for each appliance required by this chapter, and any required information relating to the interface of those appliances and products with the airplane. If Instructions for Continued Airworthiness are not supplied by the manufacturer of an appliance or product installed in the airplane, the Instructions for Continued Airworthiness for the airplane must include the information essential to the continued airworthiness of the airplane.
 - (c) The applicant must submit to the FAA a program to show how changes to the Instructions for Continued Airworthiness made by the applicant or by the manufacturers of products and appliances installed in the airplane will be distributed.]
- Amdt. 23-26, Eff. 10/14/80

FAR 23.G2 : [Format.]

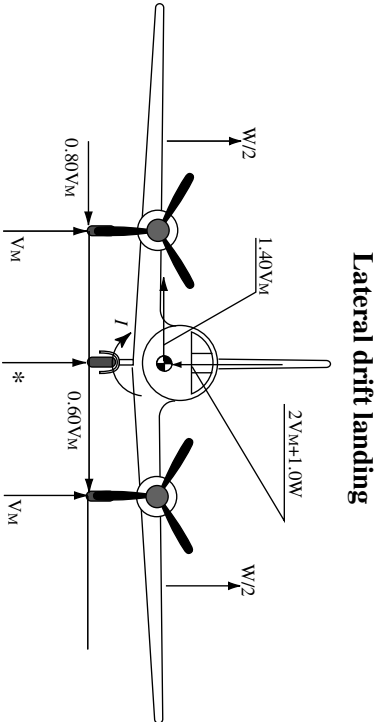
- (a) [The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.
 - (b) The format of the manual or manuals must provide for a practical arrangement.]
- Amdt. 23-26, Eff. 10/14/80

FAR 23.G3 : Content.

The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following manuals or sections, as appropriate, and information :

(a) Airplane maintenance manual or section.

- (1) Introduction information that includes an explanation of the airplane's features and data to the extent necessary for maintenance or preventive maintenance.
 - (2) A description of the airplane and its systems and installations including its engines, propellers, and appliances.
 - (3) Basic control and operation information describing how the airplane components and systems are controlled and how they operate, including any special procedures and limitations that apply.
 - (4) Servicing information that covers details regarding servicing points, capacities of tanks, reservoirs, types of fluids to be used, pressures applicable to the various systems, location of access panels for inspection and servicing, locations of lubrication points, lubricants to be used, equipment required for servicing, tow instructions and limitations, mooring, jacking, and leveling information.
- (b) Maintenance Instructions.
- (1) Scheduling information for each part of the airplane and its engines, auxiliary power units, propellers, accessories, instruments, and equipment that provides the recommended periods at which they should be cleaned, inspected, adjusted, tested, and lubricated, and the degree of inspection, the applicable



VM - one-half the maximum vertical ground reaction obtained at lock main gear in the level landing conditions.

* Nose gear wheel reaction -O

Nose or tail wheel type airplane in the level altitude

FIG. 51.5 - Lateral drift landing.

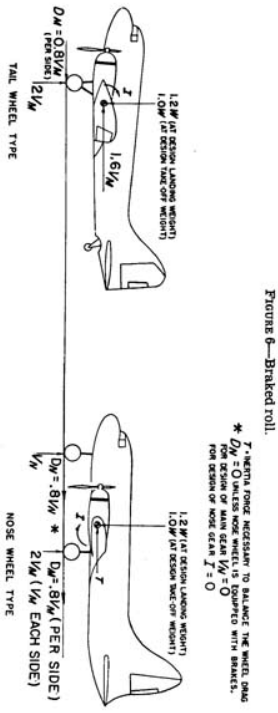


FIG. 51.6 - Braked roll.

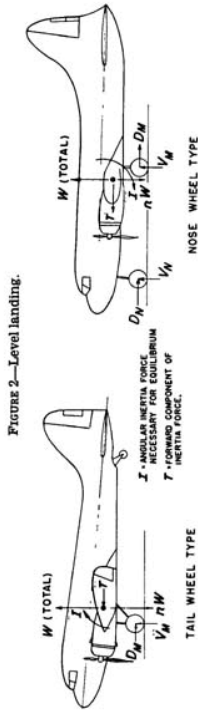


FIG. 51.2 – Level landing.

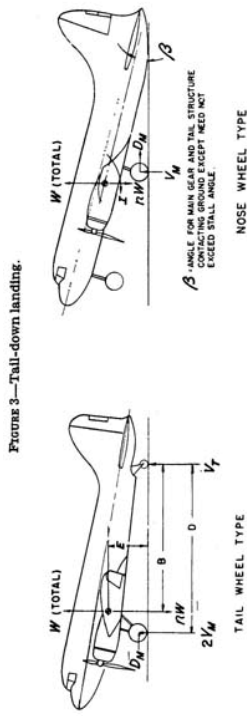
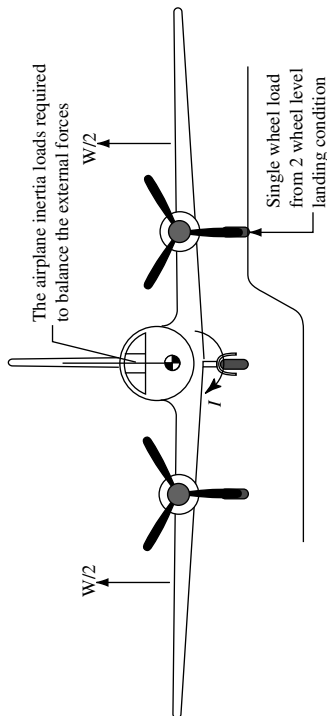


FIG. 51.3 – Tail-down landing.

One wheel landing



Nose or tail wheel type

FIG. 51.4 – One-wheel landing.

wear tolerances, and work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree of complexity requiring specialized maintenance techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross reference to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the airplane.

- (2) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.
- (3) Information describing the order and method of removing and replacing products and parts with any necessary precautions to be taken.
- (4) Other general procedural instructions including procedures for system testing during ground running, symmetry checks, weighing and determining the center of gravity, lifting and shoring, and storage limitations.
- (c) Diagrams of structural access plates and information needed to gain access for inspections when access plates are not provided.
- (d) Details for the application of special inspection techniques including radiographic and ultrasonic testing where such processes are specified.
- (e) Information needed to apply protective treatments to the structure after inspection.
- (f) All data relative to structural fasteners such as identification, discard recommendations, and torque values.
- (g) A list of special tools needed.
- (h) [In addition, for commuter category airplanes, the following information must be furnished :

- (1) Electrical loads applicable to the various systems ;
- (2) Methods of balancing control surfaces ;
- (3) Identification of primary and secondary structures ; and
- (4) Special repair methods applicable to the airplane.]

Amdt. 23-34, Eff. 02/17/87

FAR 23.G4 : Airworthiness limitations section.

[The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, structural inspection interval, and related structural inspection procedure required for type certification. If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads : "The Airworthiness Limitations section is FAA approved and specifies maintenance required under Secs. 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved."]

Amdt. 23-37, Eff. 08/18/90

Chapitre 51

Appendix A

FAR 25.A1 : Appendix A.

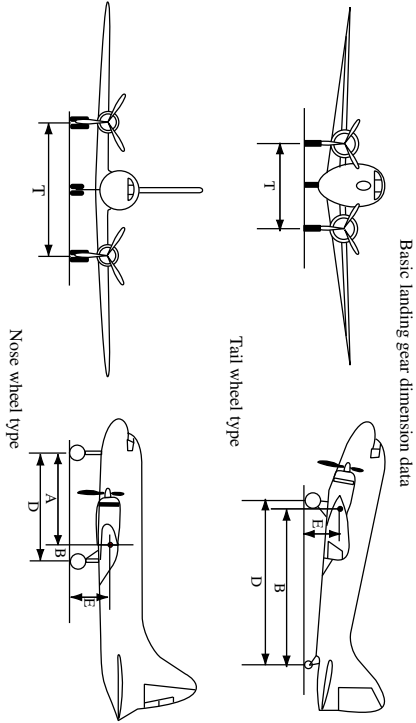


FIG. 51.1 – Basic landing gear dimension data.

- (2) [V_{SR} determined in accordance with Sec. 25.103.]
- (3) The following performance information (determined by extrapolation and computed for the range of weights between the maximum landing weight and the maximum takeoff weight) :
 - (i) Climb in the landing configuration.
 - (ii) Climb in the approach configuration.
 - (iii) Landing distance.
- (4) Procedures established under Sec. 25.101(f) and (g) that are related to the limitations and information required by Sec. 25.1533 and by this paragraph (b) in the form of guidance material, including any relevant limitations or information.
- (5) An explanation of significant or unusual flight or ground handling characteristics of the airplane.
- (6) Corrections to indicated values of airspeed, altitude, and outside air temperature.
- (7) An explanation of operational landing runway length factors included in the presentation of the landing distance, if appropriate.

Amdt. 25-108, Eff. 12/26/2002

Chapitre 42

Appendix H : Installation of an Automatic Power Reserve (APR) System

Sommaire

FAR 23.H1 : [General.]	476
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FAR 23.H1 : [General.]

- (a) [This appendix specifies requirements for installation of an APR engine power control system that automatically advances power or thrust on the operating engine(s) in the event any engine fails during takeoff.]
- (b) With the APR system and associated systems functioning normally, all applicable requirements (except as provided in this appendix) must be met without requiring any action by the crew to increase power or thrust.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.H2 : [Definitions.]

- (a) [Automatic power reserve system, means the entire automatic system used only during takeoff, including all devices both mechanical and electrical that sense engine failure, transmit signals, actuate fuel controls or power levers on operating engines, including power sources, to achieve the scheduled power increase and furnish cockpit information on system operation.]
- (b) Selected takeoff power, notwithstanding the definition of "Takeoff Power" in part 1 of the Federal Aviation Regulations, means the power obtained from each initial power setting approved for takeoff.]
- (c) Critical Time Interval, as illustrated in figure H1, means that period starting at V_1 minus one second and ending at the intersection of the engine and APR failure flight path line with the minimum performance all engine flight path line. The engine and APR failure flight path line intersects the one-engine-inoperative flight path line at 400 feet above the takeoff surface. The engine and APR failure flight path is based on the airplane's performance and must have a positive gradient of at least 0.5 percent at 400 feet above the takeoff surface.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.H3 : [Reliability and performance requirements.]

- (a) [It must be shown that, during the critical time interval, an APR failure that increases or does not affect power on either engine will not create a hazard to the airplane, or it must be shown that such failures are improbable.]
- (b) It must be shown that, during the critical time interval, there are no failure modes of the APR system that would result in a failure that will decrease the power on either engine or it must be shown that such failures are extremely improbable.]
- (c) It must be shown that, during the critical time interval, there will be no failure of the APR system in combination with an engine failure or it must be shown that such failures are extremely improbable.]
- (d) All applicable performance requirements must be met with an engine failure occurring at the most critical point during takeoff with the APR system functioning normally.]

Amdt. 23-43, Eff. 05/10/93

- (g) [Reserved.]
- (h) *Additional operating limitations.* The operating limitations established under Sec. 25.1535 must be furnished.
- (i) *Maneuvering flight load factors.* The positive maneuvering limit load factors for which the structure is proven, described in terms of accelerations, must be furnished.

Amdt. 25-105, Eff. 7/26/01

FAR 25.1585 : Operating procedures.

- (a) [Operating procedures must be furnished for—]
 - (1) Normal procedures peculiar to the particular type or model encountered in connection with routine operations;
 - (2) Non-normal procedures for malfunction cases and failure conditions involving the use of special systems or the alternative use of regular systems; and
 - (3) Emergency procedures for foreseeable but unusual situations in which immediate and precise action by the crew may be expected to substantially reduce the risk of catastrophe.
- (b) Information or procedures not directly related to airworthiness or not under the control of the crew, must not be included, nor must any procedure that is accepted as basic airmanship.
- (c) Information identifying each operating condition in which the fuel system independence prescribed in Sec. 25.953 is necessary for safety must be furnished, together with instructions for placing the fuel system in a configuration used to show compliance with that section.
- (d) The buffet onset envelopes, determined under Sec. 25.251 must be furnished. The buffet onset envelopes presented may reflect the center of gravity at which the airplane is normally loaded during cruise if corrections for the effect of different center of gravity locations are furnished.
- (e) Information must be furnished that indicates that when the fuel quantity indicator reads "zero" in level flight, any fuel remaining in the fuel tank cannot be used safely in flight.
- (f) Information on the total quantity of usable fuel for each fuel tank must be furnished.]

Amdt. 25-105, Eff. 7/26/01

FAR 25.1587 : Performance information.

- (a) Each Airplane Flight Manual must contain information to permit conversion of the indicated temperature to free air temperature if other than a free air temperature indicator is used to comply with the requirements of Sec. 25.1303(a)(1).
- (b) Each Airplane Flight Manual must contain the performance information computed under the applicable provisions of this part (including Secs. 25.115, 25.123, and 25.125 for the weights, altitudes, temperatures, wind components, and runway gradients, as applicable) within the operational limits of the airplane, and must contain the following :
 - (1) In each case, the conditions of power, configuration, and speeds, and the procedures for handling the airplane and any system having a significant effect on the performance information.

FAR 25.1583 : Operating limitations.

(a) *Airspeed limitations.* The following airspeed limitations and any other airspeed limitations necessary for safe operation must be furnished :

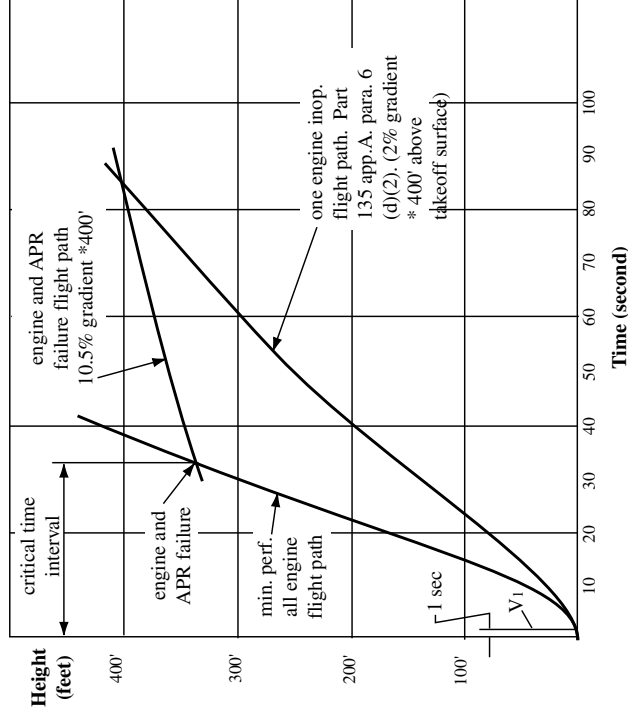
- (1) The maximum operating limit speed V_{MO}/M_{MO} and a statement that this speed limit may not be deliberately exceeded in any regime of flight (climb, cruise, or descent) unless a higher speed is authorized for flight test or pilot training.
- (2) If an airspeed limitation is based upon compressibility effects, a statement to this effect and information as to any symptoms, the probable behavior of the airplane, and the recommended recovery procedures.
- (3) The maneuvering speed V_A and a statement that full application of rudder and aileron controls, as well as maneuvers that involve angles of attack near the stall, should be confined to speeds below this value.
- (4) The flap extended speed V_{FE} and the pertinent flap positions and engine powers.
- (5) The landing gear operating speed or speeds, and a statement explaining the speeds as defined in Sec. 25.1515(a).
- (6) The landing gear extended speed V_{LE} , if greater than V_{LO} , and a statement that this is the maximum speed at which the airplane can be safely flown with the landing gear extended.

(b) *Powerplant limitations.* The following information must be furnished :

- (1) Limitations required by Sec. 25.1521 and Sec. 25.1522.
- (2) Explanation of the limitations, when appropriate.
- (3) Information necessary for marking the instruments required by Secs. 25.1549 through 25.1553.

(c) *[Weight and loading distribution.* The weight and center of gravity limitations established under Sec. 25.1519 must be furnished in the Airplane Flight Manual. All of the following information, including the weight distribution limitations established under Sec. 25.1519, must be presented either in the Airplane Flight Manual or in a separate weight and balance control and loading document that is incorporated by reference in the Airplane Flight Manual :

- (1) The condition of the airplane and the items included in the empty weight as defined in accordance with Sec. 25.29.
- (2) Loading instructions necessary to ensure loading of the airplane within the weight and center of gravity limits, and to maintain the loading within these limits in flight.
- (3) If certification for more than one center of gravity range is requested, the appropriate limitations, with regard to weight and loading procedures, for each separate center of gravity range.]
- (d) *Flight crew.* The number and functions of the minimum flight crew determined under Sec. 25.1523 must be furnished.
- (e) *Kinds of operation.* The kinds of operation approved under Sec. 25.1525 must be furnished.
- (f) *[Ambient air temperatures and operating altitudes.* The extremes of the ambient air temperatures and operating altitudes established under Sec. 25.1527 must be furnished.]



(For illustration only - typical for 120K climb speed)

FIG. 42.1 - Critical Time Interval Illustration

FAR 23.H4 : [Power setting.]

[The selected takeoff power set on each engine at the beginning of the takeoff roll may not be less than—

- (a) The power necessary to attain, at V_1 , 90 percent of the maximum takeoff power approved for the airplane for the existing conditions;
- (b) That required to permit normal operation of all safety-related systems and equipment that are dependent upon engine power or power level position; and
- (c) That shown to be free of hazardous engine response characteristics when power is advanced from the selected takeoff power level to the maximum approved takeoff power.]

Amdt. 23-43, Eff. 05/10/93

FAR 23.H5 : [Powerplant controls—general.]

- (a) [In addition to the requirements of Sec. 23.1141, no single failure or malfunction (or probable combination thereof) of the APR, including associated systems, may

cause the failure of any powerplant function necessary for safety.

- (b) The APR must be designed to—

- (1) Provide a means to verify to the flight crew before takeoff that the APR is in an operating condition to perform its intended function;
- (2) Automatically advance power on the operating engines following an engine failure during takeoff to achieve the maximum attainable takeoff power without exceeding engine operating limits;
- (3) Prevent deactivation of the APR by manual adjustment of the power levers following an engine failure;
- (4) Provide a means for the flight crew to deactivate the automatic function. This means must be designed to prevent inadvertent deactivation; and
- (5) Allow normal manual decrease or increase in power up to the maximum takeoff power approved for the airplane under the existing conditions through the use of power levers, as stated in Sec. 23.114(c), except as provided under paragraph (c) of H23.5 of this appendix.
- (c) For airplanes equipped with limiters that automatically prevent engine operating limits from being exceeded, other means may be used to increase the maximum level of power controlled by the power levers in the event of an APR failure. The means must be located on or forward of the power levers, must be easily identified and operated under all operating conditions by a single action of any pilot with the hand that is normally used to actuate the power levers, and must meet the requirements of Sec. 23.777(a), (b), and (c).

Amdt. 23-43, Eff. 05/10/93

FAR 23.H6 : [Powerplant instruments.]

[In addition to the requirements of Sec. 23.1305 :

- (a) A means must be provided to indicate when the APR is in the armed or ready condition.
- (b) If the inherent flight characteristics of the airplane do not provide warning that an engine has failed, a warning system independent of the APR must be provided to give the pilot a clear warning of any engine failure during takeoff.
- (c) Following an engine failure at V_1 or above, there must be means for the crew to readily and quickly verify that the APR has operated satisfactorily.]

Amdt. 23-43, Eff. 05/10/93

- (d) *Doors.* Each door that must be used in order to reach any required emergency exit must have a suitable placard stating that the door is to be latched in the open position during takeoff and landing.

Amdt. 25-72, Eff. 8/20/90

FAR 25.1561 : Safety equipment.

- (a) Each safety equipment control to be operated by the crew in emergency, such as controls for automatic liferaft releases, must be plainly marked as to its method of operation.
- (b) Each location, such as a locker or compartment, that carries any fire extinguishing, signaling, or other lifesaving equipment must be marked accordingly.
- (c) Stowage provisions for required emergency equipment must be conspicuously marked to identify the contents and facilitate [the easy] removal of the equipment.
- (d) Each liferaft must have obviously marked operating instructions.
- (e) Approved survival equipment must be marked for identification and method of operation.

Amdt. 25-46, Eff. 12/1/78

FAR 25.1563 : Airspeed placard.

A placard showing the maximum airspeeds for flap extension for the takeoff, approach, and landing positions must be installed in clear view of each pilot.

50.3 Airplane Flight Manual

FAR 25.1581 : General.

- (a) *Furnishing information.* An Airplane Flight Manual must be furnished with each airplane, and it must contain the following :

- (1) Information required by Secs. 25.1583 through 25.1587.
- (2) Other information that is necessary for safe operation because of design, operation, or handling characteristics.
- (3) [Any limitation, procedure, or other information established as a condition of compliance with the applicable noise standards of Part 36 of this chapter.]
- (b) *Approved information.* Each part of the manual listed in Secs. 25.1583 through 25.1587, that is appropriate to the airplane, must be furnished, verified, and approved, and must be segregated, identified, and clearly distinguished from each unapproved part of that manual.
- (c) [Reserved]
- (d) Each Airplane Flight Manual must include a table of contents if the complexity of the manual indicates a need for it.

Amdt. 25-72, Eff. 8/20/90

FAR 25.1553 : Fuel quantity indicator.

If the unusable fuel supply for any tank exceeds one gallon, or five percent of the tank capacity, whichever is greater, a red arc must be marked on its indicator extending from the calibrated zero reading to the lowest reading obtainable in level flight.

FAR 25.1555 : Control markings.

- (a) Each cockpit control, other than primary flight controls and controls whose function is obvious, must be plainly marked as to its function and method of operation.
- (b) Each aerodynamic control must be marked under the requirements of Secs. 25.677 and 25.699.
- (c) For powerplant fuel controls—
 - (1) Each fuel tank selector control must be marked to indicate the position corresponding to each tank and to each existing cross feed position ;
 - (2) If safe operation requires the use of any tanks in a specific sequence, that sequence must be marked on, or adjacent to, the selector for those tanks ; and
 - (3) Each valve control for each engine must be marked to indicate the position corresponding to each engine controlled.
- (d) For accessory, auxiliary, and emergency controls—
 - (1) Each emergency control (including each fuel jettisoning and fluid shutoff control) must be colored red ; and
 - (2) Each visual indicator required by Sec. 25.729(e) must be marked so that the pilot can determine at any time when the wheels are locked in either extreme position, if retractable landing gear is used.

FAR 25.1557 : Miscellaneous markings and placards.

- (a) *Baggage and cargo compartments and ballast location.* Each baggage and cargo compartment, and each ballast location must have a placard stating any limitations on contents, including weight, that are necessary under the loading requirements. However, underseat compartments designed for the storage of carry-on articles weighing not more than 20 pounds need not have a loading limitation placard.
- (b) *[Powerplant fluid filler openings].* The following apply :
 - (1) Fuel filler openings must be marked at or near the filler cover with—
 - (i) The word "fuel" ;
 - (ii) For reciprocating engine powered airplanes, the minimum fuel grade ;
 - (iii) For turbine engine powered airplanes, the permissible fuel designations ; and
 - (iv) For pressure fueling systems, the maximum permissible fueling supply pressure and the maximum permissible defueling pressure.
 - (2) Oil filler openings must be marked at or near the filler cover with the word "oil".
 - (3) [Augmentation fluid filler openings must be marked at or near the filler cover to identify the required fluid.]
- (c) *Emergency exit placards.* Each emergency exit placard must meet the requirements of Sec. 25.811.

Chapitre 43

Appendix I : Seaplane Loads

Sommaire

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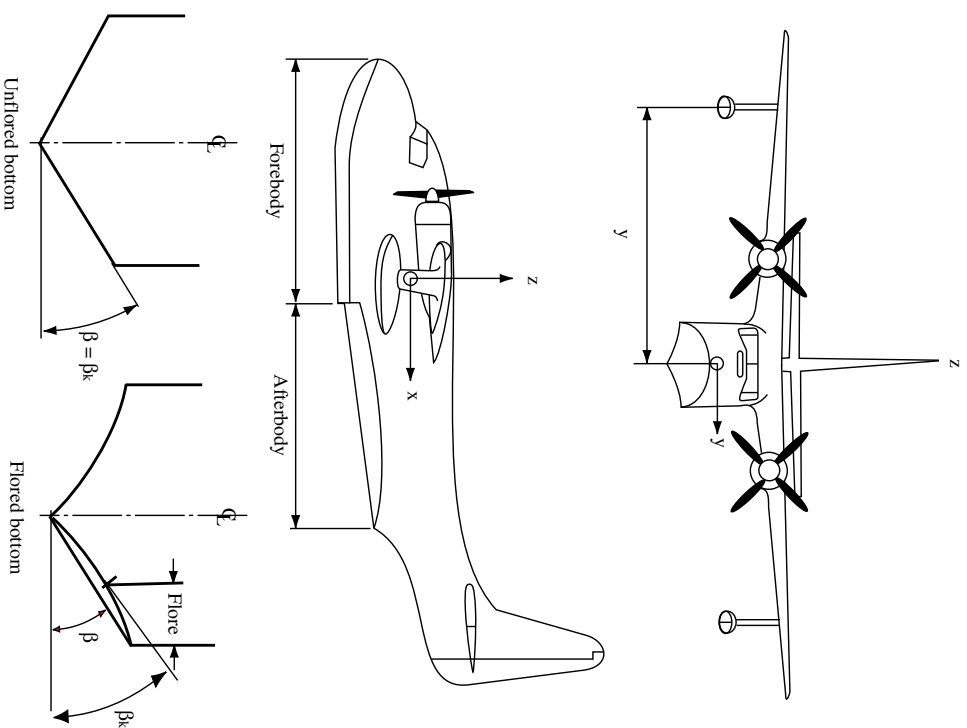
FAR 23.1 : [Seaplane loads.]

FIG. 43.1 – [Pictorial definition of angles, dimensions, and directions on a seaplane.]

Amdt. 23-45, Eff. 09/07/93

(b) Each marking and placard prescribed in paragraph (a) of this section—

- (1) Must be displayed in a conspicuous place; and
- (2) May not be easily erased, disfigured, or obscured.

FAR 25.1543 : Instrument markings : general.

For each instrument—

- (a) When markings are on the cover glass of the instrument, there must be means to maintain the correct alignment of the glass cover with the face of the dial; and
- (b) [Each instrument marking must be clearly visible to the appropriate crewmember.] Amdt. 25-72, Eff. 8/20/90

FAR 25.1545 : Airspeed limitation information.

The airspeed limitations required by Sec. 25.1583(a) must be easily read and understood by the flight crew.

FAR 25.1547 : Magnetic direction indicator.

- (a) A placard meeting the requirements of this section must be installed on, or near, the magnetic direction indicator.
- (b) The placard must show the calibration of the instrument in level flight with the engines operating.
- (c) The placard must state whether the calibration was made with radio receivers on or off.
- (d) Each calibration reading must be in terms of magnetic heading in not more than 45 degree increments.

FAR 25.1549 : Powerplant [and auxiliary power unit instruments.]

[For each required powerplant and auxiliary power unit instrument, as appropriate to the type of instrument—

- (a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line;
- (b) Each normal operating range must be marked with a green arc or green line, not extending beyond the maximum and minimum safe limits;
- (c) Each takeoff and precautionary range must be marked with a yellow arc or a yellow line; and
- (d) Each engine, auxiliary power unit, or propeller speed range that is restricted because of excessive vibration stresses must be marked with red arcs or red lines.] Amdt. 25-40, Eff. 5/2/77

FAR 25.1551 : Oil quantity indicator.

[Each oil quantity indicating means must be marked to indicate the quantity of oil readily and accurately.] Amdt. 25-72, Eff. 8/20/90

FAR 25.1529 : [Instructions for Continued Airworthiness.]

[The applicant must prepare Instructions for Continued Airworthiness in accordance with Appendix H 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 airplane or issuance of a standard certificate of airworthiness, whichever occurs later.]
Amdt. 25-54, Eff. 10/14/80

FAR 25.1531 : Maneuvering flight load factors.

Load factor limitations, not exceeding the positive limit load factors determined from the maneuvering diagram in Sec. 25.333(b), must be established.

FAR 25.1533 : Additional operating limitations.

(a) Additional operating limitations must be established as follows :

- (1) The maximum takeoff weights must be established as the weights at which compliance is shown with the applicable provisions of this part (including the takeoff climb provisions of Sec. 25.121(a) through (c), for altitudes and ambient temperatures.
- (2) The maximum landing weights must be established as the weights at which compliance is shown with the applicable provisions of this part (including the landing and approach climb provisions of Sec. 25.119 and 25.121(d) for altitudes and ambient temperatures).
- (3) [The minimum takeoff distances must be established as the distances at which compliance is shown with the applicable provisions of this part (including the provisions of Sec. 25.109 and 25.113, for weights, altitudes, temperatures, wind components, runway surface conditions (dry and wet), and runway gradients) for smooth, hard-surfaced runways. Additionally, at the option of the applicant, wet runway takeoff distances may be established for runway surfaces that have been grooved or treated with a porous friction course, and may be approved for use on runways where such surfaces have been designed, constructed, and maintained in a manner acceptable to the Administrator.]
- (b) The extremes for variable factors (such as altitude, temperature, wind, and runway gradients) are those at which compliance with the applicable provisions of this part is shown.

Amdt. 25-92, Eff. 3/20/98

50.2 Markings and Placards

FAR 25.1541 : General.

- (a) The airplane must contain—
- (1) The specified markings and placards ; and
 - (2) Any additional information, instrument markings, and placards required for the safe operation if there are unusual design, operating, or handling characteristics.

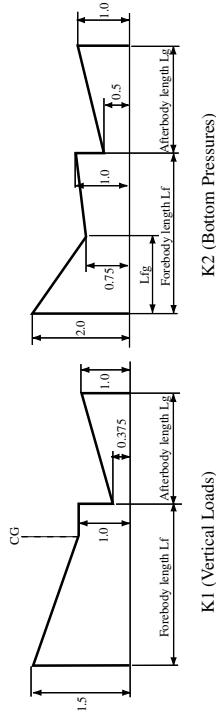


FIG. 43.2 — [Hull station weighing factor.]

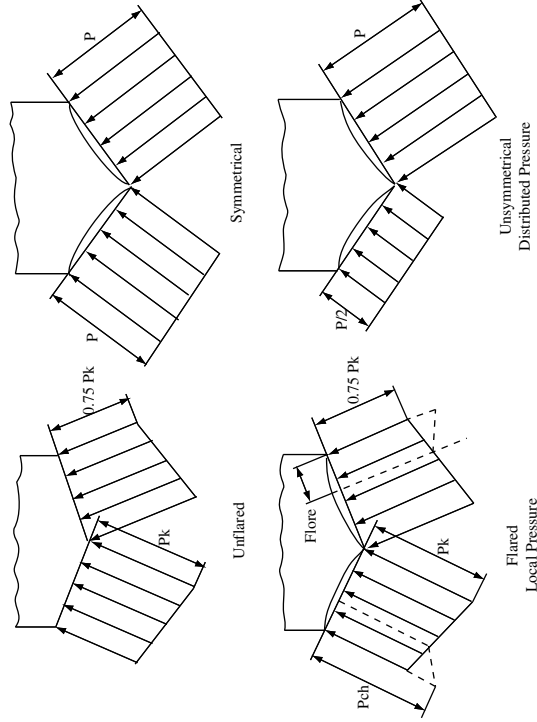


FIG. 43.3 — [Transverse pressure distributions.]

- (4) Any other parameter for which a limitation has been established as part of the engine type certificate except that a limitation need not be established for a parameter that cannot be exceeded during normal operation due to the design of the installation or to another established limitation.
- (c) *Turbine engine installations* Operating limitations relating to the following must be established for turbine engine installations :
 - (1) Horsepower, torque or thrust, r.p.m., gas temperature, and time for—
 - (i) Maximum continuous power or thrust (relating to augmented or unaugmented operation as applicable).
 - (ii) Takeoff power or thrust (relating to augmented or unaugmented operation as applicable).
 - (2) Fuel designation or specification.
 - (3) Any other parameter for which a limitation has been established as part of the engine type certificate except that a limitation need not be established for a parameter that cannot be exceeded during normal operation due to the design of the installation or to another established limitation.
 - (d) *Ambient temperature*. An ambient temperature limitation (including limitations for winterization installations, if applicable) must be established as the maximum ambient atmospheric temperature established in accordance with Sec. 25.1043(b).] Amdt. 25-72, Eff. 8/20/90

FAR 25.1522 : Auxiliary power unit limitations.

[If an auxiliary power unit is installed in the airplane, limitations established for the auxiliary power unit, including categories of operation, must be specified as operating limitations for the airplane.] Amdt. 25-72, Eff. 8/20/90

FAR 25.1523 : Minimum flight crew.

The minimum flight crew must be established so that it is sufficient for safe operation, considering—

- (a) The workload on individual crewmembers;
 - (b) The accessibility and ease of operation of necessary controls by the appropriate crewmember; and
 - (c) The kind of operation authorized under Sec. 25.1525.
- [The criteria used in making the determinations required by this section are set forth in Appendix D.] Amdt. 25-3, Eff. 5/28/65

FAR 25.1525 : Kinds of operation.

The kinds of operation to which the airplane is limited are established by the category in which it is eligible for certification and by the installed equipment.

FAR 25.1527 : [Ambient air temperature and operating altitude.]

[The extremes of the ambient air temperature and operating altitude for which operation is allowed, as limited by flight, structural, powerplant, functional, or equipment characteristics, must be established.] Amdt. 25-105, Eff. 7/26/01

the same as the retraction speed, the two speeds must be designated as $V_{LO(EXT)}$ and $V_{LO(RET)}$, respectively.]

- (b) The established landing gear extended speed V_{LE} may not exceed the speed at which it is safe to fly with the landing gear secured in the fully extended position, and that determined under Sec. 25.729.

Amdt. 25-38, Eff. 2/1/77

FAR 25.1516 : [Other speed limitations.]

[Any other limitation associated with speed must be established.]

Amdt. 25-105, Eff. 7/26/01

FAR 25.1517 : [Rough air speed, V_{RA} .]

[A rough air speed, V_{RA} , for use as the recommended turbulence penetration airspeed in Sec. 25.1585(a)(8), must be established, which—

- (1) Is not greater than the design airspeed for maximum gust intensity, selected for V_B ; and
- (2) Is not less than the minimum value of V_B specified in Sec. 25.335(d); and
- (3) Is sufficiently less than V_{MO} to ensure that likely speed variation during rough air encounters will not cause the overspeed warning to operate too frequently. In the absence of a rational investigation substantiating the use of other values, V_{RA} must be less than $V_{MO}-35$ knots (TAS).]

Amdt. 25-86, Eff. 3/11/96

FAR 25.1519 : Weight, center of gravity, and weight distribution.

The airplane weight, center of gravity, and weight distribution limitations determined under Secs. 25.23 through 25.27 must be established as operating limitations.

FAR 25.1521 : Powerplant limitations.

- (a) [General. The powerplant limitations prescribed in this section must be established so that they do not exceed the corresponding limits for which the engines or propellers are type certificated and do not exceed the values on which compliance with any other requirement of this part is based.

- (b) *Reciprocating engine installations.* Operating limitations relating to the following must be established for reciprocating engine installations :

- (1) Horsepower or torque, r.p.m., manifold pressure, and time at critical pressure altitude and sea level pressure altitude for—
 - (i) Maximum continuous power (relating to unsupercharged operation or to operation in each supercharge mode as applicable); and
 - (ii) Takeoff power (relating to unsupercharged operation or to operation in each supercharger mode as applicable).
- (2) Fuel grade or specification.
- (3) Cylinder head and oil temperatures.

FAR 25.1501 : General.

- (a) [Each operating limitation specified in Secs. 25.1503 through 25.1533 and other limitations and information necessary for safe operation must be established.
 - (b) The operating limitations and other information necessary for safe operation must be made available to the crewmembers as prescribed in Secs. 25.1541 through 25.1587.]
- Amdt. 25-42, Eff. 3/1/78

50.1 Operating Limitations**FAR 25.1503 : Airspeed limitations : general.**

When airspeed limitations are a function of weight, weight distribution, altitude, or Mach number, limitations corresponding to each critical combination of these factors must be established.

FAR 25.1505 : Maximum operating limit speed.

[The maximum operating limit speed (V_{MO}/M_{MO} airspeed or Mach Number, whichever is critical at a particular altitude) is a speed that may not be deliberately exceeded in any regime of flight (climb, cruise, or descent), unless a higher speed is authorized for flight test or pilot training operations. V_{MO}/M_{MO} must be established so that it is not greater than the design cruising speed V_C and so that it is sufficiently below V_D/M_D or V_{DF}/M_{DF} , to make it highly improbable that the latter speeds will be inadvertently exceeded in operations. The speed margin between V_{MO}/M_{MO} and V_D/M_D or V_{DF}/M_{DF} may not be less than that determined under Sec. 25.335(b) or found necessary during the flight tests conducted under Sec. 25.253.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.1507 : Maneuvering speed.

The maneuvering speed must be established so that it does not exceed the design maneuvering speed V_A determined under Sec. 25.335(c).

FAR 25.1511 : Flap extended speed.

The established flap extended speed V_{FE} must be established so that it does not exceed the design flap speed V_F chosen under Secs. 25.335(c) and 25.345, for the corresponding flap positions and engine powers.

FAR 25.1513 : Minimum control speed.

The minimum control speed V_{MC} determined under Sec. 25.149 must be established as an operating limitation.

FAR 25.1515 : Landing gear speeds.

- (a) [The established landing gear operating speed or speeds, V_{LO} , may not exceed the speed at which it is safe both to extend and to retract the landing gear, as determined under Sec. 25.729 or by flight characteristics. If the extension speed is not

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Chapitre 50

Subpart G : Operating Limitations and Information

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- (b) Each nonjectable record container must be located and mounted so as to minimize the probability of container rupture resulting from crash impact and subsequent damage to the record from fire. In meeting this requirement the container must be located as far aft as practicable, but need not be aft of the pressurized compartment, and may not be where aft-mounted engines may crush the container upon impact.
 - (c) A correlation must be established between the flight recorder readings of airspeed, altitude, and heading and the corresponding readings (taking into account correction factors) of the first pilot's instruments. The correlation must cover the airspeed range over which the airplane is to be operated, the range of altitude to which the airplane is limited and 360 degrees of heading. Correlation may be established on the ground as appropriate.
 - (d) Each recorder container must—
 - (1) Be either bright orange or bright yellow ;
 - (2) Have reflective tape affixed to its external surface to facilitate its location under water ; and
 - (3) Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such a manner that they are not likely to be separated during crash impact.
 - (e) [Any novel or unique design or operational characteristics of the aircraft shall be evaluated to determine if any dedicated parameters must be recorded on flight recorders in addition to or in place of existing requirements.]
- Amdt. 25-65, EFF. 10/11/88

FAR 25.1461 : [Equipment containing high energy rotors]

- (a) [Equipment containing high energy rotors must meet paragraph (b), (c), or (d) of this section.
 - (b) High energy rotors contained in equipment must be able to withstand damage caused by malfunctions, vibration, abnormal speeds, and abnormal temperatures. In addition—
 - (1) Auxiliary rotor cases must be able to contain damage caused by the failure of high energy rotor blades ; and
 - (2) Equipment control devices, systems, and instrumentation must reasonably ensure that no operating limitations affecting the integrity of high energy rotors will be exceeded in service.
 - (c) It must be shown by test that equipment containing high energy rotors can contain any failure of a high energy rotor that occurs at the highest speed obtainable with the normal speed control devices inoperative.
 - (d) Equipment containing high energy rotors must be located where rotor failure will neither endanger the occupants nor adversely affect continued safe flight.]
- Amdt. 25-41, EFF. 9/1/77

- (2) There is an automatic means to simultaneously stop the recorder and prevent each erasure feature from functioning, within 10 minutes after crash impact ; and
- (3) There is an aural or visual means for preflight checking of the recorder for proper operation.
- (e) The record container must be located and mounted to minimize the probability of rupture of the container as a result of crash impact and consequent heat damage to the record from fire. In meeting this requirement, the record container must be as far aft as practicable, but may not be where aft mounted engines may crush the container during impact. However, it need not be outside of the pressurized compartment.
- (f) If the cockpit voice recorder has a bulk erasure device, the installation must be designed to minimize the probability of inadvertent operation and actuation of the device during crash impact.
- (g) Each recorder container must—
 - (1) Be either bright orange or bright yellow ;
 - (2) Have reflective tape affixed to its external surface to facilitate its location under water ; and
 - (3) Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such manner that they are not likely to be separated during crash impact.

Amdt. 25-65, Eff. 10/11/88

FAR 25.1459 : Flight recorders.

- (a) Each flight recorder required by the operating rules of this chapter must be installed so that—
 - (1) It is supplied with airspeed, altitude, and directional data obtained from sources that meet the accuracy requirements of Secs. 25.1323, 25.1325, and 25.1327, as appropriate ;
 - (2) The vertical acceleration sensor is rigidly attached, and located longitudinally either within the approved center of gravity limits of the airplane, or at a distance forward or aft of these limits that does not exceed 25 percent of the airplane's mean aerodynamic chord ;
 - (3) It receives its electrical power from the bus that provides the maximum reliability for operation of the flight recorder without jeopardizing service to essential or emergency loads ;
 - (4) [There is an aural or visual means for preflight checking of the recorder for proper recording of data in the storage medium.]
 - (5) Except for recorders powered solely by the engine-driven electrical generator system, there is an automatic means to simultaneously stop a recorder that has a data erasure feature and prevent each erasure feature from functioning, within 10 minutes after crash impact ; and
 - (6) There is a means to record data from which the time of each radio transmission either to or from ATC can be determined.
 - (7) [Deleted]

Chapitre 44

Subpart A : General

Sommaire

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FAR 25.1 : Applicability.

- (a) This part prescribes airworthiness standards for the issue of type certificates, and changes to those certificates, for transport category airplanes.
- (b) Each person who applies under Part 21 [New] for such a certificate or change must show compliance with the applicable requirements in this part.

FAR 25.2 : Special retroactive requirements.

The following special retroactive requirements are applicable to an airplane for which the regulations referenced in the type certificate predate the sections specified below—

- (a) Irrespective of the date of application, each applicant for a supplemental type certificate (or an amendment to a type certificate) involving an increase in passenger seating capacity to a total greater than that for which the airplane has been type certificated must show that the airplane concerned meets the requirements of :
 - (1) Sections 25.721(d), 25.783(g), 25.785(c), 25.803(c)(2) through (9), 25.803(d) and (e), 25.807(a), (c), and (d), 25.809(f) and (h), 25.811, 25.812, 25.813(a), (b) and (c), 25.815, 25.817, 25.853(a) and (b), 25.855(a), 25.933(f), and 25.1353(c) in effect on October 24, 1967, and
 - (2) Sections 25.803(b) and 25.803(c)(1) in effect on April 23, 1969.
 - (b) Irrespective of the date of application, each applicant for a supplemental type certificate (or an amendment to a type certificate) for an airplane manufactured after October 16, 1987, must show that the airplane meets the requirements of Sec. 25.807(c)(7) in effect on July 24, 1989.
 - (c) [Compliance with subsequent revisions to the sections specified in paragraph (a) or (b) of this section may be elected or may be required in accordance with Sec. 21.101(a) of this chapter.]
- Amdt. 25-99, Eff. 6/10/2003

FAR 25.1457 : Cockpit voice recorders.

- (a) Each cockpit voice recorder required by the operating rules of this chapter must be approved and must be installed so that it will record the following :
 - (1) Voice communications transmitted from or received in the airplane by radio.
 - (2) Voice communications of flight crewmembers on the flight deck.
 - (3) Voice communications of flight crewmembers on the flight deck, using the airplane's interphone system.
 - (4) Voice or audio signals identifying navigation or approach aids introduced into a headset or speaker.
 - (5) Voice communications of flight crewmembers using the passenger loudspeaker system, if there is such a system and if the fourth channel is available in accordance with the requirements of paragraph (c)(4)(ii) of this section.
- (b) The recording requirements of paragraph (a)(2) of this section must be met by installing a cockpit-mounted area microphone, located in the best position for recording voice communications originating at the first and second pilot stations and voice communications of other crewmembers on the flight deck when directed to those stations. The microphone must be so located and, if necessary, the preamplifiers and filters of the recorder must be so adjusted or supplemented, that the intelligibility of the recorded communications is as high as practicable when recorded under flight cockpit noise conditions and played back. Repeated aural or visual playback of the record may be used in evaluating intelligibility.
- (c) Each cockpit voice recorder must be installed so that the part of the communication or audio signals specified in paragraph (a) of this section obtained from each of the following sources is recorded on a separate channel :
 - (1) [For the first channel, from each boom, mask, or hand-held microphone, headset, or speaker used at the first pilot station.
 - (2) For the second channel, from each boom, mask, or hand-held microphone, headset, or speaker used at the second pilot station.
 - (3) For the third channel—from the cockpit-mounted area microphone.
 - (4) For the fourth channel, from—
 - (i) Each boom, mask, or hand-held microphone, headset, or speaker used at the stations for the third and fourth crewmembers; or]
 - (ii) If the stations specified in subdivision (i) of this subparagraph are not required or if the signal at such a station is picked up by another channel, each microphone on the flight deck that is used with the passenger loudspeaker system, if its signals are not picked up by another channel.
 - (5) [As far as is practicable all sounds received by the microphone listed in paragraphs (c)(1), (2), and (4) of this section must be recorded without interruption irrespective of the position of the interphone-transmitter key switch. The design shall ensure that sidetone for the flight crew is produced only when the interphone, public address system, or radio transmitters are in use.]
- (d) Each cockpit voice recorder must be installed so that—
 - (1) It receives its electric power from the bus that provides the maximum reliability for operation of the cockpit voice recorder without jeopardizing service to essential or emergency loads;

FAR 25.1449 : Means for determining use of oxygen.

There must be a means to allow the crew to determine whether oxygen is being delivered to the dispensing equipment.

FAR 25.1450 : [Chemical oxygen generators.]

- (a) [For the purpose of this section, a chemical oxygen generator is defined as a device which produces oxygen by chemical reaction.
- (b) Each chemical oxygen generator must be designed and installed in accordance with the following requirements :
 - (1) Surface temperature developed by the generator during operation may not create a hazard to the airplane or to its occupants.
 - (2) Means must be provided to relieve any internal pressure that may be hazardous.
- (c) In addition to meeting the requirements in paragraph (b) of this section, each portable chemical oxygen generator that is capable of sustained operation by successive replacement of a generator element must be placarded to show—

- (1) The rate of oxygen flow, in liters per minute;
- (2) The duration of oxygen flow, in minutes, for the replaceable generator element ; and
- (3) A warning that the replaceable generator element may be hot, unless the element construction is such that the surface temperature cannot exceed 100 degrees F.]

Amdt. 25-41, Eff. 9/1/77

FAR 25.1451 : [Removed.]

[Removed.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.1453 : Protection of oxygen equipment from rupture.

Oxygen pressure tanks, and lines between tanks and the shutoff means, must be—

- (a) Protected from unsafe temperatures ; and
- (b) Located where the probability and hazards of rupture in a crash landing are minimized.

FAR 25.1455 : Draining of fluids subject to freezing.

[If fluids subject to freezing may be drained overboard in flight or during ground operation, the drains must be designed and located to prevent the formation of hazardous quantities of ice on the airplane as a result of the drainage.]

Amdt. 25-23, Eff. 5/8/70

Chapitre 45

Subpart B : Flight

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- (a) There must be an individual dispensing unit for each occupant for whom supplemental oxygen is to be supplied. Units must be designed to cover the nose and mouth and must be equipped with a suitable means to retain the unit in position on the face. Flight crew masks for supplemental oxygen must have provisions for the use of communication equipment.
- (b) If certification for operation up to and including 25,000 feet is requested, an oxygen supply terminal and unit of oxygen dispensing equipment for the immediate use of oxygen by each crewmember must be within easy reach of that crewmember. For any other occupants, the supply terminals and dispensing equipment must be located to allow the use of oxygen as required by the operating rules in this chapter.
- (c) If certification for operation above 25,000 feet is requested, there must be oxygen dispensing equipment meeting the following requirements :
- (1) [There must be an oxygen dispensing unit connected to oxygen supply terminals immediately available to each occupant wherever seated, and at least two oxygen dispensing units connected to oxygen terminals in each lavatory. The total number of dispensing units and outlets in the cabin must exceed the number of seats by at least 10 percent. The extra units must be as uniformly distributed throughout the cabin as practicable. If certification for operation above 30,000 feet is requested, the dispensing units providing the required oxygen flow must be automatically presented to the occupants before the cabin pressure altitude exceeds 15,000 feet. The crew must be provided with a manual means of making the dispensing units immediately available in the event of failure of the automatic system.
- (2) Each flight crewmember on flight deck duty must be provided with a quick-donning type oxygen dispensing unit connected to an oxygen supply terminal. This dispensing unit must be immediately available to the flight crewmember when seated at his station, and installed so that it :
- (i) Can be placed on the face from its ready position, properly secured, sealed, and supplying oxygen upon demand, with one hand, within five seconds and without disturbing eyeglasses or causing delay in proceeding with emergency duties ; and
- (ii) Allows, while in place, the performance of normal communication functions.
- (3) [The oxygen dispensing equipment for the flight crewmembers must be :
- (i) The diluter demand or pressure demand (pressure demand mask with a diluter demand pressure breathing regulator) type, or other approved oxygen equipment shown to provide the same degree of protection, for airplanes to be operated above 25,000 feet.
- (ii) The pressure demand (pressure demand mask with a diluter demand pressure breathing regulator) type with mask-mounted regulator, or other approved oxygen equipment shown to provide the same degree of protection, for airplanes operated at altitudes where decompressions that are not extremely improbable may expose the flightcrew to cabin pressure altitudes in excess of 34,000 feet.
- (4) Portable oxygen equipment must be immediately available for each cabin attendant.]

Amdt. 25-87, EFF. 7/5/96

than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 149 mm. Hg. when breathing 15 liters per minute, BTPS, and with a maximum tidal volume of 700 cc. with a constant time interval between respirations.

- (b) If demand equipment is installed for use by flight crewmembers, the minimum mass flow of supplemental oxygen required for each crewmember may not be less than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 122 mm. Hg. up to and including a cabin pressure altitude of 35,000 feet, and 95 percent oxygen between cabin pressure altitudes of 35,000 and 40,000 feet, when breathing 20 liters per minute BTPS. In addition, there must be means to allow the crew to use undiluted oxygen at their discretion.

- (c) For passengers and cabin attendants, the minimum mass flow of supplemental oxygen required for each person at various cabin pressure altitudes may not be less than the flow required to maintain, during inspiration and while using the oxygen equipment (including masks) provided, the following mean tracheal oxygen partial pressures :

- (1) At cabin pressure altitudes above 10,000 feet up to and including 18,500 feet, a mean tracheal oxygen partial pressure of 100 mm. Hg. when breathing 15 liters per minute, BTPS, and with a tidal volume of 700 cc. with a constant time interval between respirations.
- (2) At cabin pressure altitudes above 18,500 feet up to and including 40,000 feet, a mean tracheal oxygen partial pressure of 83.8 mm. Hg. when breathing 30 liters per minute, BTPS, and with a tidal volume of 1,100 cc. with a constant time interval between respirations.
- (d) If first-aid oxygen equipment is installed, the minimum mass flow of oxygen to each user may not be less than four liters per minute, STPD. However, there may be a means to decrease this flow to not less than two liters per minute, STPD, at any cabin altitude. The quantity of oxygen required is based upon an average flow rate of three liters per minute per person for whom first-aid oxygen is required.
- (e) If portable oxygen equipment is installed for use by crewmembers, the minimum mass flow of supplemental oxygen is the same as specified in paragraph (a) or (b) of this section, whichever is applicable.

FAR 25.1445 : Equipment standards for the oxygen distributing system.

- (a) When oxygen is supplied to both crew and passengers, the distribution system must be designed for either—

- (1) A source of supply for the flight crew on duty and a separate source for the passengers and other crewmembers; or
- (2) A common source of supply with means to separately reserve the minimum supply required by the flight crew on duty.

- (b) Portable walk-around oxygen units of the continuous flow, diluter-demand, and straight demand kinds may be used to meet the crew or passenger breathing requirements.

FAR 25.1447 : Equipment standards for oxygen dispensing units.

If oxygen dispensing units are installed, the following apply :

45.1 General

FAR 25.21 : Proof of compliance.

- (a) Each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested. This must be shown—

- (1) By tests upon an airplane of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and
- (2) By systematic investigation of each probable combination of weight and center of gravity, if compliance cannot be reasonably inferred from combinations investigated.

- (b) [Reserved.]

- (c) The controllability, stability, trim, and stalling characteristics of the airplane must be shown for each altitude up to the maximum expected in operation.

- (d) Parameters critical for the test being conducted, such as weight, loading (center of gravity and inertia), airspeed, power, and wind, must be maintained within acceptable tolerances of the critical values during flight testing.]

- (e) If compliance with the flight characteristics requirements is dependent upon a stability augmentation system or upon any other automatic or power-operated system, compliance must be shown with Secs. 25.671 and 25.672.

- (f) In meeting the requirements of Secs. 25.105(d), 25.125, 25.233, and 25.237, the wind velocity must be measured at a height of 10 meters above the surface, or corrected for the difference between the height at which the wind velocity is measured and the 10-meter height.

Amdt. 25-72, Eff. 8/20/90

FAR 25.23 : Load distribution limits.

- (a) Ranges of weights and centers of gravity within which the airplane may be safely operated must be established. If a weight and center of gravity combination is allowable only within certain load distribution limits (such as spanwise) that could be inadvertently exceeded, these limits and the corresponding weight and center of gravity combinations must be established.

- (b) The load distribution limits may not exceed—

- (1) The selected limits;
- (2) The limits at which the structure is proven; or
- (3) The limits at which compliance with each applicable flight requirement of this subpart is shown.

FAR 25.25 : Weight limits.

- (a) *Maximum weights.* Maximum weights corresponding to the airplane operating conditions (such as ramp, ground or water taxi, takeoff, en route, and landing) environmental conditions (such as altitude and temperature), and loading conditions (such as zero fuel weight, center of gravity position and weight distribution) must be established so that they are not more than—

- (1) The highest weight selected by the applicant for the particular conditions;
 - (2) The highest weight at which compliance with each applicable structural loading and flight requirement is shown, except that for airplanes equipped with standby power rocket engines the maximum weight must not be more than the highest weight established in accordance with Appendix E of this part; or
 - (3) [The highest weight at which compliance is shown with the certification requirements of Part 36 of this chapter.]
- (b) *Minimum weight.* The minimum weight (the lowest weight at which compliance with each applicable requirement of this part is shown) must be established so that it is not less than—
- (1) The lowest weight selected by the applicant;
 - (2) The design minimum weight (the lowest weight at which compliance with each structural loading condition of this part is shown); or
 - (3) The lowest weight at which compliance with each applicable flight requirement is shown.

Amdt. 25-63, Eff 5/6/88

FAR 25.27 : Center of gravity limits.

The extreme forward and the extreme aft center of gravity limitations must be established for each practicably separable operating condition. No such limit may be beyond—

- (a) The extremes selected by the applicant;
- (b) The extremes within which the structure is proven; or
- (c) The extremes within which compliance with each applicable flight requirement is shown.

FAR 25.29 : Empty weight and corresponding center of gravity.

- (a) The empty weight and corresponding center of gravity must be determined by weighing the airplane with—

- (1) Fixed ballast;
 - (2) Unusable fuel determined under Sec. 25.959; and
 - (3) Full operating fluids, including—
 - (i) Oil;
 - (ii) Hydraulic fluid; and
 - (iii) [Other fluids required for normal operation of airplane systems, except potable water, lavatory precharge water, and fluids intended for injection in the engine.]
 - (b) The condition of the airplane at the time of determining empty weight must be one that is well defined and can be easily repeated.
- Amdt. 25-72, Eff. 8/20/90

FAR 25.31 : Removable ballast.

Removable ballast may be used in showing compliance with the flight requirements of this subpart.

airplane, including upper and lower lobe galleys, in which crewmember occupancy is permitted during flight for the maximum number of crewmembers expected to be in the area during any operation.]

- (b) For protective breathing equipment required by paragraph (a) of this section or by any operating rule of this chapter, the following apply :

- (1) The equipment must be designed to protect the flight crew from smoke, carbon dioxide, and other harmful gases while on flight deck duty and while combating fires in cargo compartments.
- (2) The equipment must include—
 - (i) Masks covering the eyes, nose, and mouth; or
 - (ii) Masks covering the nose and mouth, plus accessory equipment to cover the eyes.
- (3) The equipment, while in use, must allow the flight crew to use the radio equipment and to communicate with each other, while at their assigned duty stations.
- (4) The part of the equipment protecting the eyes may not cause any appreciable adverse effect on vision and must allow corrective glasses to be worn.
- (5) The equipment must supply protective oxygen of 15 minutes duration per crewmember at a pressure altitude of 8,000 feet with a respiratory minute volume of 30 liters per minute BTPD. If a demand oxygen system is used, a supply of 300 liters of free oxygen at 70° F. and 760 mm. Hg. pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. If a continuous flow protective breathing system is used (including a mask with a standard rebreather bag) a flow rate of 60 liters per minute at 8,000 feet (45 liters per minute at sea level) and a supply of 600 liters of free oxygen at 70° F. and 760 mm. Hg. pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. BTPD refers to body temperature conditions (that is, 37° C., at ambient pressure, dry).
- (6) The equipment must meet the requirements of paragraphs (b) and (c) of Sec. 25.1441.

Amdt. 25-38, Eff. 2/1/77

FAR 25.1441 : Oxygen equipment and supply.

- (a) If certification with supplemental oxygen equipment is requested, the equipment must meet the requirements of this section and Secs. 25.1443 through 25.1453.
- (b) The oxygen system must be free from hazards in itself, in its method of operation, and in its effect upon other components.
- (c) There must be a means to allow the crew to readily determine, during flight, the quantity of oxygen available in each source of supply.
- (d) The oxygen flow rate and the oxygen equipment for airplanes for which certification for operation above 40,000 feet is requested must be approved.

FAR 25.1443 : Minimum mass flow of supplemental oxygen.

- (a) If continuous flow equipment is installed for use by flight crewmembers, the minimum mass flow of supplemental oxygen required for each crewmember may not be less

capabilities of each element, such that they meet the requirements defined in Sec. 25.1435(a)(1) through (a)(5) ;

- (3) Have means to minimize the release of harmful or hazardous concentrations of hydraulic fluid or vapors into the crew and passenger compartments during flight ;
- (4) Meet the applicable requirements of Secs. 25.863, 25.1183, 25.1185, and 25.1189 if a flammable hydraulic fluid is used ; and
- (5) Be designed to use any suitable hydraulic fluid specified by the airplane manufacturer, which must be identified by appropriate markings as required by Sec. 25.1541.
- (c) Tests. Tests must be conducted on the hydraulic system(s), and/ or subsystem(s) and elements, except that analysis may be used in place of or to supplement testing, where the analysis is shown to be reliable and appropriate. All internal and external influences must be taken into account to an extent necessary to evaluate their effects, and to assure reliable system and element functioning and integration. Failure or unacceptable deficiency of an element or system must be corrected and be sufficiently retested, where necessary.
- (1) The system(s), subsystem(s), or element(s) must be subjected to performance, fatigue, and endurance tests representative of airplane ground and flight operations.
- (2) The complete system must be tested to determine proper functional performance and relation to the other systems, including simulation of relevant failure conditions, and to support or validate element design.
- (3) The complete hydraulic system(s) must be functionally tested on the airplane in normal operation over the range of motion of all associated user systems. The test must be conducted at the system relief pressure or 1.25 times the DOP if a system pressure relief device is not part of the system design. Clearances between hydraulic system elements and other systems or structural elements must remain adequate and there must be no detrimental effects.]

Amdt. 25-104, Eff. 6/15/2001

FAR 25.1438 : [Pressurization and pneumatic systems]

- (a) [Pressurization system elements must be burst pressure tested to 2.0 times, and proof pressure tested to 1.5 times, the maximum normal operating pressure.
- (b) Pneumatic system elements must be burst pressure tested to 3.0 times, and proof pressure tested to 1.5 times the maximum normal operating pressure.
- (c) An analysis, or a combination of analysis and tests, may be substituted for any test required by paragraph (a) or (b) of this section if the Administrator finds it equivalent to the required test.]

Amdt. 25-41 Eff. 9/1/77

FAR 25.1439 : Protective breathing equipment.

- (a) If there is a class A, B, or E cargo compartment, protective breathing equipment must be installed for the use of appropriate crewmembers. [In addition, protective breathing equipment must be installed in each isolated separate compartment in the

FAR 25.33 : Propeller speed and pitch limits.

- (a) The propeller speed and pitch must be limited to values that will ensure—
 - (1) Safe operation under normal operating conditions ; and
 - (2) Compliance with the performance requirements of Secs. 25.101 through 25.125.
- (b) There must be a propeller speed limiting means at the governor. It must limit the maximum possible governed engine speed to a value not exceeding the maximum allowable r.p.m.
- (c) [The means used to limit the low pitch position of the propeller blades must be set so that the engine does not exceed 103 percent of the maximum allowable engine rpm or 99 percent of an approved maximum overspeed, whichever is greater, with—
 - (1) The propeller blades at the low pitch limit and governor inoperative ;
 - (2) The airplane stationary under standard atmospheric conditions with no wind ; and
 - (3) The engines operating at the takeoff manifold pressure limit for reciprocating engine powered airplanes or the maximum takeoff torque limit for turbopropeller engine-powered airplanes.]

Amdt. 25-72, Eff. 8/20/90

45.2 Performance

FAR 25.101 : General.

- (a) Unless otherwise prescribed, airplanes must meet the applicable performance requirements of this subpart for ambient atmospheric conditions and still air.
- (b) The performance, as affected by engine power or thrust, must be based on the following relative humidities :
 - (1) For turbine engine powered airplanes, a relative humidity of—
 - (i) 80 percent, at and below standard temperatures ; and
 - (ii) 34 percent, at and above standard temperatures plus 50 degrees F.

Between these two temperatures, the relative humidity must vary linearly.

- (2) For reciprocating engine powered airplanes, a relative humidity of 80 percent in a standard atmosphere. Engine power corrections for vapor pressure must be made in accordance with the following table :

Altitude H (ft.)	Vapor pressure e (In. Hg.)	Specific humidity w (lb. moisture per lb. dry air)	Density ratio ρ $\rho = \rho_{0.0253769}$
0	0.403	0.00849	0.99508
1,000	0.354	0.00773	0.96672
2,000	0.311	0.00703	0.93895
3,000	0.272	0.00638	0.91178
4,000	0.238	0.00578	0.88514
5,000	0.207	0.00523	0.8591
6,000	0.1805	0.00472	0.83361
7,000	0.1566	0.00425	0.8087
8,000	0.1356	0.00382	0.78434
9,000	0.1172	0.00343	0.76053
10,000	0.101	0.00307	0.73722
15,000	0.0463	0.00171	0.62868
20,000	0.01978	0.000896	0.53263
25,000	0.00778	0.000436	0.44806

- (c) The performance must correspond to the propulsive thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraph (b) of this section. The available propulsive thrust must correspond to engine power or thrust, not exceeding the approved power or thrust, less—
- (1) Installation losses; and
 - (2) The power or equivalent thrust absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.
 - (d) Unless otherwise prescribed, the applicant must select the takeoff, en route, approach, and landing configurations for the airplane.
 - (e) The airplane configurations may vary with weight, altitude, and temperature, to the extent they are compatible with the operating procedures required by paragraph (f) of this section.
 - (f) Unless otherwise prescribed, in determining the accelerate-stop distances, takeoff flight paths, takeoff distances, and landing distances, changes in the airplane's configuration, speed, power, and thrust, must be made in accordance with procedures established by the applicant for operation in service.
 - (g) Procedures for the execution of balked landings and missed approaches associated with the conditions prescribed in Secs. 25.119 and 25.121(d) must be established.
 - (h) The procedures established under paragraph (f) and (g) of this section must—
 - (1) Be able to be consistently executed in service by crews of average skill;
 - (2) Use methods or devices that are safe and reliable; and
 - (3) Include allowance for any time delays, in the execution of the procedures, that may reasonably be expected in service.
 - (i) [The accelerate-stop and landing distances prescribed in Secs. 25.109 and 25.125, respectively, must be determined with all the airplane wheel brake assemblies at the fully worn limit of their allowable wear range.]
- Amdt. 25-92, Eff. 3/20/98

- (c) Radio and electronic equipment, controls, and wiring must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other radio or electronic unit, or system of units, required by this chapter.

FAR 25.1433 : Vacuum systems.

[There must be means, in addition to the normal pressure relief, to automatically relieve the pressure in the discharge lines from the vacuum air pump when the delivery temperature of the air becomes unsafe.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.1435 : Hydraulic systems.

- (a) [Element design. Each element of the hydraulic system must be designed to :

- (1) Withstand the proof pressure without permanent deformation that would prevent it from performing its intended functions, and the ultimate pressure without rupture. The proof and ultimate pressures are defined in terms of the design operating pressure (DOP) as follows :

Element	Proof (x DOP)	Ultimate (x DOP)
1. Tubes and fittings	1.5	3.0
2. Pressure vessels containing gas : High pressure (e.g., accumulators). Low pressure (e.g., reservoirs)	3.0 1.5	4.0 3.0
3. Hoses	2.0	4.0
4. All other elements.	1.5	2.0

- (2) Withstand, without deformation that would prevent it from performing its intended function, the design operating pressure in combination with limit structural loads that may be imposed;
- (3) Withstand, without rupture, the design operating pressure multiplied by a factor of 1.5 in combination with ultimate structural load that can reasonably occur simultaneously;
- (4) Withstand the fatigue effects of all cyclic pressures, including transients, and associated externally induced loads, taking into account the consequences of element failure; and
- (5) Perform as intended under all environmental conditions for which the airplane is certificated.
- (b) System design. Each hydraulic system must :
- (1) Have means located at a flightcrew station to indicate appropriate system parameters, if
 - (i) It performs a function necessary for continued safe flight and landing; or
 - (ii) In the event of hydraulic system malfunction, corrective action by the crew to ensure continued safe flight and landing is necessary;
 - (2) Have means to ensure that system pressures, including transient pressures and pressures from fluid volumetric changes in elements that are likely to remain closed long enough for such changes to occur, are within the design

Amdt. 25-72, Eff. 8/20/90

FAR 25.1421 : [Megaphones.]

[If a megaphone is installed, a restraining means must be provided that is capable of restraining the megaphone when it is subjected to the ultimate inertia forces specified in Sec. 25.561 (b)(3).]

Amdt. 25-41, Eff. 9/1/77

FAR 25.1423 : Public address system.

[A public address system required by this chapter must—

- (a) Be powerable when the aircraft is in flight or stopped on the ground, after the shutdown or failure of all engines and auxiliary power units, or the disconnection or failure of all power sources dependent on their continued operation, for—

- (1) A time duration of at least 10 minutes, including an aggregate time duration of at least 5 minutes of announcements made by flight and cabin crewmembers, considering all other loads which may remain powered by the same source when all other power sources are inoperative; and

- (2) An additional time duration in its standby state appropriate or required for any other loads that are powered by the same source and that are essential to safety of flight or required during emergency conditions.

- (b) Be capable of operation within 10 seconds by a flight attendant at those stations in the passenger compartment from which the system is accessible.

- (c) Be intelligible at all passenger seats, lavatories, and flight attendant seats and work stations.

- (d) Be designed so that no unused, unstowed microphone will render the system inoperative.

- (e) Be capable of functioning independently of any required crewmember interphone system.

- (f) Be accessible for immediate use from each of two flight crewmember stations in the pilot compartment.

- (g) For each required floor-level passenger emergency exit which has an adjacent flight attendant seat, have a microphone which is readily accessible to the seated flight attendant, except that one microphone may serve more than one exit, provided the proximity of the exits allows unassisted verbal communication between seated flight attendants.]

Amdt. 25-79, Eff. 9/27/93

49.6 Miscellaneous Equipment

FAR 25.1431 : Electronic equipment.

- (a) In showing compliance with Sec. 25.1309 (a) and (b) with respect to radio and electronic equipment and their installations, critical environmental conditions must be considered.

- (b) Radio and electronic equipment must be supplied with power under the requirements of Sec. 25.1355(c).

FAR 25.103 : [Stall speed.]

- (a) [The reference stall speed, V_{SR} , is a calibrated airspeed defined by the applicant. V_{SR} may not be less than a 1-g stall speed. V_{SR} is expressed as :

$$V_{SR} \geq \frac{V_{CLMAX}}{\sqrt{n_{ZW}}}$$

where : V_{CLMAX} = Calibrated airspeed obtained when the load factor- corrected lift coefficient $\left(\frac{n_{ZW}W}{qS}\right)$ is first a maximum during the maneuver prescribed in paragraph (c) of this section. In addition, when the maneuver is limited by a device that abruptly pushes the nose down at a selected angle of attack (e.g., a stick pusher), V_{CLMAX} may not be less than the speed existing at the instant the device operates;

n_{ZW} : Load factor normal to the flight path at V_{CLMAX} ;

W : Airplane gross weight ;

S : Aerodynamic reference wing area ; and

q : Dynamic pressure.

- (b) V_{CLMAX} is determined with :

- (1) Engines idling, or, if that resultant thrust causes an appreciable decrease in stall speed, not more than zero thrust at the stall speed ;

- (2) Propeller pitch controls (if applicable) in the takeoff position ;

- (3) The airplane in other respects (such as flaps and landing gear) in the condition existing in the test or performance standard in which V_{SR} is being used ;

- (4) The weight used when V_{SR} is being used as a factor to determine compliance with a required performance standard ;

- (5) The center of gravity position that results in the highest value of reference stall speed ; and

- (6) The airplane trimmed for straight flight at a speed selected by the applicant, but not less than $1.13 V_{SR}$ and not greater than $1.3 V_{SR}$.

- (c) Starting from the stabilized trim condition, apply the longitudinal control to decelerate the airplane so that the speed reduction does not exceed one knot per second.

- (d) In addition to the requirements of paragraph (a) of this section, when a device that abruptly pushes the nose down at a selected angle of attack (e.g., a stick pusher) is installed, the reference stall speed, V_{SR} , may not be less than 2 knots or 2 percent, whichever is greater, above the speed at which the device operates.]

Amdt. 25-108, Eff. 12/26/2002

FAR 25.105 : Takeoff.

- (a) The takeoff speeds described in Sec. 23.107, the accelerate-stop distance described in Sec. 25.109, the takeoff path described in Sec. 25.111, and the takeoff distance and takeoff run described in Sec. 25.113, must be determined—

- (1) At each weight, altitude, and ambient temperature within the operational limits selected by the applicant ; and

- (2) In the selected configuration for takeoff.

- (b) No takeoff made to determine the data required by this section may require exceptional piloting skill or alertness.
- (c) The takeoff data must be based on—
 - (1) [In the case of land planes and amphibians :
 - (i) Smooth, dry and wet, hard-surfaced runways; and
 - (ii) At the option of the applicant, grooved or porous friction course wet, hard-surfaced runways.]
 - (2) Smooth water, in the case of seaplanes and amphibians; and
 - (3) Smooth, dry snow, in the case of skiplanes.
- (d) The takeoff data must include, within the established operational limits of the airplane, the following operational correction factors :
 - (1) Not more than 50 percent of nominal wind components along the takeoff path opposite to the direction of takeoff, and not less than 150 percent of nominal wind components along the takeoff path in the direction of takeoff.
 - (2) Effective runway gradients.

Amdt. 25-92, Eff. 3/20/98

FAR 25.107 : Takeoff speeds.

- (a) V_1 must be established in relation to V_{EF} as follows :
 - (1) V_{EF} is the calibrated airspeed at which the critical engine is assumed to fail. V_{EF} must be selected by the applicant, but may not be less than V_{MCG} determined under Sec. 25.149(e).
 - (2) V_1 , in terms of calibrated airspeed, is selected by the applicant ; however, V_1 may not be less than V_{EF} plus the speed gained with the critical engine inoperative during the time interval between the instant at which the critical engine is failed, and the instant at which the pilot recognizes and reacts to the engine failure, as indicated by the pilot's initiation of the first action (e.g., applying brakes, reducing thrust, deploying speed brakes) to stop the airplane during accelerate-stop tests.
- (b) V_{2min} , in terms of calibrated airspeed, may not be less than—
 - (1) $1.13V_{SR}$ for—
 - (i) Two-engine and three-engine turbopropeller and reciprocating engine powered airplanes ; and
 - (ii) Turbopjet powered airplanes without provisions for obtaining a significant reduction in the one-engine-inoperative power-on stall speed ;
 - (2) $1.08V_{SR}$ for—
 - (i) Turbopropeller and reciprocating engine powered airplanes with more than three engines ; and
 - (ii) Turbopjet powered airplanes with provisions for obtaining a significant reduction in the one-engine-inoperative power-on stall speed ; and]
 - (3) 1.10 times V_{MCG} established under Sec. 25.149.
- (c) V_2 , in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by Sec. 25.121(b) but may not be less than—

- (b) Each life raft and each life preserver must be approved. In addition—
 - (1) Unless excess rafts of enough capacity are provided, the buoyancy and seating capacity beyond the rated capacity of the rafts must accommodate all occupants of the airplane in the event of a loss of one raft of the largest rated capacity ; and
 - (2) Each raft must have a trailing line, and must have a static line designed to hold the raft near the airplane but to release it if the airplane becomes totally submerged.
- (c) Approved survival equipment must be attached to each life raft.
- (d) [There must be an approved survival type emergency locator transmitter for use in one life raft.]
- (e) For airplanes not certificated for ditching under Sec. 25.801 and not having approved life preservers, there must be an approved flotation means for each occupant. This means must be within easy reach of each seated occupant and must be readily removable from the airplane.

Amdt. 25-82, Eff. 6/21/94

FAR 25.1416 : [Removed.]

[Removed.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.1419 : Ice protection.

- [If certification with ice protection provisions is desired, the airplane must be able to safely operate in the continuous maximum and intermittent maximum icing conditions of Appendix C. To establish that the airplane can operate within the continuous maximum and intermittent maximum conditions of Appendix C :
- (a) An analysis must be performed to establish that the ice protection for the various components of the airplane is adequate, taking into account the various airplane operational configurations ; and
 - (b) To verify the ice protection analysis, to check for icing anomalies, and to demonstrate that the ice protection system and its components are effective, the airplane or its components must be flight tested in the various operational configurations, in measured natural atmospheric icing conditions and, as found necessary, by one or more of the following means :
 - (1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.
 - (2) Flight dry air tests of the ice protection system as a whole, or of its individual components.
 - (3) Flight tests of the airplane or its components in measured simulated icing conditions.
 - (c) Caution information, such as an amber caution light or equivalent, must be provided to alert the flightcrew when the anti-ice or de-ice system is not functioning normally.
 - (d) For turbine engine powered airplanes, the ice protection provisions of this section are considered to be applicable primarily to the airframe. For the powerplant installation, certain additional provisions of Subpart E of this part may be found applicable.]

49.5 Safety Equipment

FAR 25.1411 : General.

(a) *[Accessibility]* Required safety equipment to be used by the crew in an emergency must be readily accessible.]

(b) *Stowage provisions.* Stowage provisions for required emergency equipment must be furnished and must—

(1) Be arranged so that the equipment is directly accessible and its location is obvious; and

(2) Protect the safety equipment from inadvertent damage.

(c) *Emergency exit descent device.* The stowage provisions for the emergency exit descent device required by Sec. 25.809(f) must be at the exits for which they are intended.

(d) *Liferafts.*

(1) The stowage provisions for the liferafts described in Sec. 25.1415 must accommodate enough rafts for the maximum number of occupants for which certification for ditching is requested.

(2) Liferafts must be stowed near exits through which the rafts can be launched during an unplanned ditching.

(3) Rafts automatically or remotely released outside the airplane must be attached to the airplane by means of the static line prescribed in Sec. 25.1415.

(4) The stowage provisions for each portable liferaft must allow rapid detachment and removal of the raft for use at other than the intended exits.

(e) *Long-range signaling device.* The stowage provisions for the long-range signaling device required by Sec. 25.1415 must be near an exit available during an unplanned ditching.

(f) *Life preserver stowage provisions.* The stowage provisions for life preservers described in Sec. 25.1415 must accommodate one life preserver for each occupant for which certification for ditching is requested. Each life preserver must be within easy reach of each seated occupant.

(g) *Life line stowage provisions.* If certification for ditching under Sec. 25.801 is requested, there must be provisions to store life lines. These provisions must—

(1) Allow one life line to be attached to each side of the fuselage; and

(2) Be arranged to allow the life lines to be used to enable the occupants to stay on the wing after ditching.

Amdt. 25-79, Eff. 9/27/93

FAR 25.1413 : [Removed.]

[Removed.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.1415 : Ditching equipment.

(a) Ditching equipment used in airplanes to be certificated for ditching under Sec. 25.801, and required by the operating rules of this chapter, must meet the requirements of this section.

(1) V_{2MIN} ;

(2) V_R plus the speed increment attained (in accordance with Sec. 25.111(c)(2)) before reaching a height of 35 feet above the takeoff surface; and

(3) A speed that provides the maneuvering capability specified in Sec. 25.143(g).]

(d) V_{MU} is the calibrated airspeed at and above which the airplane can safely lift off the ground, and continue the takeoff. V_{MU} speeds must be selected by the applicant throughout the range of thrust-to-weight ratios to be certificated. These speeds may be established from free air data if these data are verified by ground takeoff tests.

(e) V_R , in terms of calibrated airspeed, must be selected in accordance with the conditions of paragraphs (e)(1) through (4) of this section :

(1) V_R may not be less than—

(i) V_1 ;

(ii) 105 percent of V_{MC} ;

(iii) The speed (determined in accordance with Sec. 25.111(c)(2)) that allows reaching V_2 before reaching a height of 35 feet above the takeoff surface; or

(iv) A speed that, if the airplane is rotated at its maximum practicable rate, will result in a V_{LOF} of not less than 110 percent of V_{MU} in the all-engines-operating condition and not less than 105 percent of V_{MU} determined at the thrust-to-weight ratio corresponding to the one-engine-inoperative condition.

(2) For any given set of conditions (such as weight, configuration, and temperature), a single value of V_R , obtained in accordance with this paragraph, must be used to show compliance with both the one-engine-inoperative and the all-engines-operating takeoff provisions.

(3) It must be shown that the one-engine-inoperative takeoff distance, using a rotation speed of 5 knots less than V_R established in accordance with paragraphs (e)(1) and (2) of this section, does not exceed the corresponding one-engine-inoperative takeoff distance using the established V_R . The takeoff distances must be determined in accordance with Sec. 25.113(a)(1).

(4) Reasonably expected variations in service from the established takeoff procedures for the operation of the airplane (such as over-rotation of the airplane and out-of-trim conditions) may not result in unsafe flight characteristics or in marked increases in the scheduled takeoff distances established in accordance with Sec. 25.113(a).

(f) V_{LOF} is the calibrated airspeed at which the airplane first becomes airborne.

(g) V_{FTO} , in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by Sec. 25.121(c), but may not be less than—

(1) 1.18 V_{SR} ; and

(2) A speed that provides the maneuvering capability specified in Sec. 25.143(g).]

Amdt. 25-108, Eff. 12/26/2002

FAR 25.109 : Accelerate-stop distance.

- (a) [The accelerate-stop distance on a dry runway is the greater of the following distances :
- (1) The sum of the distances necessary to—
 - (i) Accelerate the airplane from a standing start with all engines operating to V_{EF} for takeoff from a dry runway;
 - (ii) Allow the airplane to accelerate from V_{EF} to the highest speed reached during the rejected takeoff, assuming the critical engine fails at V_{EF} and the pilot takes the first action to reject the takeoff at the V_1 for takeoff from a dry runway; and
 - (iii) Come to a full stop on a dry runway from the speed reached as prescribed in paragraph (a)(1)(ii) of this section; plus
 - (iv) A distance equivalent to 2 seconds at the V_1 for takeoff from a dry runway.
 - (2) The sum of the distances necessary to—
 - (i) Accelerate the airplane from a standing start with all engines operating to the highest speed reached during the rejected takeoff, assuming the pilot takes the first action to reject the takeoff at the V_1 for takeoff from a dry runway; and
 - (ii) With all engines still operating, come to a full stop on dry runway from the speed reached as prescribed in paragraph (a)(2)(i) of this section; plus
 - (iii) A distance equivalent to 2 seconds at the V_1 for takeoff from a dry runway.
- (b) The accelerate-stop distance on a wet runway is the greater of the following distances :
- (1) The accelerate-stop distance on a dry runway determined in accordance with paragraph (a) of this section; or
 - (2) The accelerate-stop distance determined in accordance with paragraph (a) of this section, except that the runway is wet and the corresponding wet runway values of V_{EF} and V_1 are used. In determining the wet runway accelerate-stop distance, the stopping force from the wheel brakes may never exceed :
 - (i) The wheel brakes stopping force determined in meeting the requirements of Sec. 25.101(i) and paragraph (a) of this section; and
 - (ii) The force resulting from the wet runway braking coefficient of friction determined in accordance with paragraphs (c) or (d) of this section, as applicable, taking into account the distribution of the normal load between braked and unbraked wheels at the most adverse center-of-gravity position approved for takeoff.
- (c) The wet runway braking coefficient of friction for a smooth wet runway is defined as a curve of friction coefficient versus ground speed and must be computed as follows :
- (1) The maximum tire-to-ground wet runway braking coefficient of friction is defined as :

500

- (b) *Field of coverage.* The system must consist of enough lights to illuminate the vital areas around the airplane considering the physical configuration and light characteristics of the airplane. The field of coverage must extend in each direction within at least [75°] above and [75°] below the horizontal plane of the airplane, except that a solid angle or angles of obstructed visibility totaling not more than 0,03 steradians is allowable within a solid angle equal to 0,15 steradians centered about the longitudinal axis in the rearward direction.
- (c) *Flashing characteristics.* The arrangement of the system, that is, the number of light sources, beam width, speed of rotation, and other characteristics, must give an effective flash frequency of not less than 40, nor more than 100, cycles per minute. The effective flash frequency is the frequency at which the airplane's complete anticollision light system is observed from a distance, and applies to each sector of light including any overlaps that exist when the system consists of more than one light source. In overlaps, flash frequencies may exceed 100, but not 180, cycles per minute.
- (d) *Color.* Each anticollision light must be either aviation red or aviation white and must meet the applicable requirements of Sec. 25.1397.
- (e) *Light intensity.* The minimum light intensities in all vertical planes, measured with the red filter (if used) and expressed in terms of "effective" intensities, must meet the requirements of paragraph (f) of this section. The following relation must be assumed :

$$I_e = \frac{1}{0.2 + (t_2 - t_1)} \int_{t_1}^{t_2} I(t) dt$$

where :

I_e : effective intensity (candlcs).

$I(t)$: instantaneous intensity as a function of time. (seconds).

$t_2 - t_1$: flash time interval (seconds).

Normally, the maximum value of effective intensity is obtained when t_2 and t_1 are chosen so that the effective intensity is equal to the instantaneous intensity at t_2 and t_1 .

- (f) *Minimum effective intensities for anticollision lights.* Each anticollision light effective intensity must equal or exceed the applicable values in the following table.

Angle above or below the horizontal plane :	Effective intensity (candlcs)
0° to 5°	400
5° to 10°	240
10° to 20°	80
20° to 30°	40
[30° to 75°	20]

Amdt. 25-41, Eff. 9/1/77

FAR 25.1403 : Wing icing detection lights.

Unless operations at night in known or forecast icing conditions are prohibited by an operating limitation, a means must be provided for illuminating or otherwise determining the formation of ice on the parts of the wings that are critical from the standpoint of ice accumulation. Any illumination that is used must be a type that will not cause glare or reflection that would handicap crewmembers in the performance of their duties.

Amdt. 25-38, Eff. 2/1/77

Élodie Roux- Septembre 2003

Where—

- (a) Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 10 degrees but less than 20 degrees; and
- (b) Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 20 degrees.

FAR 25.1397 : Color specifications.

Each position light color must have the applicable International Commission on Illumination chromaticity coordinates as follows :

- (a) Aviation red—

"y" is not greater than 0.335; and
"z" is not greater than 0.002.

- (b) Aviation green—

"x" is not greater than 0.440 - 0.320y;
"x" is not greater than y - 0.170; and
"y" is not less than 0.390 - 0.170x.

- (c) Aviation white—

"x" is not less than 0.300 and not greater than 0.540;
"y" is not less than "x - 0.040" or "y0 - 0.010", whichever is the smaller; and
"y" is not greater than "x + 0.020" nor "0.636 - 0.400x";

Where "y0" is the "y" coordinate of the Planckian radiator for the value of "x" considered.]

Amdt. 25-27, Eff. 8/11/71

FAR 25.1399 : Riding light.

- (a) Each riding (anchor) light required for a seaplane or amphibian must be installed so that it can—
- (1) Show a white light for at least two nautical miles at night under clear atmospheric conditions; and
- (2) Show the maximum unbroken light practicable when the airplane is moored or drifting on the water.
- (b) Externally hung lights may be used.

FAR 25.1401 : Anticollision light system.

- (a) General The airplane must have an anticollision light system that—
- (1) Consists of one or more approved anticollision lights located so that their light will not impair the crew's vision or detract from the conspicuity of the position lights; and
- (2) Meets the requirements of paragraphs (b) through (f) of this section.

Tire Pressure (psi)	Maximum Braking Coefficient (tire-to-ground)
50	$\mu_{t/g\ max} = -0.0350 \left(\frac{V}{100}\right)^3 + 0.306 \left(\frac{V}{100}\right)^2 - 0.851 \left(\frac{V}{100}\right) + 0.883$
100	$\mu_{t/g\ max} = -0.0437 \left(\frac{V}{100}\right)^3 + 0.320 \left(\frac{V}{100}\right)^2 - 0.805 \left(\frac{V}{100}\right) + 0.804$
200	$\mu_{t/g\ max} = -0.0331 \left(\frac{V}{100}\right)^3 + 0.252 \left(\frac{V}{100}\right)^2 - 0.658 \left(\frac{V}{100}\right) + 0.692$
300	$\mu_{t/g\ max} = -0.0401 \left(\frac{V}{100}\right)^3 + 0.263 \left(\frac{V}{100}\right)^2 - 0.611 \left(\frac{V}{100}\right) + 0.614$

Where—

Tire Pressure : maximum airplane operating tire pressure (psi) ;
 $\mu_{t/g\ max}$: maximum tire-to-ground braking coefficient ;
 V : airplane true ground speed (knots) ; and

Linear interpolation may be used for tire pressures other than those listed.

- (2) The maximum tire-to-ground wet runway braking coefficient of friction must be adjusted to take into account the efficiency of the anti-skid system on a wet runway. Anti-skid system operation must be demonstrated by flight testing on a smooth wet runway, and its efficiency must be determined. Unless a specific anti-skid system efficiency is determined from a quantitative analysis of the flight testing on a smooth wet runway, the maximum tire-to-ground wet runway braking coefficient of friction determined in paragraph (c)(1) of this section must be multiplied by the efficiency value associated with the type of anti-skid system installed on the airplane :

Type of anti-skid system	Efficiency value
On-Off	0.30
Quasi-Modulating	0.50
Fully Modulating	0.80

- (d) At the option of the applicant, a higher wet runway braking coefficient of friction may be used for runway surfaces that have been grooved or treated with a porous friction course material. For grooved and porous friction course runways, the wet runway braking coefficient of friction is defined as either :

- (1) 70 percent of the dry runway braking coefficient of friction used to determine the dry runway accelerate-stop distance ; or
- (2) The wet runway braking coefficient defined in paragraph (c) of this section, except that a specific anti-skid system efficiency, if determined, is appropriate for a grooved or porous friction course wet runway, and the maximum tire-to-ground wet runway braking coefficient of friction is defined as :

Tire Pres. (psi)	Maximum Braking Coefficient (tire-to-ground)
50	$\mu_{t/g\ max} = 0.1470 \left(\frac{V}{100}\right)^5 - 1.050 \left(\frac{V}{100}\right)^4 + 2.673 \left(\frac{V}{100}\right)^3 - 2.683 \left(\frac{V}{100}\right)^2 + 0.403 \left(\frac{V}{100}\right) + 0.859$
100	$\mu_{t/g\ max} = 0.1106 \left(\frac{V}{100}\right)^5 - 0.813 \left(\frac{V}{100}\right)^4 + 2.130 \left(\frac{V}{100}\right)^3 - 2.200 \left(\frac{V}{100}\right)^2 + 0.317 \left(\frac{V}{100}\right) + 0.807$
200	$\mu_{t/g\ max} = 0.0498 \left(\frac{V}{100}\right)^5 - 0.398 \left(\frac{V}{100}\right)^4 + 1.140 \left(\frac{V}{100}\right)^3 - 1.285 \left(\frac{V}{100}\right)^2 + 0.140 \left(\frac{V}{100}\right) + 0.701$
300	$\mu_{t/g\ max} = 0.0314 \left(\frac{V}{100}\right)^5 - 0.247 \left(\frac{V}{100}\right)^4 + 0.703 \left(\frac{V}{100}\right)^3 - 0.779 \left(\frac{V}{100}\right)^2 + 0.0094 \left(\frac{V}{100}\right) + 0.614$

Where—

The Pressure : maximum airplane operating tire pressure (psi) ;
 μ/g_{max} : maximum tire-to-ground braking coefficient ;
 V : airplane true ground speed (knots) ; and

Linear interpolation may be used for tire pressures other than those listed.

(e) Except as provided in paragraph (f)(1) of this section, means other than wheel brakes may be used to determine the accelerate-stop distance if that means—

- (1) Is safe and reliable ;
- (2) Is used so that consistent results can be expected under normal operating conditions ; and
- (3) Is such that exceptional skill is not required to control the airplane.

(f) [The effects of available reverse thrust—

- (1) Shall not be included as an additional means of deceleration when determining the accelerate-stop distance on a dry runway ; and
- (2) May be included as an additional means of deceleration using recommended reverse thrust procedures when determining the accelerate-stop distance on a wet runway, provided the requirements of paragraph (e) of this section are met.]

(g) [The landing gear must remain extended throughout the accelerate-stop distance.

(h) If the accelerate-stop distance includes a stopway with surface characteristics substantially different from those of the runway, the takeoff data must include operational correction factors for the accelerate-stop distance.] The correction factors must account for the particular surface characteristics of the stopway and the variations in these characteristics with seasonal weather conditions (such as temperature, rain, snow, and ice) within the established operational limits.

(i) [A flight test demonstration of the maximum brake kinetic energy accelerate-stop distance must be conducted with not more than 10 percent of the allowable brake wear range remaining on each of the airplane wheel brakes.]

Amnd. 25-92, Eff. 3/20/98

FAR 25.111 : Takeoff path.

(a) [The takeoff path extends from a standing start to a point in the takeoff at which the airplane is 1,500 feet above the takeoff surface, or at which the transition from the takeoff to the en route configuration is completed and V_{FTO} is reached, whichever point is higher. In addition—

- (1) The takeoff path must be based on the procedures prescribed in Sec. 25.101(f) ;
 - (2) The airplane must be accelerated on the ground to V_{EF} , at which point the critical engine must be made inoperative and remain inoperative for the rest of the takeoff ; and
 - (3) After reaching V_{EF} , the airplane must be accelerated to V_2 .
- (b) During the acceleration to speed V_2 , the nose gear may be raised off the ground at a speed not less than V_R . However, landing gear retraction may not be begun until the airplane is airborne.
- (c) During the takeoff path determination in accordance with paragraphs (a) and (b) of this section—

substantially greater than the minima specified in Secs. 25.1391 and 25.1393 if the overlap intensities in relation to the main beam intensities do not adversely affect signal clarity. When the peak intensity of the forward position lights is more than 100 candles, the maximum overlap intensities between them may exceed the values given in Sec. 25.1395 if the overlap intensity in Area A is not more than 10 percent of peak position light intensity and the overlap intensity in Area B is not greater than 2.5 percent of peak position light intensity.

FAR 25.1391 : Minimum intensities in the horizontal plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table :

Dihedral angle (light included)	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity (candles)
L and R (forward red and green).	0° to 10°	40
	10° to 20°	30
	20° to 110°	5
A (rear white)	110° to 180°	20

FAR 25.1393 : Minimum intensities in any vertical plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table :

Angle above or below the horizontal plane :	Intensity
0°	1.00 I.
0° to 5°	0.90 I.
5° to 10°	0.80 I.
10° to 15°	0.70 I.
15° to 20°	0.50 I.
20° to 30°	0.30 I.
30° to 40°	0.10 I.
40° to 90°	0.05 I.

FAR 25.1395 : Maximum intensities in overlapping beams of forward and rear position lights.

No position light intensity may exceed the applicable values in the following table, except as provided in Sec. 25.1389 (b)(3).

Overlaps	Maximum intensity (candles)	
	Area A	Area B
Green in dihedral angle L	10	1
Red in dihedral angle R	10	1
Green in dihedral angle A	5	1
Red in dihedral angle A	5	1
Rear white in dihedral angle L	5	1
Rear white in dihedral angle R	5	1

FAR 25.1387 : Position light system dihedral angles.

- (a) [Except as provided in paragraph (e) of this section, each forward and rear position light must, as installed, show unbroken light within the dihedral angles described in this section.]
- (b) Dihedral angle L (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airplane, and the other at 110 degrees to the left of the first, as viewed when looking forward along the longitudinal axis.
- (c) Dihedral angle R (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airplane, and the other at 110 degrees to the right of the first, as viewed when looking forward along the longitudinal axis.
- (d) Dihedral angle A (aft) is formed by two intersecting vertical planes making angles of 70 degrees to the right and to the left, respectively, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.
- (e) [If the rear position light, when mounted as far aft as practicable in accordance with Sec. 25.1385(c), cannot show unbroken light within dihedral angle A (as defined in paragraph (d) of this section), a solid angle or angles of obstructed visibility totaling not more than 0.04 steradians is allowable within that dihedral angle, if such solid angle is within a cone whose apex is at the rear position light and whose elements make an angle of 30° with a vertical line passing through the rear position light.]

Amdt. 25-30, Eff. 11/5/71

FAR 25.1389 : Position light distribution and intensities.

- (a) *General.* The intensities prescribed in this section must be provided by new equipment with light covers and color filters in place. Intensities must be determined with the light source operating at a steady value equal to the average luminous output of the source at the normal operating voltage of the airplane. The light distribution and intensity of each position light must meet the requirements of paragraph (b) of this section.
- (b) *Forward and rear position lights.* The light distribution and intensities of forward and rear position lights must be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane, and maximum intensities in overlapping beams, within dihedral angles L, R, and A, and must meet the following requirements :
- (1) *Intensities in the horizontal plane.* Each intensity in the horizontal plane (the plane containing the longitudinal axis of the airplane and perpendicular to the plane of symmetry of the airplane) must equal or exceed the values in Sec. 25.1391.
- (2) *Intensities in any vertical plane.* Each intensity in any vertical plane (the plane perpendicular to the horizontal plane) must equal or exceed the appropriate value in Sec. 25.1393, where I is the minimum intensity prescribed in Sec. 25.1391 for the corresponding angles in the horizontal plane.
- (3) *Intensities in overlaps between adjacent signals.* No intensity in any overlap between adjacent signals may exceed the values given in Sec. 25.1395, except that higher intensities in overlaps may be used with main beam intensities

- (1) The slope of the airborne part of the takeoff path must be positive at each point ;

- (2) The airplane must reach V_2 before it is 35 feet above the takeoff surface and must continue at a speed as close as practical to, but not less than V_2 , until it is 400 feet above the takeoff surface ;

- (3) At each point along the takeoff path, starting at the point at which the airplane reaches 400 feet above the takeoff surface, the available gradient of climb may not be less than—

(i) 1.2 percent for two-engine airplanes ;

(ii) 1.5 percent for three-engine airplanes ; and

(iii) 1.7 percent for four-engine airplanes ; and

- (4) Except for gear retraction and propeller feathering, the airplane configuration may not be changed, and no change in power or thrust that requires action by the pilot may be made, until the airplane is 400 feet above the takeoff surface.

- (d) The takeoff path must be determined by a continuous demonstrated takeoff or by synthesis from segments. If the takeoff path is determined by the segmental method—

- (1) The segments must be clearly defined and must be related to the distinct changes in the configuration, power or thrust, and speed ;

- (2) The weight of the airplane, the configuration, and the power or thrust must be constant throughout each segment and must correspond to the most critical condition prevailing in the segment ;

- (3) The flight path must be based on the airplane's performance without ground effect ; and

- (4) The takeoff path data must be checked by continuous demonstrated takeoffs up to the point at which the airplane is out of ground effect and its speed is stabilized, to ensure that the path is conservative relative to the continuous path.

The airplane is considered to be out of ground effect when it reaches a height equal to its wing span.

- (e) For airplanes equipped with standby power rocket engines, the takeoff path may be determined in accordance with section II of appendix E.

Amdt. 25-108, Eff. 12/26/2002

FAR 25.113 : Takeoff distance and takeoff run.

- (a) [Takeoff distance on a dry runway is the greater of—

- (1) The horizontal distance along the takeoff path from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface, determined under Sec. 25.111 for a dry runway ; or]

- (2) 115 percent of the horizontal distance along the takeoff path, with all engines operating, from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface, as determined by a procedure consistent with Sec. 25.111.

- (b) [Takeoff distance on a wet runway is the greater of—

- (1) The takeoff distance on a dry runway determined in accordance with paragraph (a) of this section ; or

- (2) The horizontal distance along the takeoff path from the start of the takeoff to the point at which the airplane is 15 feet above the takeoff surface, achieved in a manner consistent with the achievement of V_2 before reaching 35 feet above the takeoff surface, determined under Sec. 25.111 for a wet runway.
- (c) [If the takeoff distance does not include a clearway, the takeoff run is equal to the takeoff distance. If the takeoff distance includes a clearway–
 - (1) The takeoff run on a dry runway is the greater of–
 - (i) The horizontal distance along the takeoff path from the start of the takeoff to a point equidistant between the point at which V_{LOF} is reached and the point at which the airplane is 35 feet above the takeoff surface, as determined under Sec. 25.111 for a dry runway ; or
 - (ii) 115 percent of the horizontal distance along the takeoff path, with all engines operating, from the start of the takeoff to a point equidistant between the point at which V_{LOF} is reached and the point at which the airplane is 35 feet above the takeoff surface, determined by a procedure consistent with Sec. 25.111.
 - (2) The takeoff run on a wet runway is the greater of–
 - (i) The horizontal distance along the takeoff path from the start of the takeoff to the point at which the airplane is 15 feet above the takeoff surface, achieved in a manner consistent with the achievement of V_2 before reaching 35 feet above the takeoff surface, as determined under Sec. 25.111 for a wet runway ; or
 - (ii) 115 percent of the horizontal distance along the takeoff path, with all engines operating, from the start of the takeoff to a point equidistant between the point at which V_{LOF} is reached and the point at which the airplane is 35 feet above the takeoff surface, determined by a procedure consistent with Sec. 25.111.]

Amdt. 25-92, Eff. 3/20/98

FAR 25.115 : Takeoff flight path.

- (a) [The takeoff flight path shall be considered to begin 35 feet above the takeoff surface at the end of the takeoff distance determined in accordance with Sec. 25.113(a) or (b), as appropriate for the runway surface condition.]
- (b) The net takeoff flight path data must be determined so that they represent the actual takeoff flight paths (determined in accordance with Sec. 25.111 and with paragraph (a) of this section) reduced at each point by a gradient of climb equal to–
 - (1) 0.8 percent for two-engine airplanes ;
 - (2) 0.9 percent for three-engine airplanes ; and
 - (3) 1.0 percent for four-engine airplanes.
- (c) The prescribed reduction in climb gradient may be applied as an equivalent reduction in acceleration, along that part of the takeoff flight path at which the airplane is accelerated in level flight.

Amdt. 25-92, Eff. 3/20/98

49.4 Lights

FAR 25.1381 : Instrument lights.

- (a) The instrument lights must–
 - (1) [Provide sufficient illumination to make each instrument, switch and other device necessary for safe operation easily readable unless sufficient illumination is available from another source ; and]
 - (2) Be installed so that–
 - (i) Their direct rays are shielded from the pilot's eyes ; and
 - (ii) No objectionable reflections are visible to the pilot.
- (b) Unless undimmed instrument lights are satisfactory under each expected flight condition, there must be a means to control the intensity of illumination.

Amdt. 25-72, Eff. 8/20/90

FAR 25.1383 : Landing lights.

- (a) Each landing light must be approved, and must be installed so that–
 - (1) No objectionable glare is visible to the pilot ;
 - (2) The pilot is not adversely affected by halation ; and
 - (3) It provides enough light for night landing.
- (b) Except when one switch is used for the lights of a multiple light installation at one location, there must be a separate switch for each light.
- (c) There must be a means to indicate to the pilots when the landing lights are extended.

FAR 25.1385 : Position light system installation.

- (a) *General.* Each part of each position light system must meet the applicable requirements of this section and each system as a whole must meet the requirements of Secs. 25.1387 through 25.1397.
- (b) *Forward position lights.* Forward position lights must consist of a red and a green light spaced laterally as far apart as practicable and installed forward on the airplane so that, with the airplane in the normal flying position, the red light is on the left side, and the green light is on the right side. Each light must be approved.
- (c) [*Rear position light.* The rear position light must be a white light mounted as far aft as practicable on the tail or on each wing tip, and must be approved.]
- (d) *Light covers and color filters.* Each light cover and color filter must be at least flame resistant and may not change color or shape or lose any appreciable light transmission during normal use.
- (e) [[Deleted].]

Amdt. 25-38, Eff. 2/1/77

FAR 25.1357 : Circuit protective devices.

- (a) Automatic protective devices must be used to minimize distress to the electrical system and hazard to the airplane in the event of wiring faults or serious malfunction of the system or connected equipment.
- (b) The protective and control devices in the generating system must be designed to de-energize and disconnect faulty power sources and power transmission equipment from their associated busses with sufficient rapidity to provide protection from hazardous over-voltage and other malfunctioning.
- (c) Each resettable circuit protective device must be designed so that, when an overload or circuit fault exists, it will open the circuit irrespective of the position of the operating control.
- (d) If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be located and identified so that it can be readily reset or replaced in flight.
- (e) Each circuit for essential loads must have individual circuit protection. However, individual protection for each circuit in an essential load system (such as each position light circuit in a system) is not required.
- (f) If fuses are used, there must be spare fuses for use in flight equal to at least 50 percent of the number of fuses of each rating required for complete circuit protection.
- (g) Automatic reset circuit breakers may be used as integral protectors for electrical equipment (such as thermal cut-outs) if there is circuit protection to protect the cable to the equipment.

FAR 25.1359 : [Removed.]

[Removed.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.1363 : Electrical system tests.

- (a) When laboratory tests of the electrical system are conducted—
 - (1) The tests must be performed on a mock-up using the same generating equipment used in the airplane;
 - (2) The equipment must simulate the electrical characteristics of the distribution wiring and connected loads to the extent necessary for valid test results; and
 - (3) Laboratory generator drives must simulate the actual prime movers on the airplane with respect to their reaction to generator loading, including loading due to faults.
- (b) For each flight condition that cannot be simulated adequately in the laboratory or by ground tests on the airplane, flight tests must be made.

FAR 25.1369 : [Revoked.]

[Revoked.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.117 : Climb : general.

Compliance with the requirements of Secs. 25.119 and 25.121 must be shown at each weight, altitude, and ambient temperature within the operational limits established for the airplane and with the most unfavorable center of gravity for each configuration.

FAR 25.119 : Landing climb : All-engines-operating.

In the landing configuration, the steady gradient of climb may not be less than 3.2 percent, with—

- (a) The engines at the power or thrust that is available eight seconds after initiation of movement of the power or thrust controls from the minimum flight idle to the go-around power or thrust setting; and
- (b) [A climb speed of not more than V_{REF} .]
Amdt. 25-108, Eff. 12/26/2002

FAR 25.121 : Climb : One-engine-inoperative.

(a) *Takeoff* : landing gear extended. In the critical takeoff configuration existing along the flight path (between the points at which the airplane reaches V_{LOF} and at which the landing gear is fully retracted) and in the configuration used in Sec. 25.111 but without ground effect, the steady gradient of climb must be positive for two-engine airplanes, and not less than 0.3 percent for three-engine airplanes or 0.5 percent for four-engine airplanes, at V_{LOF} and with—

- (1) The critical engine inoperative and the remaining engines at the power or thrust available when retraction of the landing gear is begun in accordance with Sec. 25.111 unless there is a more critical power operating condition existing later along the flight path but before the point at which the landing gear is fully retracted; and
- (2) The weight equal to the weight existing when retraction of the landing gear is begun, determined under Sec. 25.111.
- (b) *Takeoff* : landing gear retracted. In the takeoff configuration existing at the point of the flight path at which the landing gear is fully retracted, and in the configuration used in Sec. 25.111 but without ground effect, the steady gradient of climb may not be less than 2.4 percent for two-engine airplanes, 2.7 percent for three-engine airplanes, and 3.0 percent for four-engine airplanes, at V_2 and with—
 - (1) The critical engine inoperative, the remaining engines at the takeoff power or thrust available at the time the landing gear is fully retracted, determined under Sec. 25.111, unless there is a more critical power operating condition existing later along the flight path but before the point where the airplane reaches a height of 400 feet above the takeoff surface; and
 - (2) The weight equal to the weight existing when the airplane's landing gear is fully retracted, determined under Sec. 25.111.
- (c) [Final takeoff]. In the en route configuration at the end of the takeoff path determined in accordance with Sec. 25.111, the steady gradient of climb may not be less than 1.2 percent for two-engine airplanes, 1.5 percent for three-engine airplanes and 1.7 percent for four-engine airplanes, at VFTO and with—
 - (1) The critical engine inoperative and the remaining engines at the available maximum continuous power or thrust; and

- (2) The weight equal to the weight existing at the end of the takeoff path, determined under Sec. 25.111.
- (d) [*Approach.* In a configuration corresponding to the normal all-engines-operating procedure in which V_{SR} for this configuration does not exceed 110 percent of the V_{SR} for the related all-engines-operating landing configuration, the steady gradient of climb may not be less than 2.1 percent for two-engine airplanes, 2.4 percent for three-engine airplanes, and 2.7 percent for four-engine airplanes, with—]
 - (1) The critical engine inoperative, the remaining engines at the go-around power or thrust setting;
 - (2) [The maximum landing weight;
 - (3) A climb speed established in connection with normal landing procedures, but not more than $1.4 V_{SR}$; and
 - (4) Landing gear retracted.]

Amdt. 25-108, Eff. 12/26/2002

FAR 25.123 : En route flight paths.

- (a) For the en route configuration, the flight paths prescribed in paragraphs (b) and (c) of this section must be determined at each weight, altitude, and ambient temperature, within the operating limits established for the airplane. The variation of weight along the flight path, accounting for the progressive consumption of fuel and oil by the operating engines, may be included in the computation. The flight paths must be determined at any selected speed, with—
 - (1) The most unfavorable center of gravity;
 - (2) The critical engines inoperative;
 - (3) The remaining engines at the available maximum continuous power or thrust; and
 - (4) The means for controlling the engine-cooling air supply in the position that provides adequate cooling in the hot-day condition.
 - (b) The one-engine-inoperative net flight path data must represent the actual climb performance diminished by a gradient of climb of 1.1 percent for two-engine airplanes, 1.4 percent for three-engine airplanes, and 1.6 percent for four-engine airplanes.
 - (c) For three- or four-engine airplanes, the two-engine-inoperative net flight path data must represent the actual climb performance diminished by a gradient of climb of 0.3 percent for three-engine airplanes and 0.5 percent for four-engine airplanes.
- FAR 25.125 : Landing.**
- (a) The horizontal distance necessary to land and to come to a complete stop (or to a speed of approximately 3 knots for water landings) from a point 50 feet above the landing surface must be determined (for standard temperatures, at each weight, altitude, and wind within the operational limits established by the applicant for the airplane) as follows :
 - (1) The airplane must be in the landing configuration.
 - (2) [A stabilized approach, with a calibrated airspeed of V_{REF} , must be maintained down to the 50 foot height. V_{REF} may not be less than

- (b) Cables must be grouped, routed, and spaced so that damage to essential circuits will be minimized if there are faults in heavy current-carrying cables.
- (c) Storage batteries must be designed and installed as follows :
 - (1) Safe cell temperatures and pressures must be maintained during any probable charging or discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge)—
 - (i) At maximum regulated voltage or power;
 - (ii) During a flight of maximum duration; and
 - (iii) Under the most adverse cooling condition likely to occur in service.
 - (2) Compliance with subparagraph (1) of this paragraph must be shown by test unless experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.
 - (3) No explosive or toxic gases emitted by any battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation may accumulate in hazardous quantities within the airplane.
 - (4) No corrosive fluids or gases that may escape from the battery may damage surrounding airplane structures or adjacent essential equipment.
 - (5) Each nickel cadmium battery installation capable of being used to start an engine or auxiliary power unit must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.
 - (6) [Nickel cadmium battery installations capable of being used to start an engine or auxiliary power unit must have—
 - (i) A system to control the charging rate of the battery automatically so as to prevent battery overheating;
 - (ii) A battery temperature sensing and over-temperature warning system with a means for disconnecting the battery from its charging source in the event of an over-temperature condition; or
 - (iii) A battery failure sensing and warning system with a means for disconnecting the battery from its charging source in the event of battery failure.]

Amdt. 25-42, Eff. 3/1/78

FAR 25.1355 : Distribution system.

- (a) The distribution system includes the distribution busses, their associated feeders, and each control and protective device.
- (b) [Revoked.]
- (c) [If two independent sources of electrical power for particular equipment or systems are required by this chapter, in the event of the failure of one power source for such equipment or system, another power source (including its separate feeder) must be automatically provided or be manually selectable to maintain equipment or system operation.]

Amdt. 25-38, Eff. 2/1/77

49.3 Electrical Systems and Equipment

FAR 25.1351 : General.

- (a) *Electrical system capacity.* The required generating capacity, and number and kinds of power sources must—
- (1) Be determined by an electrical load analysis; and
 - (2) Meet the requirements of Sec. 25.1309.
- (b) *Generating system.* The generating system includes electrical power sources, main power busses, transmission cables, and associated control, regulation, and protective devices. It must be designed so that—
- (1) Power sources function properly when independent and when connected in combination;
 - (2) No failure or malfunction of any power source can create a hazard or impair the ability of remaining sources to supply essential loads;
 - (3) The system voltage and frequency (as applicable) at the terminals of all essential load equipment can be maintained within the limits for which the equipment is designed, during any probable operating condition; and
 - (4) System transients due to switching, fault clearing, or other causes do not make essential loads inoperative, and do not cause a smoke or fire hazard.
 - (5) There are means accessible, in flight, to appropriate crewmembers for the individual and collective disconnection of the electrical power sources from the system.
 - (6) There are means to indicate to appropriate crewmembers the generating system quantities essential for the safe operation of the system, such as the voltage and current supplied by each generator.
- (c) *External power.* If provisions are made for connecting external power to the airplane, and that external power can be electrically connected to equipment other than that used for engine starting, means must be provided to ensure that no external power supply having a reverse polarity, or a reverse phase sequence, can supply power to the airplane's electrical system.
- (d) *Operation without normal electrical power.* It must be shown by analysis, tests, or both, that the airplane can be operated safely in VFR conditions, for a period or not less than five minutes, with the normal electrical power (electrical power sources excluding the battery) inoperative, with critical type fuel (from the standpoint of flameout and restart capability), and with the airplane initially at the maximum certificated altitude. Parts of the electrical system may remain on if—
- (1) [A single malfunction, including a wire bundle or junction box fire, cannot result in loss of both the part turned off and the part turned on; and
 - (2) The parts turned on are electrically and mechanically isolated from the parts turned off.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.1353 : Electrical equipment and installations.

- (a) Electrical equipment, controls, and wiring must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other electrical unit or system essential to the safe operation.

- (i) $1.23 V_{SRO}$;
 - (ii) V_{MCL} established under Sec. 25.149(f) and
 - (iii) A speed that provides the maneuvering capability specified in Sec. 25.143(g).]
- (3) Changes in configuration, power or thrust, and speed, must be made in accordance with the established procedures for service operation.
- (4) The landing must be made without excessive vertical acceleration, tendency to bounce, nose over, ground loop, porpoise, or water loop.
- (5) The landings may not require exceptional piloting skill or alertness.
- (b) For landplanes and amphibians, the landing distance on land must be determined on a level, smooth, dry, hard-surfaced runway. In addition—
- (1) The pressures on the wheel braking systems may not exceed those specified by the brake manufacturer;
 - (2) The brakes may not be used so as to cause excessive wear of brakes or tires; and
 - (3) Means other than wheel brakes may be used if that means—
 - (i) Is safe and reliable;
 - (ii) Is used so that consistent results can be expected in service; and
 - (iii) Is such that exceptional skill is not required to control the airplane.
- (c) For seaplanes and amphibians, the landing distance on water must be determined on smooth water.
- (d) For skiplanes, the landing distance on snow must be determined on smooth, dry, snow.
- (e) The landing distance data must include correction factors for not more than 50 percent of the nominal wind components along the landing path opposite to the direction of landing, and not less than 150 percent of the nominal wind components along the landing path in the direction of landing.
- (f) If any device is used that depends on the operation of any engine, and if the landing distance would be noticeably increased when a landing is made with that engine inoperative, the landing distance must be determined with that engine inoperative unless the use of compensating means will result in a landing distance not more than that with each engine operating.

Amdt. 25-108, Eff. 12/26/2002

45.3 Controllability and Maneuverability

FAR 25.143 : General.

- (a) The airplane must be safely controllable and maneuverable during—
- (1) Takeoff;
 - (2) Climb;
 - (3) Level flight;
 - (4) Descent; and
 - (5) Landing.

- (b) It must be possible to make a smooth transition from one flight condition to any other flight condition without exceptional piloting skill, alertness, or strength, and without danger of exceeding the airplane limit-load factor under any probable operating conditions, including—

- (1) The sudden failure of the critical engine;
- (2) For airplanes with three or more engines, the sudden failure of the second critical engine when the airplane is in the en route, approach, or landing configuration and is trimmed with the critical engine inoperative; and
- (3) Configuration changes, including deployment or retraction of deceleration devices.

- (c) The following table prescribes, for conventional wheel type controls, the maximum control forces permitted during this testing required by paragraphs (a) and (b) of this section :

Force, in pounds, applied to the control wheel or rudder pedals	Pitch	Roll	Yaw
For short term application for pitch and roll control—two hands available for control	75	50	-
For short term application for pitch and roll control—one hand available for control	50	25	-
For short term application for yaw control	-	-	150
For long term application	10	5	20

- (d) Approved operating procedures or conventional operating practices must be followed when demonstrating compliance with the control force limitations for short term application that are prescribed in paragraph (c) of this section. The airplane must be in trim, or as near to being in trim as practical, in the immediately preceding steady flight condition. For the takeoff condition, the airplane must be trimmed according to the approved operating procedures.

- (e) When demonstrating compliance with the control force limitations for long term application that are prescribed in paragraph (c) of this section, the airplane must be in trim, or as near to being in trim as practical.

- (f) When maneuvering at a constant airspeed or Mach number (up to V_{FC}/M_{FC}), the stick forces and the gradient of the stick force versus maneuvering load factor must lie within satisfactory limits. The stick forces must not be so great as to make excessive demands on the pilot's strength when maneuvering the airplane, and must not be so low that the airplane can easily be overstressed inadvertently. Changes of gradient that occur with changes of load factor must not cause undue difficulty in maintaining control of the airplane, and local gradients must not be so low as to result in a danger of overcontrolling.

- (g) [The maneuvering capabilities in a constant speed coordinated turn at forward center of gravity, as specified in the following table, must be free of stall warning or other characteristics that might interfere with normal maneuvering :

FAR 25.1337 : Powerplant instruments.

- (a) [Instruments and instrument lines.

- (1) Each powerplant and auxiliary power unit instrument line must meet the requirements of Sec. 25.993 and 25.1183.

- (2) Each line carrying flammable fluids under pressure must—

- (i) Have restricting orifices or other safety devices at the source of pressure to prevent the escape of excessive fluid if the line fails; and
- (ii) Be installed and located so that the escape of fluids would not create a hazard.

- (3) Each powerplant and auxiliary power unit instrument that utilizes flammable fluids must be installed and located so that the escape of fluid would not create a hazard.]

- (b) *Fuel quantity indicator.* There must be means to indicate to the flight crewmembers, the quantity, in gallons or equivalent units, of usable fuel in each tank during flight. In addition—

- (1) Each fuel quantity indicator must be calibrated to read "zero" during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under Sec. 25.959;

- (2) Tanks with interconnected outlets and airspace may be treated as one tank and need not have separate indicators; and

- (3) Each exposed sight gauge, used as a fuel quantity indicator, must be protected against damage.

- (c) *Fuel flowmeter system.* If a fuel flowmeter system is installed, each metering component must have a means for bypassing the fuel supply if malfunction of that component severely restricts fuel flow.

- (d) *Oil quantity indicator.* There must be a stick gauge or equivalent means to indicate the quantity of oil in each tank. If an oil transfer or reserve oil supply system is installed, there must be a means to indicate to the flight crew, in flight, the quantity of oil in each tank.

- (e) *Turbopropeller blade position indicator.* Required turbopropeller blade position indicators must begin indicating before the blade moves more than eight degrees below the flight low pitch stop. The source of indication must directly sense the blade position.

- (f) *Fuel pressure indicator.* There must be means to measure fuel pressure, in each system supplying reciprocating engines, at a point downstream of any fuel pump except fuel injection pumps. In addition—

- (1) If necessary for the maintenance of proper fuel delivery pressure, there must be a connection to transmit the carburetor air intake static pressure to the proper pump relief valve connection; and

- (2) If a connection is required under subparagraph (1) of this paragraph, the gauge balance lines must be independently connected to the carburetor inlet pressure to avoid erroneous readings.

Amdt. 25-40, EFF. 5/2/77

FAR 25.1331 : Instruments using a power supply.

(a) For each instrument required by Sec. 25.1303(b) that uses a power supply, the following apply :

- (1) [Each instrument must have a visual means integral with the instrument, to indicate when power adequate to sustain proper instrument performance is not being supplied. The power must be measured at or near the point where it enters the instruments. For electric instruments, the power is considered to be adequate when the voltage is within approved limits.]
- (2) Each instrument must, in the event of the failure of one power source, be supplied by another power source. This may be accomplished automatically or by manual means.
- (3) If an instrument presenting navigation data receives information from sources external to that instrument and loss of that information would render the presented data unreliable, the instrument must incorporate a visual means to warn the crew when such loss of information occurs, that the presented data should not be relied upon.]
- (b) As used in this section, "instrument" includes devices that are physically contained in one unit, and devices that are composed of two or more physically separate units or components connected together (such as a remote indicating gyroscopic direction indicator that includes a magnetic sensing element, a gyroscopic unit, an amplifier, and an indicator connected together.)

Amdt. 25-41, Eff. 9/1/77

FAR 25.1333 : [Instrument systems.]

[For systems that operate the instruments required by Sec. 25.1303(b) which are located at each pilot's station—

- (a) Means must be provided to connect the required instruments at the first pilot's station to operating systems which are independent of the operating systems at other flight crew stations, or other equipment.
- (b) The equipment, systems, and installations must be designed so that one display of the information essential to the safety of flight which is provided by the instruments, including attitude, direction, airspeed, and altitude will remain available to the pilots, without additional crewmember action, after any single failure or combination of failures that is not shown to be extremely improbable; and
- (c) Additional instruments, systems, or equipment may not be connected to the operating systems for the required instruments, unless provisions are made to ensure the continued normal functioning of the required instruments in the event of any malfunction of the additional instruments, systems, or equipment which is not shown to be extremely improbable.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.1335 : [Flight director systems.]

[If a flight director system is installed, means must be provided to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.]

Amdt. 25-41, Eff. 9/1/77

Configuration	Speed	Maneuvering bank angle in a coordinated turn	Thrust power setting
Takeoff	V_2	30(deg)	Asymmetric WAT-Limited ¹ .
Takeoff	$^2 V_2 + XX$	40(deg)	All-engines-operating climb ³ .
En route	V_{FTO}	40(deg)	Asymmetric WAT-Limited ¹ .
Landing	V_{REF}	40(deg)	Symmetric for -3(deg) flight path angle.

¹ A combination of weight, altitude, and temperature (WAT) such that the thrust or power setting produces the minimum climb gradient specified in Sec. 25.121 for the flight condition.

² Airspeed approved for all-engines-operating initial climb.

³ That thrust or power setting which, in the event of failure of the critical engine, and without any crew action to adjust the thrust or power of the remaining engines, would result in the thrust or power specified for the takeoff condition at V_2 , or any lesser thrust or power setting that is used for all-engines-operating initial climb procedures.]

Amdt. 25-108, Eff. 12/26/2002

FAR 25.145 : Longitudinal control.

(a) [It must be possible, at any point between the trim speed prescribed in Sec. 25.103(b)(6) and stall identification (as defined in Sec. 25.201(d)), to pitch the nose downward so that the acceleration to this selected trim speed is prompt with—

(1) The airplane trimmed at the trim speed prescribed in Sec. 25.103(b)(6);]

(2) The landing gear extended;

(3) The wing flaps (i) retracted and (ii) extended; and

(4) Power (i) off and (ii) at maximum continuous power on the engines.

(b) With the landing gear extended, no change in trim control, or exertion of more than 50 pounds control force (representative of the maximum short-term force that can be applied readily by one hand) may be required for the following maneuvers :

(1) [With power off, flaps retracted, and the airplane trimmed at $1.3V_{SR1}$, extend the flaps as rapidly as possible while maintaining the airspeed at approximately 30 percent above the reference stall speed existing at each instant throughout the maneuver.]

(2) Repeat paragraph (b)(1) except initially extend the flaps and then retract them as rapidly as possible.

(3) Repeat paragraph (b)(2), except at the go-around power or thrust setting.

(4) [With power off, flaps retracted, and the airplane trimmed at $1.3V_{SR1}$, rapidly set go-around power or thrust while maintaining the same airspeed.]

(5) Repeat paragraph (b)(4) except with flaps extended.

(6) [With power off, flaps extended, and the airplane trimmed at $1.3V_{SR1}$, obtain and maintain airspeeds between V_{SW} and either $1.6V_{SR1}$ or V_{FE} whichever is lower.

- (c) It must be possible, without exceptional piloting skill, to prevent loss of altitude when complete retraction of the high-lift devices from any position is begun during steady, straight, level flight at $1.08V_{SR}$ for propeller powered airplanes, or $1.3V_{SR}$ for turbojet powered airplanes, with—
- (1) Simultaneous movement of the power or thrust controls to the go-around power or thrust setting ;
 - (2) The landing gear extended ; and
 - (3) The critical combinations of landing weights and altitudes.
- (d) If gated high-life device control positions are provided, paragraph (c) of this section applies to retractions of the high-lift devices from any position from the maximum landing position to the first gated position, between gated positions, and from the last gated position to the fully retracted position. The requirements of paragraph (c) of this section also apply to retractions from each approved landing position to the control position(s) associated with the high-lift device configuration(s) used to establish the go-around procedure(s) from that landing position. In addition, the first gated control position from the maximum landing position must correspond with a configuration of the high-lift devices used to establish a go-around procedure from a landing configuration. Each gated control position must require a separate and distinct motion of the control to pass through the gated position and must have features to prevent inadvertent movement of the control through the gated position. It must only be possible to make this separate and distinct motion once the control has reached the gated position.

Amdt. 25-108, Eff. 12/26/2002

FAR 25.147 : Directional and lateral control.

- (a) *Directional control ; general.* It must be possible, with the wings level, to yaw into the operative engine and to safely make a reasonably sudden change in heading of up to 15 degrees in the direction of the critical inoperative engine. This must be shown at $[1.3V_{SR}]$ for heading changes up to 15 degrees (except that the heading change at which the rudder pedal force is 150 pounds need not be exceeded), and with—
- (1) The critical engine inoperative and its propeller in the minimum drag position ;
 - (2) The power required for level flight at $[1.3V_{SR}]$, but not more than maximum continuous power ;
 - (3) The most unfavorable center of gravity ;
 - (4) Landing gear retracted ;
 - (5) Flaps in the approach position ; and
 - (6) Maximum landing weight.
- (b) *Directional control ; airplanes with four or more engines.* Airplanes with four or more engines must meet the requirements of paragraph (a) of this section except that—
- (1) The two critical engines must be inoperative with their propellers (if applicable) in the minimum drag position ;
 - (2) Reserved.
 - (3) The flaps must be in the most favorable climb position.

FAR 25.1326 : Pitot heat indication systems.

[If a flight instrument pitot heating system is installed, an indication system must be provided to indicate to the flight crew when that pitot heating system is not operating. The indication system must comply with the following requirements :

- (a) The indication provided must incorporate an amber light that is in clear view of a flight crewmember.
 - (b) The indication provided must be designed to alert the flight crew if either of the following conditions exist :
 - (1) The pitot heating system is switched "off".
 - (2) The pitot heating system is switched "on" and any pitot tube heating element is inoperative.]
- Amdt. 25-43, Eff. 4/12/78
- #### FAR 25.1327 : Magnetic direction indicator.
- (a) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the airplane's vibration or magnetic fields.
 - (b) The compensated installation may not have a deviation, in level flight, greater than 10 degrees on any heading.

FAR 25.1329 : Automatic pilot system.

- (a) Each automatic pilot system must be approved and must be designed so that the automatic pilot can be quickly and positively disengaged by the pilots to prevent it from interfering with their control of the airplane.
- (b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.
- (c) Each manually operated control for the system must be readily accessible to the pilots.
- (d) Quick release (emergency) controls must be on both control wheels, on the side of each wheel opposite the throttles.
- (e) Attitude controls must operate in the plane and sense of motion specified in Sec. 25.777 (b) and Sec. 25.779(a) for cockpit controls. The direction of motion must be plainly indicated on, or adjacent to, each control.
- (f) The system must be designed and adjusted so that, within the range of adjustment available to the human pilot, it cannot produce hazardous loads on the airplane, or create hazardous deviations in the flight path, under any condition of flight appropriate to its use either during normal operation, or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.
- (g) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation. Protection against adverse interaction of integrated components, resulting from a malfunction, is also required.
- (h) [If the automatic pilot system can be coupled to airborne navigation equipment, means must be provided to indicate to the flight crew the current mode of operation. Selector switch position is not acceptable as a means of indication.]

Amdt. 25-46, Eff. 12/1/78

pressure system and true ambient atmospheric static pressure is not changed when the airplane is exposed to the continuous and intermittent maximum icing conditions defined in Appendix C of this Part.

- (c) The design and installation of the static pressure system must be such that—
- (1) Positive drainage of moisture is provided; chafing of the tubing and excessive distortion or restriction at bends in the tubing is avoided; and the materials used are durable, suitable for the purpose intended, and protected against corrosion; and
 - (2) It is airtight except for the port into the atmosphere. A proof test must be conducted to demonstrate the integrity of the static pressure system in the following manner :
 - (i) Unpressurized airplanes. Evacuate the static pressure system to a pressure differential of approximately 1 inch of mercury or to a reading on the altimeter, 1,000 feet above the airplane elevation at the time of the test. Without additional pumping for a period of 1 minute, the loss of indicated altitude must not exceed 100 feet on the altimeter.
 - (ii) Pressurized airplanes. Evacuate the static pressure system until a pressure differential equivalent to the maximum cabin pressure differential for which the airplane is type certificated is achieved. Without additional pumping for a period of 1 minute, the loss of indicated altitude must not exceed 2 percent of the equivalent altitude of the maximum cabin differential pressure or 100 feet, whichever is greater.
 - (d) Each pressure altimeter must be approved and must be calibrated to indicate pressure altitude in a standard atmosphere, with a minimum practicable calibration error when the corresponding static pressures are applied.
 - (e) Each system must be designed and installed so that the error in indicated pressure altitude, at sea level, with a standard atmosphere, excluding instrument calibration error, does not result in an error of more than ± 30 feet per 100 knots speed for the appropriate configuration in the speed range between $[1.23 V_{SR}]$ with flaps extended and $[1.7 V_{SR}]$ with flaps retracted. However, the error need not be less than ± 30 feet.
 - (f) If an altimeter system is fitted with a device that provides corrections to the altimeter indication, the device must be designed and installed in such manner that it can be bypassed when it malfunctions, unless an alternate altimeter system is provided. Each correction device must be fitted with a means for indicating the occurrence of reasonably probable malfunctions, including power failure, to the flight crew. The indicating means must be effective for any cockpit lighting condition likely to occur.
 - (g) Except as provided in paragraph (h) of this section, if the static pressure system incorporates both a primary and an alternate static pressure source, the means for selecting one or the other source must be designed so that—
 - (1) When either source is selected, the other is blocked off; and
 - (2) Both sources cannot be blocked off simultaneously.
 - (h) For unpressurized airplanes, paragraph (g)(1) of this section does not apply if it can be demonstrated that the static pressure system calibration, when either static pressure source is selected, is not changed by the other static pressure source being open or blocked.

Amdt. 25-108, Eff. 12/26/2002

- (c) *Lateral control; general.* It must be possible to make 20° banked turns, with and against the inoperative engine, from steady flight at a speed equal to $[1.3 V_{SR}]$ with—

- (1) The critical engine inoperative and its propeller (if applicable) in the minimum drag position;
 - (2) The remaining engines at maximum continuous power;
 - (3) The most unfavorable center of gravity;
 - (4) Landing gear (i) retracted and (ii) extended;
 - (5) Flaps in the most favorable climb position; and
 - (6) Maximum takeoff weight.
- (d) *Lateral control; airplanes with four or more engines.* Airplanes with four or more engines must be able to make 20° banked turns, with and against the inoperative engines, from steady flight at a speed equal to $[1.3 V_{SR}]$, with maximum continuous power, and with the airplane in the configuration prescribed by paragraph (b) of this section.
- (e) *Lateral control; all engines operating.* With the engines operating, roll response must allow normal maneuvers (such as recovery from upsets produced by gusts and the initiation of evasive maneuvers). There must be enough excess lateral control in sidesteps (up to sidestep angles that might be required in normal operation), to allow a limited amount of maneuvering and to correct for gusts. Lateral control must be enough at any speed up to V_{FC}/M_{FC} to provide a peak roll rate necessary for safety, without excess control forces or travel.

Amdt. 25-108, Eff. 12/26/2002

FAR 25.149 : Minimum control speed.

- (a) In establishing the minimum control speeds required by this section, the method used to simulate critical engine failure must represent the most critical mode of powerplant failure with respect to controllability expected in service.
- (b) V_{MC} is the calibrated airspeed at which, when the critical engine is suddenly made inoperative, it is possible to maintain control of the airplane with that engine still inoperative and maintain straight flight with an angle of bank of not more than 5 degrees.
- (c) $[V_{MC} \text{ may not exceed } 1.13 V_{SR} \text{ with—}]$
- (1) Maximum available takeoff power or thrust on the engines;
 - (2) The most unfavorable center of gravity;
 - (3) The airplane trimmed for takeoff;
 - (4) The maximum sea level takeoff weight (or any lesser weight necessary to show V_{MC});
 - (5) The airplane in the most critical takeoff configuration existing along the flight path after the airplane becomes airborne, except with the landing gear retracted;
 - (6) The airplane airborne and the ground effect negligible; and
 - (7) If applicable, the propeller of the inoperative engine—
 - (i) Windmilling;

- (ii) In the most probable position for the specific design of the propeller control; or
 - (iii) Feathered, if the airplane has an automatic feathering device acceptable for showing compliance with the climb requirements of Sec. 25.121.
- (d) The rudder forces required to maintain control at V_{MC} may not exceed 150 pounds nor may it be necessary to reduce power or thrust of the operative engines. During recovery, the airplane may not assume any dangerous attitude or require exceptional piloting skill, alertness, or strength to prevent a heading change of more than 20 degrees.
- (e) V_{MCG} , the minimum control speed on the ground, is the calibrated airspeed during the takeoff run at which, when the critical engine is suddenly made inoperative, it is possible to maintain control of the airplane using the rudder control alone (without the use of nosewheel steering), as limited by 150 pounds of force, and the lateral control to the extent of keeping the wings level to enable the takeoff to be safely continued using normal piloting skill. In the determination of V_{MCG} , assuming that the path of the airplane accelerating with all engines operating is along the centerline of the runway, its path from the point at which the critical engine is made inoperative to the point at which recovery to a direction parallel to the centerline is completed may not deviate more than 30 feet laterally from the centerline at any point. V_{MCG} must be established with—
 - (1) The airplane in each takeoff configuration or, at the option of the applicant, in the most critical takeoff configuration;
 - (2) Maximum available takeoff power or thrust on the operating engines;
 - (3) The most unfavorable center of gravity;
 - (4) The airplane trimmed for takeoff; and
 - (5) The most unfavorable weight in the range of takeoff weights.
- (f) V_{MCTL} , the minimum control speed during approach and landing with all engines operating, is the calibrated airspeed at which, when the critical engine is suddenly made inoperative, it is possible to maintain control of the airplane with that engine still inoperative, and maintain straight flight with an angle of bank of not more than 5 degrees. V_{MCL} must be established with—
 - (1) The airplane in the most critical configuration (or, at the option of the applicant, each configuration) for approach and landing with all engines operating;
 - (2) The most unfavorable center of gravity;
 - (3) The airplane trimmed for approach with all engines operating;
 - (4) The most unfavorable weight, or, at the option of the applicant, as a function of weight;
 - (5) For propeller airplanes, the propeller of the inoperative engine in the position it achieves without pilot action, assuming the engine fails while at the power or thrust necessary to maintain a three degree approach path angle; and
 - (6) Go-around power or thrust setting on the operating engine(s).
- (g) For airplanes with three or more engines, V_{MCL-2} , the minimum control speed during approach and landing with one critical engine inoperative, is the calibrated airspeed at which, when a second critical engine is suddenly made inoperative, it is possible to maintain control of the airplane with both engines still inoperative, and maintain straight flight with an angle of bank of not more than 5 degrees. V_{MCL-2} must be established with—

FAR 25.1323 : Airspeed indicating system.

For each airspeed indicating system, the following apply :

- (a) Each airspeed indicating instrument must be approved and must be calibrated to indicate true airspeed (at sea level with a standard atmosphere) with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied.
- (b) Each system must be calibrated to determine the system error (that is, the relation between IAS and CAS) in flight and during the accelerated takeoff ground run. The ground run calibration must be determined—
 - (1) From 0.8 of the minimum value of V_1 to the maximum value of V_2 , considering the approved ranges of altitude and weight; and
 - (2) With the flaps and power settings corresponding to the values determined in the establishment of the takeoff path under Sec. 25.111 assuming that the critical engine fails at the minimum value of V_1 .
- (c) The airspeed error of the installation, excluding the airspeed indicator instrument calibration error, may not exceed three percent or five knots, whichever is greater, throughout the speed range, from—
 - (1) V_{MO} to $1.23 V_{SR1}$ with flaps retracted; and
 - (2) $1.23 V_{SR0}$ to V_{FE} with flaps in the landing position.
- (d) [From $1.23 V_{SR}$ to the speed at which stall warning begins, the IAS must change perceptibly with CAS and in the same sense, and at speeds below stall warning speed the IAS must not change in an incorrect sense.
- (e) From V_{MO} to $V_{MO} + \frac{2}{3}(V_{DF} - V_{MO})$, the IAS must change perceptibly with CAS and in the same sense, and at higher speeds up to V_{DF} the IAS must not change in an incorrect sense.
- (f) There must be no indication of airspeed that would cause undue difficulty to the pilot during the takeoff between the initiation of rotation and the achievement of a steady climbing condition.
- (g) The effects of airspeed indicating system lag may not introduce significant takeoff indicated airspeed bias, or significant errors in takeoff or accelerate-stop distances.
- (h) Each system must be arranged, so far as practicable, to prevent malfunction or serious error due to the entry of moisture, dirt, or other substances.
- (i) Each system must have a heated pitot tube or an equivalent means of preventing malfunction due to icing.
- (j) Where duplicate airspeed indicators are required, their respective pitot tubes must be far enough apart to avoid damage to both tubes in a collision with a bird.]
Amdt. 25-109, Eff. 1/13/2003

FAR 25.1325 : Static pressure systems.

- (a) Each instrument with static air case connections must be vented to the outside atmosphere through an appropriate piping system.
- (b) Each static port must be designed and located in such manner that the static pressure system performance is least affected by airflow variation, or by moisture or other foreign matter, and that the correlation between air pressure in the static

49.2 Instruments : Installation

FAR 25.1321 : Arrangement and visibility.

- (a) Each flight, navigation, and powerplant instrument for use by any pilot must be plainly visible to him from his station with the minimum practicable deviation from his normal position and line of vision when he is looking forward along the flight path.
- (b) The flight instruments required by Sec. 25.1303 must be grouped on the instrument panel and centered as nearly as practicable about the vertical plane of the pilot's forward vision. In addition—
 - (1) The instrument that most effectively indicates attitude must be on the panel in the top center position;
 - (2) The instrument that most effectively indicates airspeed must be adjacent to and directly to the left of the instrument in the top center position;
 - (3) The instrument that most effectively indicates altitude must be adjacent to and directly to the right of the instrument in the top center position.
 - (4) The instrument that most effectively indicates direction of flight must be adjacent to and directly below the instrument in the top center position.
- (c) Required powerplant instruments must be closely grouped on the instrument panel. In addition—
 - (1) The location of identical powerplant instruments for the engines must prevent confusion as to which engine each instrument relates; and
 - (2) Powerplant instruments vital to the safe operation of the airplane must be plainly visible to the appropriate crewmembers.
- (d) Instrument panel vibration may not damage or impair the accuracy of any instrument.
- (e) [If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.]

Amdt. 25-41, Eff. 9/1/77

FAR 25.1322 : [Warning, caution, and advisory lights.]

[If warning, caution, or advisory lights are installed in the cockpit, they must, unless otherwise approved by the Administrator, be—

- (a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action);
- (b) Amber, for caution lights (lights indicating the possible need for future corrective action);
- (c) Green for safe operation lights; and
- (d) Any other color, including white, for lights not described in paragraphs (a) through (c) of this section, provided the color differs sufficiently from the colors prescribed in paragraphs (a) through (c) of this section to avoid possible confusion.]

Amdt. 25-38, Eff. 2/1/77

- (1) The airplane in the most critical configuration (or, at the option of the applicant, each configuration) for approach and landing with one critical engine inoperative;
- (2) The most unfavorable center of gravity;
- (3) The airplane trimmed for approach with one critical engine inoperative;
- (4) The most unfavorable weight, or, at the option of the applicant, as a function of weight;
- (5) For propeller airplanes, the propeller of the more critical inoperative engine in the position it achieves without pilot action, assuming the engine fails while at the power or thrust necessary to maintain a three degree approach path angle, and the propeller of the other inoperative engine feathered;
- (6) The power or thrust on the operating engine(s) necessary to maintain an approach path angle of three degrees when one critical engine is inoperative; and
- (7) The power or thrust on the operating engine(s) rapidly changed, immediately after the second critical engine is made inoperative, from the power or thrust prescribed in paragraph (g)(6) of this section to—
 - (i) Minimum power or thrust; and
 - (ii) Go-around power or thrust setting.
- (h) In demonstrations of V_{MCL} and V_{MCL-2} —
 - (1) The rudder force may not exceed 150 pounds;
 - (2) The airplane may not exhibit hazardous flight characteristics or require exceptional piloting skill, alertness, or strength;
 - (3) Lateral control must be sufficient to roll the airplane, from an initial condition of steady straight flight, through an angle of 20 degrees in the direction necessary to initiate a turn away from the inoperative engine(s), in not more than 5 seconds; and
 - (4) For propeller airplanes, hazardous flight characteristics must not be exhibited due to any propeller position achieved when the engine fails or during any likely subsequent movements of the engine or propeller controls.

Amdt. 25-108, Eff. 12/26/2002

45.4 Trim

FAR 25.161 : Trim.

- (a) *General.* Each airplane must meet the trim requirements of this section after being trimmed, and without further pressure upon, or movement of, either the primary controls or their corresponding trim controls by the pilot or the automatic pilot.
- (b) *Lateral and directional trim.* The airplane must maintain lateral and directional trim with the most adverse lateral displacement of the center of gravity within the relevant operating limitations, during normally expected conditions of operation (including operation at any speed from $[1.3 V_{SR1}]$ to V_{MO}/M_{MO}).
- (c) *Longitudinal trim.* The airplane must maintain longitudinal trim during—

- (1) A climb with maximum continuous power at a speed not more than $[1.3 V_{Srl}]$, with the landing gear retracted, and the flaps (i) retracted and (ii) in the takeoff position;
 - (2) A glide with power off at a speed not more than $[1.3 V_{Srl}]$, with the landing gear extended, the wing flaps (i) retracted and (ii) extended, the most unfavorable center of gravity position approved for landing with the maximum landing weight, and with the most unfavorable center of gravity position approved for landing regardless of weight ; and
 - (3) Level flight at any speed from $[1.3 V_{Srl}]$ to V_{MO}/M_{MO} , with the landing gear and flaps retracted, and from $[1.3 V_{Srl}]$ to V_{LE} with the landing gear extended.
 - (4) *Longitudinal, directional, and lateral trim.* The airplane must maintain longitudinal, directional, and lateral trim (and for lateral trim, the angle of bank may not exceed five degrees) at $[1.3 V_{Srl}]$ during climbing flight with—
 - (1) The critical engine inoperative;
 - (2) The remaining engines at maximum continuous power ; and
 - (3) The landing gear and flaps retracted.
 - (e) *Airplanes with four or more engines.* Each airplane with four or more engines must maintain trim in rectilinear flight—
 - (1) At the climb speed, configuration, and power required by Sec. 25.123(a) for the purpose of establishing the rate of climb ;
 - (2) With the most unfavorable center of gravity position ; and
 - (3) At the weight at which the two-engine-inoperative climb is equal to at least $[0.013 V_{SRO}]$ at an altitude of 5,000 feet.
- Amdt. 25-108, Eff. 12/26/2002

45.5 Stability

FAR 25.171 : General.

The airplane must be longitudinally, directionally, and laterally stable in accordance with the provisions of Secs. 25.173 through 25.177. In addition, suitable stability [and control feel (static stability)] is required in any condition normally encountered in service, if flight tests show it is necessary for safe operation.

Amdt. 25-7, Eff. 11/14/65

FAR 25.173 : Static longitudinal stability.

[Under the conditions specified in Sec. 25.175, the characteristics of the elevator control forces (including friction) must be as follow :

- (a) A pull must be required to obtain and maintain speeds below the specified trim speed, and a push must be required to obtain and maintain speeds above the specified trim speed. This must be shown at any speed that can be obtained except speeds higher than the landing gear or wing flap operating limit speeds or V_{FC}/M_{FC} , whichever is appropriate, or lower than the minimum speed for steady unstalled flight.

- (4) Essential loads for which an alternate source of power is required by this chapter, after any failure or malfunction in any one power supply system, distribution system, or other utilization system.
- (f) [In determining compliance with paragraphs (e)(2) and (3) of this section, the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operation authorized. Loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airplanes with three or more engines.]
- (g) In showing compliance with paragraphs (a) and (b) of this section with regard to the electrical system and equipment design and installation, critical environmental conditions must be considered. For electrical generation, distribution, and utilization equipment required by or used in complying with this chapter, except equipment covered by Technical Standard Orders containing environmental test procedures, the ability to provide continuous, safe service under foreseeable environmental conditions may be shown by environmental tests, design analysis, or reference to previous comparable service experience on other aircraft.

Amdt. 25-41, Eff. 9/1/77

FAR 25.1316 : [System lightning protection.]

- (a) [For functions whose failure would contribute to or cause a condition that would prevent the continued safe flight and landing of the airplane, each electrical and electronic system that performs these functions must be designed and installed to ensure that the operation and operational capabilities of the systems to perform these functions are not adversely affected when the airplane is exposed to lightning.
- (b) For functions whose failure would contribute to or cause a condition that would reduce the capability of the airplane or the ability of the flightcrew to cope with adverse operating conditions, each electrical and electronic system that performs these functions must be designed and installed to ensure that these functions can be recovered in a timely manner after the airplane is exposed to lightning.
- (c) Compliance with the lightning protection criteria prescribed in paragraphs (a) and (b) of this section must be shown for exposure to a severe lightning environment. The applicant must design for and verify that aircraft electrical/electronic systems are protected against the effects of lightning by :
 - (1) Determining the lightning strike zones for the airplane ;
 - (2) Establishing the external lightning environment for the zones ;
 - (3) Establishing the internal environment ;
 - (4) Identifying all the electrical and electronic systems that are subject to the requirements of this section, and their locations on or within the airplane ;
 - (5) Establishing the susceptibility of the systems to the internal and external lightning environment ;
 - (6) Designing protection ; and
 - (7) Verifying that the protection is adequate.]

Amdt. 25-80, Eff. 5/31/94

- (d) Two systems for two-way radio communications, with controls for each accessible from each pilot station, designed and installed so that failure of one system will not preclude operation of the other system. The use of a common antenna system is acceptable if adequate reliability is shown.
- (e) Two systems for radio navigation, with controls for each accessible from each pilot station, designed and installed so that failure of one system will not preclude operation of the other system. The use of a common antenna system is acceptable if adequate reliability is shown.

Amdt. 25-72, Eff. 8/20/90

FAR 25.1309 : [Equipment, systems, and installations.]

- (a) The equipment, systems, and installations whose functioning is required by this subchapter, must be designed to ensure that they perform their intended functions under any foreseeable operating condition.
- (b) The airplane systems and associated components, considered separately and in relation to other systems, must be designed so that—
- (1) The occurrence of any failure condition which would prevent the continued safe flight and landing of the airplane is extremely improbable, and
 - (2) [The occurrence of any other failure condition which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions is improbable.
- (c) Warning information must be provided to alert the crew to unsafe system operating conditions, and to enable them to take appropriate corrective action. Systems, controls, and associated monitoring and warning means must be designed to minimize crew errors which could create additional hazards.
- (d) Compliance with the requirements of paragraph (b) of this section must be shown by analysis, and where necessary, by appropriate ground, flight, or simulator tests. The analysis must consider—

- (1) Possible modes of failure, including malfunctions and damage from external sources.
 - (2) The probability of multiple failures and undetected failures.
 - (3) The resulting effects on the airplane and occupants, considering the stage of flight and operating conditions, and
 - (4) The crew warning cues, corrective action required, and the capability of detecting faults.
- (e) Each installation whose functioning is required by this subchapter, and that requires a power supply, is an "essential load" on the power supply. The power sources and the system must be able to supply the following power loads in probable operating combinations and for probable durations :

- (1) Loads connected to the system with the system functioning normally.
- (2) Essential loads, after failure of any one prime mover, power converter, or energy storage device.
- (3) [Essential loads after failure of—
 - (i) Any one engine on two-engine airplanes; and
 - (ii) Any two engines on three-or-more engine airplanes.]

- (b) The airspeed must return to within 10 percent of the original trim speed for the climb, approach, and landing conditions specified in Sec. 25.175 (a), (c), and (d), and must return to within 7.5 percent of the original trim speed for the cruising condition specified in Sec. 25.175(b), when the control force is slowly released from any speed within the range specified in paragraph (a) of this section.

- (c) The average gradient of the stable slope of the stick force versus speed curve may not be less than 1 pound for each 6 knots.

- (d) Within the free return speed range specified in paragraph (b) of this section, it is permissible for the airplane, without control forces, to stabilize on speeds above or below the desired trim speeds if exceptional attention on the part of the pilot is not required to return to and maintain the desired trim speed and altitude.]

Amdt. 25-7, Eff. 11/14/65

FAR 25.175 : Demonstration of static longitudinal stability.

Static longitudinal stability must be shown as follows :

- (a) *Climb.* The stick force curve must have a stable slope at speeds between 85 and 115 percent of the speed at which the airplane—

- (1) Is trimmed, with—
 - (i) Wing flaps retracted;
 - (ii) Landing gear retracted;
 - (iii) Maximum takeoff weight; and
 - (iv) 75 percent of maximum continuous power for reciprocating engines or the maximum power or thrust selected by the applicant as an operating limitation for use during climb for turbine engines; and
- (2) Is trimmed at the speed for best rate-of-climb except that the speed need not be less than $[1.3 V_{SR}]$.

- (b) *Cruise.* Static longitudinal stability must be shown in the cruise condition as follows :

- (1) With the landing gear retracted at high speed, the stick force curve must have a stable slope at all speeds within a range which is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the trim speed (except that the speed range need not include speeds less than $[1.3 V_{SR}]$, nor speeds greater than V_{FC}/M_{FC} , nor speeds that require a stick force of more than 50 pounds), with—
 - (i) The wing flaps retracted;
 - (ii) The center of gravity in the most adverse position (see Sec. 25.27);
 - (iii) The most critical weight between the maximum takeoff and maximum landing weights;
 - (iv) 75 percent of maximum continuous power for reciprocating engines or, for turbine engines, the maximum cruising power selected by the applicant as an operating limitation (see Sec. 25.1521), except that the power need not exceed that required at V_{MO}/M_{MO} ; and
- (v) The airplane trimmed for level flight with the power required in paragraph (b)(1)(iv) above.

- (2) With the landing gear retracted at low speed, the stick force curve must have a stable slope at all speeds within a range which is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the trim speed (except that the speed range need not include speeds less than $[1.3 V_{SR1}]$, nor speeds greater than the minimum speed of the applicable speed range prescribed in paragraph (b)(1), nor speeds that require a stick force of more than 50 pounds), with—
 - (i) Wing flaps, center of gravity position, and weight as specified in paragraph (b)(1) of this section;
 - (ii) Power required for level flight at a speed equal to $[(\frac{V_{MO}-1.3 V_{SR1}}{2})]$ and
 - (iii) The airplane trimmed for level flight with the power required in paragraph (b)(2)(ii) of this section.
 - (3) With the landing gear extended, the stick force curve must have a stable slope at all speeds within a range which is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the trim speed (except that the speed range need not include speeds less than $[1.3 V_{SR1}]$, nor speeds greater than V_{LE} , nor speeds that require a stick force of more than 50 pounds), with—
 - (i) Wing flap, center of gravity position, and weight as specified in paragraph (b)(1) of this section;
 - (ii) 75 percent of maximum continuous power for reciprocating engines or, for turbine engines, the maximum cruising power selected by the applicant as an operating limitation, except that the power need not exceed that required for level flight at V_{LE} ; and
 - (iii) The aircraft trimmed for level flight with the power required in paragraph (b)(3)(ii) of this section.
 - (c) *Approach.* The stick force curve must have a stable slope at speeds between $[V_{SW}]$, and $[1.7 V_{SR1}]$, with—
 - (1) Wing flaps in the approach position;
 - (2) Landing gear retracted;
 - (3) Maximum landing weight; and
 - (4) The airplane trimmed at $[1.3 V_{SR1}]$, with enough power to maintain level flight at this speed.
 - (d) *Landing.* The stick force curve must have a stable slope, and the stick force may not exceed 80 pounds, at speeds between $[V_{SW}]$ and $[1.7 V_{SR0}]$ with—
 - (1) Wing flaps in the landing position;
 - (2) Landing gear extended;
 - (3) Maximum landing weight;
 - (4) Power or thrust off on the engines; and
 - (5) The airplane trimmed at $[1.3 V_{SR0}]$ with power or thrust off.
- Amdt. 25-108, Eff. 12/26/2002

- (4) A means to indicate, to the flight crew, the operation of each engine starter that can be operated continuously but that is neither designed for continuous operation nor designed to prevent hazard if it failed.
 - (5) An indicator to indicate the functioning of the powerplant ice protection system for each engine.
 - (6) An indicator for the fuel strainer or filter required by Sec. 25.997 to indicate the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with Sec. 25.997(d).
 - (7) A warning means for the oil strainer or filter required by Sec. 25.1019, if it has no bypass, to warn the pilot of the occurrence of contamination of the strainer or filter screen before it reaches the capacity established in accordance with Sec. 25.1019(a)(2).
 - (8) An indicator to indicate the proper functioning of any heater used to prevent ice clogging of fuel system components.
 - (d) *turbopropeller engine-powered airplanes.* In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required :
 - (1) An indicator to indicate thrust, or a parameter that is directly related to thrust, to the pilot. The indication must be based on the direct measurement of thrust or parameters that are directly related to thrust. The indicator must indicate a change in thrust resulting from any engine malfunction, damage, or deterioration.
 - (2) A position indicating means to indicate to the flight crew when the thrust reversing device is in the reverse thrust position, for each engine using a thrust reversing device.
 - (3) An indicator to indicate rotor system unbalance.
 - (e) *For turbopropeller-powered airplanes.* In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required :
 - (1) A torque indicator for each engine.
 - (2) Position indicating means to indicate to the flight crew when the propeller blade angle is below the flight low pitch position, for each propeller.
 - (3) [Removed.]
 - (f) For airplanes equipped with fluid systems (other than fuel) for thrust or power augmentation, an approved means must be provided to indicate the proper functioning of that system to the flight crew.
- Amdt. 25-72, Eff. 8/20/90
- FAR 25.1307 : Miscellaneous equipment.**
- The following is required miscellaneous equipment :
- (a) [[Reserved.]]
 - (b) Two or more independent sources of electrical energy.
 - (c) Electrical protective devices, as prescribed in this part.

FAR 25.1305 : Powerplant instruments.

The following are required powerplant instruments :

- (a) *For all airplanes.*
- (1) A fuel pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.
 - (2) A fuel quantity indicator for each fuel tank.
 - (3) An oil quantity indicator for each oil tank.
 - (4) An oil pressure indicator for each independent pressure oil system of each engine.
 - (5) An oil pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.
 - (6) An oil temperature indicator for each engine.
 - (7) Fire-warning indicators.
 - (8) An augmentation liquid quantity indicator (appropriate for the manner in which the liquid is to be used in operation) for each tank.
- (b) *For reciprocating engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required :
- (1) A carburetor air temperature indicator for each engine.
 - (2) A cylinder head temperature indicator for each air-cooled engine.
 - (3) A manifold pressure indicator for each engine.
 - (4) A fuel pressure indicator (to indicate the pressure at which the fuel is supplied) for each engine.
 - (5) A fuel flowmeter, or fuel mixture indicator, for each engine without an automatic altitude mixture control.
 - (6) A tachometer for each engine.
 - (7) A device that indicates, to the flight crew (during flight), any change in the power output, for each engine with—
 - (i) An automatic propeller feathering system, whose operation is initiated by a power output measuring system ; or
 - (ii) A total engine piston displacement of 2,000 cubic inches or more.
 - (8) A means to indicate to the pilot when the propeller is in reverse pitch, for each reversing propeller.
- (c) *For turbine engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required :
- (1) A gas temperature indicator for each engine.
 - (2) A fuel flowmeter indicator for each engine.
 - (3) A tachometer (to indicate the speed of the rotors with established limiting speeds) for each engine.

FAR 25.177 : Static lateral-directional stability.

- (a) [Reserved.]
- (b) [Reserved.]
- (c) In straight, steady sideslips, the aileron and rudder control movements and forces must be substantially proportional to the angle of sideslip in a stable sense ; and the factor of proportionality must lie between limits found necessary for safe operation throughout the range of sideslip angles appropriate to the operation of the airplane. At greater angles, up to the angle at which full rudder is used or a rudder force of 180 pounds is obtained, the rudder pedal forces may not reverse ; and increased rudder deflection must be needed for increased angles of sideslip. Compliance with this paragraph must be demonstrated for all landing gear and flap positions and symmetrical power conditions at speeds from $[1.13 V_{SR1}]$ to V_{FE} , V_{LE} , or V_{FC}/M_{FC} , as appropriate.
- (d) The rudder gradients must meet the requirements of paragraph (c) at speeds between V_{MO}/M_{AO} and V_{FC}/M_{FC} except that the dihedral effect (aileron deflection opposite the corresponding rudder input) may be negative provided the divergence is gradual, easily recognized, and easily controlled by the pilot.

Amdt. 25-108, Eff. 12/26/2002

FAR 25.181 : Dynamic stability.

- (a) Any short period oscillation, not including combined lateral-directional oscillations, occurring between $[1.13 V_{SR}]$ and maximum allowable speed appropriate to the configuration of the airplane must be heavily damped with the primary controls—
 - (1) Free ; and
 - (2) In a fixed position.
- (b) Any combined lateral-directional oscillations (“Dutch roll”) occurring between $[1.13 V_{SR}]$ and maximum allowable speed appropriate to the configuration of the airplane must be positively damped with controls free, and must be controllable with normal use of the primary controls without requiring exceptional pilot skill.

Amdt. 25-108, Eff. 12/26/2002

45.6 Stalls**FAR 25.201 : Stall demonstration.**

- (a) Stalls must be shown in straight flight and in 30 degree banked turns with—
 - (1) Power off ; and
 - (2) [The power necessary to maintain level flight at $1.5 V_{SR1}$ (where V_{SR1} corresponds to the reference stall at maximum landing weight with flaps in the approach position and the landing gear retracted).]
- (b) In each condition required by paragraph (a) of this section, it must be possible to meet the applicable requirements of Sec. 25.203 with—
 - (1) Flaps, landing gear, and deceleration devices in any likely combination of positions approved for operation ;
 - (2) Representative weights within the range for which certification is requested ;

- (3) The most adverse center of gravity for recovery; and
 - (4) [The airplane trimmed for straight flight at the speed prescribed in Sec. 25.103(b)(6).]
- (c) The following procedures must be used to show compliance with Sec. 25.203;
- (1) Starting at a speed sufficiently above the stalling speed to ensure that a steady rate of speed reduction can be established, apply the longitudinal control so that the speed reduction does not exceed one knot per second until the airplane is stalled.
 - (2) In addition, for turning flight stalls, apply the longitudinal control to achieve airspeed deceleration rates up to 3 knots per second.
 - (3) As soon as the airplane is stalled, recover by normal recovery techniques.
 - (d) The airplane is considered stalled when the behavior of the airplane gives the pilot a clear and distinctive indication of an acceptable nature that the airplane is stalled. Acceptable indications of a stall, occurring either individually or in combination, are—
 - (1) A nose-down pitch that cannot be readily arrested;
 - (2) Buffeting, of a magnitude and severity that is a strong and effective deterrent to further speed reduction; or
 - (3) The pitch control reaches the aft stop and no further increase in pitch attitude occurs when the control is held full aft for a short time before recovery is initiated.

Amdt. 25-108, Eff. 12/26/2002

FAR 25.203 : Stall characteristics.

- (a) It must be possible to produce and to correct roll and yaw by unreversed use of the aileron and rudder controls, up to the time the airplane is stalled. No abnormal nose-up pitching may occur. The longitudinal control force must be positive up to and throughout the stall. In addition, it must be possible to promptly prevent stalling and to recover from a stall by normal use of the controls.
- (b) For level wing stalls, the roll occurring between the stall and the completion of the recovery may not exceed approximately 20 degrees.
- (c) [For turning flight stalls, the action of the airplane after the stall may not be so violent or extreme as to make it difficult, with normal piloting skill, to effect a prompt recovery and to regain control of the airplane. The maximum bank angle that occurs during the recovery may not exceed—
 - (1) Approximately 60 degrees in the original direction of the turn, or 30 degrees in the opposite direction, for deceleration rates up to 1 knot per second; and
 - (2) Approximately 90 degrees in the original direction of the turn, or 60 degrees in the opposite direction, for deceleration rates in excess of 1 knot per second.]

Amdt. 25-84, Eff. 7/10/95

FAR 25.205 : [Removed.]

[Removed.]

Amdt. 25-72, Eff. 8/20/90

49.1 General

FAR 25.1301 : Function and installation.

- Each item of installed equipment must—
- (a) Be of a kind and design appropriate to its intended function;
 - (b) Be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors;
 - (c) Be installed according to limitations specified for that equipment; and
 - (d) Function properly when installed.

FAR 25.1303 : Flight and navigation instruments.

- (a) The following flight and navigation instruments must be installed so that the instrument is visible from each pilot station :
 - (1) A free air temperature indicator or an air-temperature indicator which provides indications that are convertible to free-air temperature.
 - (2) A clock displaying hours, minutes, and seconds with a sweep-second pointer or digital presentation.
 - (3) A direction indicator (nonstabilized magnetic compass).
- (b) The following flight and navigation instruments must be installed at each pilot station :
 - (1) An airspeed indicator. If airspeed limitations vary with altitude, the indicator must have a maximum allowable airspeed indicator showing the variation of V_{MO} with altitude.
 - (2) An altimeter (sensitive).
 - (3) A rate-of-climb indicator (vertical speed).
 - (4) A gyroscopic rate-of-turn indicator combined with an integral slip-skid indicator (turn-and-bank indicator) except that only a slip-skid indicator is required on large airplanes with a third attitude instrument system usable through flight attitudes of 360° of pitch and roll and installed in accordance with [Sec. 121.305(k)] of this title.
 - (5) A bank and pitch indicator (gyroscopically stabilized).
 - (6) A direction indicator (gyroscopically stabilized, magnetic or nonmagnetic).
- (c) The following flight and navigation instruments are required as prescribed in this paragraph :
 - (1) A speed warning device is required for turbine engine powered airplanes and for airplanes with V_{MO}/M_{MO} greater than $0.8 V_{FE}/M_{FE}$ or $0.8 V_D/M_D$. The speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots, whenever the speed exceeds V_{MO} , plus 6 knots or $M_{MO} + 0.01$. The upper limit of the production tolerance for the warning device may not exceed the prescribed warning speed.
 - (2) A machinometer is required at each pilot station for airplanes with compressibility limitations not otherwise indicated to the pilot by the airspeed indicating system required under paragraph (b)(1) of this section.

Amdt. 25-90, Eff. 3/12/97

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FAR 25.207 : Stall warning.

- (a) Stall warning with sufficient margin to prevent inadvertent stalling with the flaps and landing gear in any normal position must be clear and distinctive to the pilot in straight and turning flight.
- (b) [The warning must be furnished either through the inherent aerodynamic qualities of the airplane or by a device that will give clearly distinguishable indications under expected conditions of flight. However, a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself. If a warning device is used, it must provide a warning in each of the airplane configurations prescribed in paragraph (a) of this section at the speed prescribed in paragraphs (c) and (d) of this section.]
- (c) When the speed is reduced at rates not exceeding one knot per second, stall warning must begin, in each normal configuration, at a speed, V_{SW} , exceeding the speed at which the stall is identified in accordance with Sec. 25.201(d) by not less than five knots or five percent CAS, whichever is greater. Once initiated, stall warning must continue until the angle of attack is reduced to approximately that at which stall warning began.
- (d) In addition to the requirement of paragraph (c) of this section, when the speed is reduced at rates not exceeding one knot per second, in straight flight with engines idling and at the center-of-gravity position specified in Sec. 25.103(b)(5), V_{SW} , in each normal configuration, must exceed V_{SR} by not less than three knots or three percent CAS, whichever is greater.
- (e) The stall warning margin must be sufficient to allow the pilot to prevent stalling (as defined in Sec. 25.201(d)) when recovery is initiated not less than one second after the onset of stall warning in slow-down turns with at least 1.5g load factor normal to the flight path and airspeed deceleration rates of at least 2 knots per second, with the flaps and landing gear in any normal position, with the airplane trimmed for straight flight at a speed of 1.3 V_{SR} , and with the power or thrust necessary to maintain level flight at 1.3 V_{SR} .
- (f) Stall warning must also be provided in each abnormal configuration of the high lift devices that is likely to be used in flight following system failures (including all configurations covered by Airplane Flight Manual procedures).]

Amdt. 25-108, Eff. 12/26/2002

45.7 Ground and Water Handling Characteristics**FAR 25.231 : Longitudinal stability and control.**

- (a) Landplanes may have no uncontrollable tendency to nose over in any reasonably expected operating condition or when rebound occurs during landing or takeoff. In addition—
- (1) Wheel brakes must operate smoothly and may not cause any undue tendency to nose over; and
 - (2) If a tail-wheel landing gear is used, it must be possible, during the takeoff ground run on concrete, to maintain any [attitude up to thrust line level, at 75 percent of V_{SR1} .]

- (b) For seaplanes and amphibians, the most adverse water conditions safe for takeoff, taxiing, and landing, must be established.

Amdt. 25-108, Eff. 12/26/2002

FAR 25.233 : Directional stability and control.

- (a) There may be no uncontrollable ground-looping tendency in 90° cross winds, up to a wind velocity of 20 knots or $[0.2 V_{SRO}]$, whichever is greater, except that the wind velocity need not exceed 25 knots at any speed at which the airplane may be expected to be operated on the ground. This may be shown while establishing the 90° cross component of wind velocity required by Sec. 25.237.

- (b) Landplanes must be satisfactorily controllable, without exceptional piloting skill or alertness, in power-off landings at normal landing speed, without using brakes or engine power to maintain a straight path. This may be shown during power-off landings made in conjunction with other tests.

- (c) The airplane must have adequate directional control during taxiing. This may be shown during taxiing prior to takeoffs made in conjunction with other tests.

Amdt. 25-108, Eff. 12/26/2002

FAR 25.235 : Taxiing condition.

The shock absorbing mechanism may not damage the structure of the airplane when the airplane is taxed on the roughest ground that may reasonably be expected in normal operation.

FAR 25.237 : Wind velocities.

- (a) For landplanes and amphibians, a 90-degree cross component of wind velocity, demonstrated to be safe for takeoff and landing, must be established for dry runways and must be at least 20 knots or $[0.2 V_{SRO}]$, whichever is greater, except that it need not exceed 25 knots.

- (b) For seaplanes and amphibians, the following applies :

- (1) A 90-degree cross component of wind velocity, up to which takeoff and landing is safe under all water conditions that may reasonably be expected in normal operation, must be established and must be at least 20 knots or $[0.2 V_{SRO}]$, whichever is greater, except that it need not exceed 25 knots.

- (2) A wind velocity, for which taxiing is safe in any direction under all water conditions that may reasonably be expected in normal operation, must be established and must be at least 20 knots or $[0.2 V_{SRO}]$, whichever is greater, except that it need not exceed 25 knots.

Amdt. 25-108, Eff. 12/26/2002

FAR 25.239 : Spray characteristics, control, and stability on water.

- (a) For seaplanes and amphibians, during takeoff, taxiing, and landing, and in the conditions set forth in paragraph (b) of this section, there may be no—

- (1) Spray characteristics that would impair the pilot's view, cause damage, or result in the taking in of an undue quantity of water;

Chapitre 49

Subpart F : Equipment

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(f) No fire or overheat detector system component for any fire zone may pass through another fire zone, unless—

- (1) It is protected against the possibility of false warnings resulting from fires in zones through which it passes; or
- (2) Each zone involved is simultaneously protected by the same detector and extinguishing system.

(g) [Each fire detector system must be constructed so that when it is in the configuration for installation it will not exceed the alarm activation time approved for the detectors using the response time criteria specified in the appropriate Technical Standard Order for the detector;]

Amdt. 25-26, Eff. 4/23/71

FAR 25.1205 : [Revoked.]

[Revoked.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.1207 : Compliance.

[Unless otherwise specified, compliance with the requirements of Secs 25.1181 through 25.1203 must be shown by a full scale fire test or by one or more of the following methods :

- (a) Tests of similar powerplant configurations;
- (b) Tests of components;
- (c) Service experience of aircraft with similar powerplant configurations;
- (d) Analysis.]

Amdt. 25-46, Eff. 12/1/78

- (2) Dangerously uncontrollable porpoising, bounding, or swinging tendency; or
- (3) Immersion of auxiliary floats or sponsons, wing tips, propeller blades, or other parts not designed to withstand the resulting water loads.

(b) Compliance with the requirements of paragraph (a) of this section must be shown—

- (1) In water conditions, from smooth to the most adverse condition established in accordance with Sec. 25.231;
- (2) In wind and cross-wind velocities, water currents, and associated waves and swells that may reasonably be expected in operation on water;
- (3) At speeds that may reasonably be expected in operation on water;
- (4) With sudden failure of the critical engine at any time while on water; and
- (5) At each weight and center of gravity position, relevant to each operating condition, within the range of loading conditions for which certification is requested.

(c) In the water conditions of paragraph (b) of this section, and in the corresponding wind conditions, the seaplane or amphibian must be able to drift for five minutes with engines inoperative, aided, if necessary, by a sea anchor.

45.8 Miscellaneous Flight Requirements

FAR 25.251 : Vibration and buffeting.

- (a) [The airplane must be demonstrated in flight to be free from any vibration and buffeting that would prevent continued safe flight in any likely operating condition.
- (b) Each part of the airplane must be demonstrated in flight to be free from excessive vibration under any appropriate speed and power conditions up to V_{DF}/M_{DF} . The maximum speeds shown must be used in establishing the operating limitations of the airplane in accordance with Sec. 25.1505.]
- (c) Except as provided in paragraph (d) of this section, there may be no buffeting condition, in normal flight, including configuration changes during cruise, severe enough to interfere with the control of the airplane, to cause excessive fatigue to the crew, or to cause structural damage. Stall warning buffeting within these limits is allowable.
- (d) There may be no perceptible buffeting condition in the cruise configuration in straight flight at any speed up to V_{MO}/M_{MO} , except that stall warning buffeting is allowable.
- (e) For an airplane with M_D greater than 0.6 or with a maximum operating altitude greater than 25,000 feet, the positive maneuvering load factors at which the onset of perceptible buffeting occurs must be determined with the airplane in the cruise configuration for the ranges of airspeed or Mach number, weight, and altitude for which the airplane is to be certificated. The envelopes of load factor, speed, altitude, and weight must provide a sufficient range of speeds and load factors for normal operations. Probable inadvertent excursions beyond the boundaries of the buffet onset envelopes may not result in unsafe conditions.

Amdt. 25-77, Eff. 7/29/92

FAR 25.253 : High-speed characteristics.

- (a) Speed increase and recovery characteristics. The following speed increase and recovery characteristics must be met :
- (1) Operating conditions and characteristics likely to cause inadvertent speed increases (including upsets in pitch and roll) must be simulated with the airplane trimmed at any likely cruise speed up to V_{MO}/M_{MO} . These conditions and characteristics include gust upsets, inadvertent control movements, low stick force gradient in relation to control friction, passenger movement, leveling off from climb, and descent from Mach to airspeed limit altitudes.
 - (2) Allowing for pilot reaction time after effective inherent or artificial speed warning occurs, it must be shown that the airplane can be recovered to a normal altitude and its speed reduced to V_{MO}/M_{MO} , without –
 - (i) Exceptional piloting strength or skill ;
 - (ii) Exceeding V_D/M_D , V_{DF}/M_{DF} , or the structural limitations ; and
 - (iii) Buffering that would impair the pilot's ability to read the instruments or control the airplane for recovery.
 - (3) With the airplane trimmed at any speed up to V_{MO}/M_{MO} , there must be no reversal of the response to control input about any axis at any speed up to V_{DF}/M_{DF} . Any tendency to pitch, roll, or yaw must be mild and readily controllable, using normal piloting techniques. When the airplane is trimmed at V_{MO}/M_{MO} , the slope of the elevator control force versus speed curve need not be stable at speeds greater than V_{FC}/M_{FC} , but there must be a push force at all speeds up to V_{DF}/M_{DF} and there must be no sudden or excessive reduction of elevator control force as V_{DF}/M_{DF} is reached.
 - (b) Maximum speed for stability characteristics. V_{FC}/M_{FC} , V_{FC}/M_{FC} is the maximum speed at which the requirements of Secs. [25.143(f)], 25.147(e), 25.175(b)(1), 25.177, and 25.181 must be met with flaps and landing gear retracted. It may not be less than a speed midway between V_{MO}/M_{MO} and V_{DF}/M_{DF} , except that, for altitudes where Mach number is the limiting factor, M_{FC} need not exceed the Mach number at which effective speed warning occurs.
- Amdt. 25-84, Eff. 7/10/95
- FAR 25.255 : [Out-of-trim characteristics.]**
- (a) [From an initial condition with the airplane trimmed at cruise speeds up to V_{MO}/M_{MO} , the airplane must have satisfactory maneuvering stability and controllability with the degree of out-of-trim in both the airplane nose-up and nose-down directions, which results from the greater of–
 - (1) A three-second movement of the longitudinal trim system at its normal rate for the particular flight condition with no aerodynamic load (or an equivalent degree of trim for airplanes that do not have a power-operated trim system), except as limited by stops in the trim system, including those required by Sec. 25.655(b) for adjustable stabilizers; or
 - (2) The maximum mistrim that can be sustained by the autopilot while maintaining level flight in the high speed cruising condition.

FAR 25.1199 : Extinguishing agent containers.

- (a) Each extinguishing agent container must have a pressure relief to prevent bursting of the container by excessive internal pressures.
 - (b) [The discharge end of each discharge line from a pressure relief connection must be located so that discharge of the fire extinguishing agent would not damage the airplane. The line must also be located or protected to prevent clogging caused by ice or other foreign matter.
 - (c) There must be a means for each fire extinguishing agent container to indicate that the container has discharged or that the charging pressure is below the established minimum necessary for proper functioning.]
 - (d) The temperature of each container must be maintained, under intended operating conditions, to prevent the pressure in the container from–
 - (1) Falling below that necessary to provide an adequate rate of discharge; or
 - (2) Rising high enough to cause premature discharge.
 - (e) If a pyrotechnic capsule is used to discharge the extinguishing agent, each container must be installed so that the temperature conditions will not cause hazardous deterioration of the pyrotechnic capsule.
- Amdt. 25-40, Eff. 5/2/77
- FAR 25.1201 : Fire extinguishing system materials.**
- (a) No material in any fire extinguishing system may react chemically with any extinguishing agent so as to create a hazard.
 - (b) Each system component in an engine compartment must be fireproof.
- FAR 25.1203 : Fire-detector system.**
- (a) There must be approved, quick acting fire or overheat detectors in each designated fire zone, and in the combustion, turbine, and tailpipe sections of turbine engine installations, in numbers and locations ensuring prompt detection of fire in those zones.
 - (b) [Each fire detector system must be constructed and installed so that–
 - (1) It will withstand the vibration, inertia, and other loads to which it may be subjected in operation;
 - (2) There is a means to warn the crew in the event that the sensor or associated wiring within a designated fire zone is severed at one point, unless the system continues to function as a satisfactory detection system after the severing; and
 - (3) There is a means to warn the crew in the event of a short circuit in the sensor or associated wiring within a designated fire zone, unless the system continues to function as a satisfactory detection system after the short circuit.]
 - (c) No fire or overheat detector may be affected by any oil, water, other fluids, or fumes that might be present.
 - (d) There must be means to allow the crew to check, in flight, the functioning of each fire or overheat detector electric circuit.
 - (e) Wiring and other components of each fire or overheat detector system in a fire zone must be at least fire-resistant.

- (c) Each airplane must—
- (1) Be designed and constructed so that no fire originating in any fire zone can enter, either through openings or by burning through external skin, any other zone or region where it would create additional hazards ;
 - (2) Meet subparagraph (1) of this paragraph with the landing gear retracted (if applicable) ; and
 - (3) Have fireproof skin in areas subject to flame if a fire starts in the engine power or accessory sections.

FAR 25.1195 : Fire extinguishing systems.

- (a) Except for combustor, turbine, and tail pipe sections of turbine engine installations that contain lines or components carrying flammable fluids or gases for which it is shown that a fire originating in these sections can be controlled, there must be a fire extinguisher system serving each designated fire zone.
- (b) [The fire extinguishing system, the quantity of the extinguishing agent, the rate of discharge, and the discharge distribution must be adequate to extinguish fires. It must be shown by either actual or simulated flight tests that under critical airflow conditions in flight the discharge of the extinguishing agent in each designated fire zone specified in paragraph (a) of this section will provide an agent concentration capable of extinguishing fires in that zone and of minimizing the probability of reignition. An individual "one-shot" system may be used for auxiliary power units, fuel burning heaters, and other combustion equipment. For each other designated fire zone, two discharges must be provided each of which produces adequate agent concentration.]
- (c) The fire-extinguishing system for a nacelle must be able to simultaneously protect each zone of the nacelle for which protection is provided.
- Amdt. 25-46, Eff. 12/1/78

FAR 25.1197 : Fire extinguishing agents.

- (a) Fire extinguishing agents must—
- (1) Be capable of extinguishing flame emanating from any burning of fluids or other combustible materials in the area protected by the fire extinguishing system ; and
 - (2) Have thermal stability over the temperature range likely to be experienced in the compartment in which they are stored.
- (b) If [any] toxic extinguishing agent is used, provisions must be made to prevent harmful concentrations of fluid of fluid vapors (from leakage during normal operation of the airplane or as a result of discharging the fire extinguisher on the ground or in flight) from entering any personnel compartment, even though a defect may exist in the extinguishing system. This must be shown by test except for built-in carbon dioxide fuselage compartment fire extinguishing systems for which—
- (1) Five pounds or less of carbon dioxide will be discharged, under established fire control procedures, into any fuselage compartment ; or
 - (2) There is protective breathing equipment for each flight crewmember on flight deck duty.

- (c) [[Deleted]]

Amdt. 25-40, Eff. 5/2/77

- (b) In the out-of-trim condition specified in paragraph (a) of this section, when the normal acceleration is varied from +1g to the positive and negative values specified in paragraph (c) of this section—

- (1) The stick force vs. g curve must have a positive slope at any speed up to and including V_{FC}/M_{FC} ; and
- (2) At speeds between V_{FC}/M_{FC} and V_{DF}/M_{DF} the direction of the primary longitudinal control force may not reverse.

- (c) Except as provided in paragraphs (d) and (e) of this section, compliance with the provisions of paragraph (a) of this section must be demonstrated in flight over the acceleration range—

- (1) -1g to +2.5g; or
- (2) 0 g to 2.0 g, and extrapolating by an acceptable method to -1g and +2.5g

- (d) If the procedure set forth in paragraph (c)(2) of this section is used to demonstrate compliance and marginal conditions exist during flight test with regard to reversal of primary longitudinal control force, flight tests must be accomplished from the normal acceleration at which a marginal condition is found to exist to the applicable limit specified in paragraph (b)(1) of this section.

- (e) During flight tests required by paragraph (a) of this section, the limit maneuvering load factors prescribed in Secs. 25.333(b) and 25.337, and the maneuvering load factors associated with probable inadvertent excursions beyond the boundaries of the buffet onset envelopes determined under Sec. 25.251(e), need not be exceeded. In addition, the entry speeds for flight test demonstrations at normal acceleration values less than 1 g must be limited to the extent necessary to accomplish a recovery, without exceeding V_{DF}/M_{DF} .

- (f) In the out-of-trim condition specified in paragraph (a) of this section, it must be possible from an overspeed condition at V_{DF}/M_{DF} to produce at least 1.5 for recovery by applying not more than 125 pounds of longitudinal control force using either the primary longitudinal control alone or the primary longitudinal control and the longitudinal trim system. If the longitudinal trim is used to assist in producing the required load factor, it must be shown at V_{DF}/M_{DF} that the longitudinal trim can be actuated in the airplane nose-up direction with primary surface loaded to correspond to the least of the following airplane nose-up control forces :

- (1) The maximum control forces expected in service as specified in Secs. 25.301 and 25.397.
- (2) The control force required to produce 1.5g.
- (3) The control force corresponding to buffeting or other phenomena of such intensity that it is a strong deterrent to further application of primary longitudinal control force.]

Amdt. 25-42, Eff. 3/1/78

- (d) Each flammable fluid shutoff means and control must be fireproof or must be located and protected so that any fire in a fire zone will not affect its operation.
 - (e) No hazardous quantity of flammable fluid may drain into any designated fire zone after shutoff.
 - (f) There must be means to guard against inadvertent operation of the shutoff means and to make it possible for the crew to reopen the shutoff means in flight after it has been closed.
 - (g) Each tank-to-engine shutoff valve must be located so that the operation of the valve will not be affected by powerplant or engine mount structural failure.
 - (h) Each shutoff valve must have a means to relieve excessive pressure accumulation unless a means for pressure relief is otherwise provided in the system.
- Amdt. 25-57, EFF. 3/26/84

FAR 25.1191 : Firewalls.

- (a) Each engine, auxiliary power unit, fuel-burning heater, other combustion equipment intended for operation in flight, and the combustion, turbine, and tailpipe sections of turbine engines, must be isolated from the rest of the airplane by firewalls, shrouds, or equivalent means.
- (b) Each firewall and shroud must be—
 - (1) Fireproof;
 - (2) Constructed so that no hazardous quantity of air, fluid, or flame can pass from the compartment to other parts of the airplane;
 - (3) Constructed so that each opening is sealed with close fitting fireproof grommets, bushings, or firewall fittings; and
 - (4) Protected against corrosion.

FAR 25.1192 : [Engine accessory section diaphragm.]

[For reciprocating engines, the engine power section and all portions of the exhaust system must be isolated from the engine accessory compartment by a diaphragm that complies with the firewall requirements of Sec. 25.1191.]

Amdt. 25-23, EFF. 5/8/70

FAR 25.1193 : Cowling and nacelle skin.

- (a) Each cowling must be constructed and supported so that it can resist any vibration, inertia, and air load to which it may be subjected in operation.
- (b) Cowling must meet the drainage and ventilation requirements of Sec. 25.1187.
- (c) On airplanes with a diaphragm isolating the engine power section from the engine accessory section, each part of the accessory section cowling subject to flame in case of fire in the engine power section of the powerplant must—
 - (1) Be fireproof; and
 - (2) Meet the requirements of Sec. 25.1191.
- (d) Each part of the cowling subject to high temperatures due to its nearness to exhaust system parts or exhaust gas impingement must be fireproof.

FAR 25.1185 : Flammable fluids.

- (a) Except for the integral oil sumps specified in [Sec. 25.1183(a)], no tank or reservoir that is a part of a system containing flammable fluids or gases may be in a designated fire zone unless the fluid contained, the design of the system, the materials used in the tank, the shut-off means, and all connections, lines, and control provide a degree of safety equal to that which would exist if the tank or reservoir were outside such a zone.
- (b) There must be at least one-half inch of clear airspace between each tank or reservoir and each firewall or shroud isolating a designated fire zone.
- (c) Absorbent materials close to flammable fluid system components that might leak must be covered or treated to prevent the absorption of hazardous quantities of fluids.

Amdt. 25-94, Eff. 3/25/98

FAR 25.1187 : Drainage and ventilation of fire zones.

- (a) There must be complete drainage of each part of each designated fire zone to minimize the hazards resulting from failure or malfunctioning of any component containing flammable fluids. The drainage means must be—
- (1) Effective under conditions expected to prevail when drainage is needed; and
- (2) Arranged so that no discharged fluid will cause an additional fire hazard.
- (b) Each designated fire zone must be ventilated to prevent the accumulation of flammable vapors.
- (c) No ventilation opening may be where it would allow the entry of flammable fluids, vapors, or flame from other zones.
- (d) Each ventilation means must be arranged so that no discharged vapors will cause an additional fire hazard.
- (e) Unless the extinguishing agent capacity and rate of discharge are based on maximum air flow through a zone, there must be means to allow the crew to shut off sources of forced ventilation to any fire zone except the engine power section of the nacelle and the combustion heater ventilating air ducts.

FAR 25.1189 : Shutoff means.

- (a) Each engine [installation] and each fire zone specified in Sec. 25.1181(a)(4) and (5) must have a means to shut off or otherwise prevent hazardous quantities of fuel, oil, deicer, and other flammable fluids, from flowing into, within, or through any designated fire zone, except that shutoff means are not required for—
- (1) [Lines, fittings, and components forming an integral part of an engine; and
- (2) Oil systems for turbine engine installations in which all components of the system in a designated fire zone, including the oil tanks, are fireproof or located in areas not subject to engine fire conditions.]
- (b) The closing of any fuel shutoff valve for any engine may not make fuel unavailable to the remaining engines.
- (c) Operation of any shutoff may not interfere with the later emergency operation of other equipment, such as the means for feathering the propeller.

Chapitre 46

Subpart C : Structure

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- (5) Any fuel-burning heater and other combustion equipment installation described in Sec. 25.859;
 - (6) The compressor and accessory sections of turbine engines; and
 - (7) Combustor, turbine, and tailpipe sections of turbine engine installations that contain lines or components carrying flammable fluids or gases.
- (b) [Each designated fire zone must meet the requirements of Secs. 25.867, and 25.1185 through 25.1203.]
- Amdt. 25-72, EFF. 8/20/90

FAR 25.1182 : [Nacelle areas behind firewalls, and engine pod attaching structures containing flammable fluid lines].

- (a) [Each nacelle area immediately behind the firewall, and each portion of any engine pod attaching structure containing flammable fluid lines, must meet each requirement of Secs. 25.1103(b), 25.1165 (d) and (e), 25.1183, 25.1185(c), 25.1187, 25.1189, and 25.1195 through 25.1203, including those concerning designated fire zones. However, engine pod attaching structures need not contain fire detection or extinguishing means.
 - (b) For each area covered by paragraph (a) of this section that contains a retractable landing gear, compliance with that paragraph need only be shown with the landing gear retracted.]
- Amdt. 25-11, EFF. 6/4/67

FAR 25.1183 : Flammable fluid-carrying components.

- (a) Except as provided in paragraph (b) of this section, each line, fitting, and other component carrying flammable fluid in any area subject to engine fire conditions, and each component which conveys or contains flammable fluid in a designated fire zone must be fire resistant, except that flammable fluid tanks and supports in a designated fire zone 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. Components must be shielded or located to safeguard against the ignition of leaking flammable fluid. An integral oil sump of less than 25-gal capacity on a reciprocating engine need not be fireproof nor be enclosed by a fireproof shield.
- (b) Paragraph (a) of this section does not apply to—
 - (1) Lines, fittings, and components which are already approved as part of a type certificated engine; and
 - (2) Vent and drain lines, and their fittings, whose failure will not result in, or add to, a fire hazard.
- (c) [All components, including ducts, within a designated fire zone must be fireproof if, when exposed to or damaged by fire, they could—
 - (1) Result in fire spreading to other regions of the airplane; or
 - (2) Cause unintentional operation of, or inability to operate, essential services or equipment.]

Amdt. 25-101, EFF. 1/18/2001

(c) The design of the engine ignition system must account for—

- (1) The condition of an inoperative generator ;
- (2) The condition of a completely depleted battery with the generator running at its normal operating speed ; and
- (3) The condition of a completely depleted battery with the generator operating at idling speed, if there is only one battery.
- (d) Magneto ground wiring (for separate ignition circuits) that lies on the engine side of the fire wall, must be installed, located, or protected, to minimize the probability of simultaneous failure of two or more wires as a result of mechanical damage, electrical faults, or other cause.
- (e) No ground wire for any engine may be routed through a fire zone of another engine unless each part of that wire within that zone is fireproof.
- (f) Each ignition system must be independent of any electrical circuit, not used for assisting, controlling, or analyzing the operation of that system.
- (g) There must be means to warn appropriate flight crewmembers if the malfunctioning of any part of the electrical system is causing the continuous discharge of any battery necessary for engine ignition.
- (h) [Each engine ignition system of a turbine powered airplane must be considered an essential electrical load.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.1167 : [Accessory gearboxes.]

[For airplanes equipped with an accessory gearbox that is not certificated as part of an engine—

- (a) The engine with gearbox and connecting transmissions and shafts attached must be subjected to the tests specified in Secs. 33.49 or 33.87 of this chapter as applicable ;
- (b) The accessory gearbox must meet the requirements of Secs. 33.25 and 33.53 or 33.91 of this chapter, as applicable ; and
- (c) Possible misalignments and torsional loadings of the gearbox, transmission, and shaft system, expected to result under normal operating conditions must be evaluated.]

Amdt. 25-38, Eff. 2/1/77

48.9 Powerplant Fire Protection

FAR 25.1181 : Designated fire zones : regions included.

(a) Designated fire zones are—

- (1) The engine power section ;
- (2) The engine accessory section ;
- (3) Except for reciprocating engines, any complete powerplant compartment in which no isolation is provided between the engine power section and the engine accessory section ;
- (4) Any auxiliary power unit compartment ;

46.1 General

FAR 25.301 : Loads.

- (a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.
- (b) Unless otherwise provided, the specified air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the airplane. These loads must be distributed to conservatively approximate or closely represent actual conditions. [Methods used to determine load intensities and distribution must be validated by flight load measurement unless the methods used for determining those loading conditions are shown to be reliable.]
- (c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

Amdt. 25-23, Eff. 5/8/70

FAR 25.303 : Factor of safety.

[Unless otherwise specified, a factor of safety of 1.5 must be applied to the prescribed limit load which are considered external loads on the structure. When a loading condition is prescribed in terms of ultimate loads, a factor of safety need not be applied unless otherwise specified.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.305 : Strength and deformation.

- (a) The structure must be able to support limit loads without any detrimental permanent deformation. At any load up to limit loads the deformation may not interfere with safe operation.
- (b) The structure must be able to support ultimate loads without failure for at least 3 seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the 3-second limit does not apply. Static tests conducted to ultimate load must include the ultimate deflections and ultimate deformation induced by the loading. When analytical methods are used to show compliance with the ultimate load strength requirements, it must be shown that—
 - (1) The effects of deformation are not significant ;
 - (2) The deformations involved are fully accounted for in the analysis ; or
 - (3) The methods and assumptions used are sufficient to cover the effects of these deformations.
- (c) Where structural flexibility is such that any rate of load application likely to occur in the operating conditions might produce transient stresses appreciably higher than those corresponding to static loads, the effects of this rate of application must be considered.
- (d) [Reserved.]
- (e) The airplane must be designed to withstand any vibration and buffeting that might occur in any likely operating condition up to V_D/M_D , including stall and probable inadvertent excursions beyond the boundaries of the buffet onset envelope.

This must be shown by analysis, flight tests, or other tests found necessary by the Administrator.

- (f) Unless shown to be extremely improbable, the airplane must be designed to withstand any forced structural vibration resulting from any failure, malfunction or adverse condition in the flight control system. These must be considered limit loads and must be investigated at airspeeds up to V_C/M_C .

Amdt. 25-86, Eff. 3/11/96

FAR 25.307 : Proof of structure.

- (a) Compliance with the strength and deformation requirements of this subpart must be shown for each critical loading condition. Structural analysis may be used only if the structure conforms to those for which experience has shown this method to be reliable. The Administrator may require ultimate load tests in cases where limit load tests may be inadequate.
- (b) [Reserved.]
- (c) [Reserved.]
- (d) When static or dynamic tests are used to show compliance with the requirements of Sec. 25.305(b) for flight structures, appropriate material correction factors must be applied to the test results, unless the structure, or part thereof, being tested has features such that a number of elements contribute to the total strength of the structure and the failure of one element results in the redistribution of the load through alternate load paths.

Amdt. 25-72, Eff. 8/20/90

46.2 Flight Loads

FAR 25.321 : General.

- (a) Flight load factors represent the ratio of the aerodynamic force component (acting normal to the assumed longitudinal axis of the airplane) to the weight of the airplane. A positive load factor is one in which the aerodynamic force acts upward with respect to the airplane.
- (b) Considering compressibility effects at each speed, compliance with the flight load requirements of this subpart must be shown—
- (1) At each critical altitude within the range of altitudes selected by the applicant ;
 - (2) At each weight from the design minimum weight to the design maximum weight appropriate to each particular flight load condition; and
 - (3) For each required altitude and weight, for any practicable distribution of disposable load within the operating limitations recorded in the Airplane Flight Manual.
- (c) [Enough points on and within the boundaries of the design envelope must be investigated to ensure that the maximum load for each part of the airplane structure is obtained.
- (d) The significant forces acting on the airplane must be placed in equilibrium in a rational or conservative manner. The linear inertia forces must be considered in

FAR 25.1155 : [Reverse thrust and propeller pitch settings below the flight regime.]

[Each control for reverse thrust and for propeller pitch settings below the flight regime must have means to prevent its inadvertent operation. The means must have a positive lock or stop at the flight idle position and must require a separate and distinct operation by the crew to displace the control from the flight regime (forward thrust regime for turbojet powered airplanes).]

Amdt. 25-11, Eff. 6/4/67

FAR 25.1157 : Carburetor air temperature controls.

There must be a separate carburetor air temperature control for each engine.

FAR 25.1159 : Supercharger controls.

Each supercharger control must be accessible to the pilots or, if there is a separate flight engineer station with a control panel, to the flight engineer.

FAR 25.1161 : Fuel jetisoning system controls.

Each fuel jetisoning system control must have guards to prevent inadvertent operation. No control may be near any fire extinguisher control or other control used to combat fire.

FAR 25.1163 : Powerplant accessories.

- (a) [Each engine-mounted accessory must—
- (1) Be approved for mounting on the engine involved ;
 - (2) Use the provisions on the engine for mounting; and
 - (3) Be sealed to prevent contamination of the engine oil system and the accessory system.]
- (b) Electrical equipment subject to arcing or sparking must be installed to minimize the probability of contact with any flammable fluids or vapors that might be present in a free state.
- (c) If continued rotation of an engine-driven cabin supercharger or of any remote accessory driven by the engine is hazardous if malfunctioning occurs, there must be means to prevent rotation without interfering with the continued operation of the engine.

Amdt. 25-57, Eff. 3/26/84

FAR 25.1165 : Engine ignition systems.

- (a) Each battery ignition system must be supplemented by a generator that is automatically available as an alternate source of electrical energy to allow continued engine operation if any battery becomes depleted.
- (b) The capacity of batteries and generators must be large enough to meet the simultaneous demands of the engine ignition system and the greatest demands of any electrical system components that draw electrical energy from the same source.

- (1) Have a positive lock or stop at the idle position ; and
- (2) Require a separate and distinct operation to place the control in the shutoff position.

Amdt. 25-57, Eff. 3/26/84

FAR 25.1145 : Ignition switches.

- (a) Ignition switches must control each engine ignition circuit on each engine.
- (b) There must be means to quickly shut off all ignition by the grouping of switches or by a master ignition control.
- (c) [Each group of ignition switches, except ignition switches for turbine engines for which continuous ignition is not required, and each master ignition control must have a means to prevent its inadvertent operation.]

Amdt. 25-40, Eff. 5/2/77

FAR 25.1147 : Mixture controls.

- (a) If there are mixture controls, each engine must have a separate control. The controls must be grouped and arranged to allow—
 - (1) Separate control of each engine ; and
 - (2) Simultaneous control of all engines.
- (b) Each intermediate position of the mixture controls that corresponds to a normal operating setting must be identifiable by feel and sight.
- (c) The mixture controls must be accessible to both pilots. However, if there is a separate flight engineer station with a control panel, the controls need be accessible only to the flight engineer.

FAR 25.1149 : Propeller speed and pitch controls.

- (a) There must be a separate propeller speed and pitch control for each propeller.
- (b) The controls must be grouped and arranged to allow—
 - (1) Separate control of each propeller ; and
 - (2) Simultaneous control of all propellers.
- (c) The controls must allow synchronization of all propellers.
- (d) The propeller speed and pitch controls must be to the right of, and at least one inch below, the pilot's throttle controls.

FAR 25.1153 : Propeller feathering controls.

- (a) There must be a separate propeller feathering control for each propeller. The control must have means to prevent its inadvertent operation.
- (b) [If feathering is accomplished by movement of the propeller pitch or speed control lever, there must be means to prevent the inadvertent movement of this lever to the feathering position during normal operation.]

Amdt. 25-11, Eff. 6/4/67

equilibrium with the thrust and all aerodynamic loads, while the angular (pitching) inertia forces must be considered in equilibrium with thrust and all aerodynamic moments, including moments due to loads on components such as tail surfaces and nacelles. Critical thrust values in the range from zero to maximum continuous thrust must be considered.]

Amdt. 25-86, Eff. 3/11/96

46.3 Flight Maneuver and Gust Conditions

FAR 25.331 : Symmetric maneuvering conditions.

- (a) Procedure. For the analysis of the maneuvering flight conditions specified in paragraphs (b) and (c) of this section, the following provisions apply :

- (1) Where sudden displacement of a control is specified, the assumed rate of control surface displacement may not be less than the rate that could be applied by the pilot through the control system.

- (2) In determining elevator angles and chordwise load distribution in the maneuvering conditions of paragraphs (b) and (c) of this section, the effect of corresponding pitching velocities must be taken into account. The in-trim and out-of-trim flight conditions specified in Sec. 25.255 must be considered.

- (b) Maneuvering balanced conditions. Assuming the airplane to be in equilibrium with zero pitching acceleration, the maneuvering conditions A through I on the maneuvering envelope in Sec. 25.333(b) must be investigated.

- (c) [Pitch maneuver conditions. The conditions specified in paragraphs (c)(1) and (2) of this section must be investigated. The movement of the pitch control surfaces may be adjusted to take into account limitations imposed by the maximum pilot effort specified by Sec. 25.397(b), control system stops and any indirect effect imposed by limitations in the output side of the control system (for example, stalling torque or maximum rate obtainable by a power control system.)

- (1) Maximum pitch control displacement at V_A . The airplane is assumed to be flying in steady level flight (point A1, Sec. 25.333(b)) and the cockpit pitch control is suddenly moved to obtain extreme nose up pitching acceleration. In defining the tail load, the response of the airplane must be taken into account. Airplane loads that occur subsequent to the time when normal acceleration at the c.g. exceeds the positive limit maneuvering load factor (at point A2 in Sec. 25.333(b)), or the resulting tailplane normal load reaches its maximum, whichever occurs first, need not be considered.]

- (2) Specified control displacement. A checked maneuver, based on a rational pitching control motion vs. time profile, must be established in which the design limit load factor specified in Sec. 25.337 will not be exceeded. Unless lesser values cannot be exceeded, the airplane response must result in pitching accelerations not less than the following :

- (i) A positive pitching acceleration (nose up) is assumed to be reached concurrently with the airplane load factor of 1.0 (points A1 to D1, Sec. 25.333(b)).

The positive acceleration must be equal to at least

$$\frac{39 n_z (n_z - 1.5)}{V} \quad (\text{Radians/sec.}^2)$$

where-

n_z is the positive load factor at the speed under consideration; and V is the airplane equivalent speed in knots.

- (ii) A negative pitching acceleration (nose down) is assumed to be reached concurrently with the positive maneuvering load factor (points A2 to D2) (Sec. 25.333(b)). This negative pitching acceleration must be equal to at least

$$\frac{-26n_z}{V}(n_z - 1.5) \text{ (Radians/sec.}^2\text{)}$$

where

n_z is the positive load factor at the speed under consideration; and V is the airplane equivalent speed in knots.

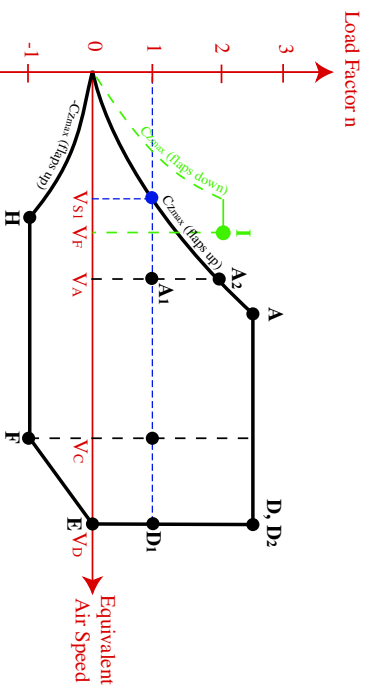
- (d) [Removed.]

Amdt. 25-91, Eff. 7/29/97

FAR 25.333 : Flight [maneuvering] envelope.

- (a) *General* [The strength requirements must be met at each combination of airspeed and load factor on and within the boundaries of the representative manœuvring envelope (V-n diagram) of paragraph (b) of this section. This envelope must also be used in determining the airplane structural operating limitations as specified in Sec. 25.1501.]

- (b) *Maneuvering envelope.* (Figure 46.1, p. 530)

FIG. 46.1 – *Maneuvering envelope*

- (c) [Removed.]

Amdt. 25-86, Eff. 3/11/96

48.8 Powerplant Controls and Accessories

FAR 25.1141 : Powerplant controls : general.

Each powerplant control must be located, arranged, and designed under Secs. 25.777 through 25.781 and marked under Sec. 25.1555. In addition, it must meet the following requirements :

- (a) Each control must be located so that it cannot be inadvertently operated by persons entering, leaving, or moving normally in, the cockpit.
- (b) Each flexible control must be approved or must be shown to be suitable for the particular application.
- (c) Each control must have sufficient strength and rigidity to withstand operating loads without failure and without excessive deflection.
- (d) Each control must be able to maintain any set position without constant attention by flight crewmembers and without creep due to control loads or vibration.
- (e) [The portion of each powerplant control located in a designated fire zone that is required to be operated in the event of fire must be at least fire resistant.]
- (f) Powerplant valve controls located in the cockpit must have—

- (1) For manual valves, positive stops or in the case of fuel valves suitable index provisions, in the open and closed position; and
- (2) For power-assisted valves, a means to indicate to the flight crew when the valve—
 - (i) Is in the fully open or fully closed position; or
 - (ii) Is moving between the fully open and fully closed position.

Amdt. 25-72, Eff. 8/20/90

FAR 25.1142: [Auxiliary power unit controls.]

[Means must be provided on the flight deck for starting, stopping, and emergency shutdown of each installed auxiliary power unit.]
Amdt. 25-46, Eff. 12/1/78

FAR 25.1143 : Engine controls

- (a) There must be a separate power or thrust control for each engine.
- (b) Power and thrust controls must be arranged to allow—
 - (1) Separate control of each engine; and
 - (2) Simultaneous control of all engines.
- (c) Each power and thrust control must provide a positive and immediately responsive means of controlling its engine.
- (d) [For each fluid injection (other than fuel) system and its controls not provided and approved as part of the engine, the applicant must show that the flow of the injection fluid is adequately controlled.]
- (e) If a power or thrust control incorporates a fuel shutoff feature, the control must have a means to prevent the inadvertent movement of the control into the shutoff position. The means must—

- (a) Exhaust piping must be heat and corrosion resistant, and must have provisions to prevent failure due to expansion by operating temperatures.
- (b) Piping must be supported to withstand any vibration and inertia loads to which it would be subjected in operation; and
- (c) Piping connected to components between which relative motion could exist must have means for flexibility.

Amdt. 25-40, Eff. 5/2/77

FAR 25.1125 : Exhaust heat exchangers.

[For reciprocating engine powered airplanes, the following apply :]

- (a) Each exhaust heat exchanger must be constructed and installed to withstand each vibration, inertia, and other load to which it would be subjected in operation. In addition.
 - (1) Each exchanger must be suitable for continued operation at high temperature and resistant to corrosion from exhaust gases ;
 - (2) There must be means for the inspection of the critical parts of each exchanger ;
 - (3) Each exchanger must have cooling provisions wherever it is subject to contact with exhaust gases; and
 - (4) No exhaust heat exchanger or muff may have any stagnant areas or liquid traps that would increase the probability of ignition of flammable fluids or vapors that might be present in case of the failure or malfunction of components carrying flammable fluids.
- (b) If an exhaust heat exchanger is used for heating ventilating air—
 - (1) There must be a secondary heat exchanger between the primary exhaust gas heat exchanger and the ventilating air system ; or
 - (2) Other means must be used to preclude the harmful contamination of the ventilating air.

Amdt. 25-38, Eff. 2/1/77

FAR 25.1127 : Exhaust driven turbo-superchargers.

- (a) Each exhaust driven turbo-supercharger must be approved or shown to be suitable for the particular application. It must be installed and supported to ensure safe operation between normal inspections and overhauls. In addition, there must be provisions for expansion and flexibility between exhaust conduits and the turbine.
- (b) There must be provisions for lubricating the turbine and for cooling turbine parts where temperatures are critical.
- (c) If the normal turbo-supercharger control system malfunctions, the turbine speed may not exceed its maximum allowable value. Except for the waste gate operating components, the components provided for meeting this requirement must be independent of the normal turbo-supercharger controls.

FAR 25.335 : Design airspeeds.

The selected design airspeeds are equivalent airspeeds (EAS). Estimated values of V_{S0} and V_{S1} must be conservative.

(a) *Design cruising speed, V_C* . For V_C , the following apply :

- (1) The minimum value of V_C must be sufficiently greater than V_B to provide for inadvertent speed increases likely to occur as a result of severe atmospheric turbulence.
- (2) [Except as provided in Sec. 25.335(d)(2), V_C may not be less than $V_B + 1.32 U_{REF}$ (with U_{REF} as specified in Sec. 25.341(a)(5)(i)). However V_C need not exceed the maximum speed in level flight at maximum continuous power for the corresponding altitude.]
- (3) At altitudes where V_D is limited by Mach number, V_C may be limited to a selected Mach number.
- (b) *Design dive speed, V_D* . V_D must be selected so that V_C / M_C is not greater than $0.8 V_D / M_D$, or so that the minimum speed margin between V_C / M_C and V_D / M_D is the greater of the following values :

- (1) From an initial condition of stabilized flight at V_C / M_C , the airplane is upset, flown for 20 seconds along a flight path 7.5° below the initial path, and then pulled up at a load factor of 1.5g (0.5g acceleration increment). The speed increase occurring in this maneuver may be calculated if reliable or conservative aerodynamic data is issued. Power as specified in Sec. 25.174(b)(1)(iv) is assumed until the pullup is initiated, at which time power reduction and the use of pilot controlled drag devices may be assumed.
- (2) [The minimum speed margin must be enough to provide for atmospheric variations (such as horizontal gusts, and penetration of jet streams and cold fronts) and for instrument errors and airframe production variations. These factors may be considered on a probability basis. The margin at altitude where M_C is limited by compressibility effects must not be less than 0.07M unless a lower margin is determined using a rational analysis that includes the effects of any automatic systems. In any case, the margin may not be reduced to less than 0.05M.]

(c) *Design maneuvering speed, V_A* . For V_A , the following apply :

- (1) V_A may not be less than $V_{S1} \sqrt{n_z}$ where—
 - (i) n_z is the limit positive maneuvering load factor at V_C ; and
 - (ii) V_{S1} is the stalling speed with flaps retracted.
- (2) V_A and V_S must be evaluated at the design weight and altitude under consideration.
- (3) V_A need not be more than V_C or the speed at which the positive $C_{N_{Amax}}$ curve intersects the positive maneuver load factor line, whichever is less.
- (d) *Design speed for maximum gust intensity, V_B* .
 - (1) V_B may not be less than

$$V_{S1} \sqrt{1 + \frac{K_g U_{REF} V_C a}{498 w}}$$

where-

$$K_g = \frac{0.88\mu}{5.3 + \mu}$$

$$\mu = \frac{2w}{\rho c a g}$$

V_{S1} : the 1-g stalling speed based on $C_{N_{Amax}}$ with the flaps retracted at the particular weight under consideration ;

V_C : design cruise speed (knots equivalent airspeed) ;

U_{HEF} : the reference gust velocity (feet per second equivalent airspeed) from Sec. 25.341(a)(5)(i) ;

w : average wing loading (pounds per square foot) at the particular weight under consideration.

ρ : density of air ($slugs/ft^3$) ;

c : mean geometric chord of the wing (feet) ;

g : acceleration due to gravity (ft/sec^2) ;

a : slope of the airplane normal force coefficient curve, C_{NA} per radian ;

(2) At altitudes where V_C is limited by Mach number-

(i) V_B may be chosen to provide an optimum margin between low and high speed buffet boundaries ; and

(ii) V_B need not be greater than V_C .

(e) *Design flap speeds, V_F .* For V_F , the following apply :

(1) The design flap speed for each flap position (established in accordance with Sec. 25.697(a)) must be sufficiently greater than the operating speed recommended for the corresponding stage of flight (including balked landings) to allow for probable variations in control of airspeed and for transition from one flap position to another.

(2) If an automatic flap positioning or load limiting device is used, the speeds and corresponding flap positions programmed or allowed by the device may be used.

(3) V_F may not be less than-

(i) $1.6 V_{S1}$, with the flaps in takeoff position at maximum takeoff weight ;

(ii) $1.8 V_{S1}$, with the flaps in approach position at maximum landing weight ; and

(iii) $1.8 V_{S0}$ with the flaps in landing position at maximum landing weight.

(f) *Design drag device speeds, V_{DD} .* The selected design speed for each drag device must be sufficiently greater than the speed recommended for the operation of the device to allow for probable variations in speed control. For drag devices intended for use in high speed descents, V_{DD} may not be less than V_D . When an automatic drag device positioning or load limiting means is used, the speeds and corresponding drag device positions programmed or allowed by the automatic means must be used for design.

Amdt. 25-91, Eff. 7/29/97

FAR 25.1105 : Induction system screens.

If induction system screens are used-

- (a) Each screen must be upstream of the carburetor ;
- (b) No screen may be in any part of the induction system that is the only passage through which air can reach the engine, unless it can be deiced by heated air ;
- (c) No screen may be deiced by alcohol alone ; and
- (d) It must be impossible for fuel to strike any screen.

FAR 25.1107 : Inter-coolers and after-coolers.

Each inter-cooler and after-cooler must be able to withstand any vibration, inertia, and air pressure load to which it would be subjected in operation.

48.7 Exhaust System

FAR 25.1121 : General.

[For powerplant and auxiliary power unit installations the following apply :]

- (a) Each exhaust system must ensure safe disposal of exhaust gases without fire hazard or carbon monoxide contamination in any personnel compartment. For test purposes, any acceptable carbon monoxide detection method may be used to show the absence of carbon monoxide.
- (b) [Each exhaust system part with a surface hot enough to ignite flammable fluids or vapors must be located or shielded so that leakage from any system carrying flammable fluids or vapors will not result in a fire caused by impingement of the fluids or vapors on any part of the exhaust system including shields for the exhaust system.]
- (c) Each component that hot exhaust gases could strike, or that could be subjected to high temperatures from exhaust system parts, must be fireproof. All exhaust system components must be separated by fireproof shields from adjacent parts of the airplane that are outside the engine [and auxiliary power unit compartments.]
- (d) No exhaust gases may discharge so as to cause a fire hazard with respect to any flammable fluid vent or drain.
- (e) No exhaust gases may discharge where they will cause a glare seriously affecting pilot vision at night.
- (f) Each exhaust system component must be ventilated to prevent points of excessively high temperature.
- (g) Each exhaust shroud must be ventilated or insulated to avoid, during normal operation, a temperature high enough to ignite any flammable fluids or vapors external to the shroud.

Amdt. 25-40, Eff. 5/2/77

FAR 25.1123 : Exhaust piping.

[For powerplant and auxiliary power unit installations, the following apply :]

thrust. During the 30 minutes of idle operation, the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator.

- (c) *Supercharged reciprocating engines.* For each engine having a supercharger to pre-surge the air before it enters the carburetor, the heat rise in the air caused by that supercharging at any altitude may be utilized in determining compliance with paragraph (a) of this section if the heat rise utilized is that which will be available, automatically, for the applicable altitude and operating condition because of supercharging.

Amdt. 25-72, Eff. 8/20/90

FAR 25.1101 : Carburetor air preheater design.

Each carburetor air preheater must be designed and constructed to—

- (a) Ensure ventilation of the preheater when the engine is operated in cold air ;
- (b) Allow inspection of the exhaust manifold parts that it surrounds ; and
- (c) Allow inspection of critical parts of the preheater itself.

FAR 25.1103 : [Induction system ducts and air duct systems.]

- (a) [Each induction system duct upstream of the first stage of the engine supercharger and of the auxiliary power unit compressor must have a drain to prevent the hazardous accumulation of fuel and moisture in the ground attitude. No drain may discharge where it might cause a fire hazard.]

- (b) Each induction system duct must be—

- (1) Strong enough to prevent induction system failures resulting from normal back-fire conditions ; and
- (2) [Fire resistant if it is in any fire zone for which a fire-extinguishing system is required, except that ducts for auxiliary power units must be fireproof within the auxiliary power unit fire zone.]

- (c) Each duct connected to components between which relative motion could exist must have means for flexibility.

- (d) [For turbine engine and auxiliary power unit bleed air duct systems, no hazard may result if a duct failure occurs at any point between the air duct source and the airplane unit served by the air.

- (e) Each auxiliary power unit induction system duct must be fireproof for a sufficient distance upstream of the auxiliary power unit compartment to prevent hot gas reverse flow from burning through auxiliary power unit ducts and entering any other compartment or area of the airplane in which a hazard would be created resulting from the entry of hot gases. The materials used to form the remainder of the induction system duct and plenum chamber of the auxiliary power unit must be capable of resisting the maximum heat conditions likely to occur.

- (f) Each auxiliary power unit induction system duct must be constructed of materials that will not absorb or trap hazardous quantities of flammable fluids that could be ignited in the event of a surge or reverse flow condition.]

Amdt. 25-46, Eff. 12/1/78

FAR 25.337 : Limit maneuvering load factors.

- (a) Except where limited by maximum (static) lift coefficients, the airplane is assumed to be subjected to symmetrical maneuvers resulting in the limit maneuvering load factors prescribed in this section. Pitching velocities appropriate to the corresponding pull-up and steady turn maneuvers must be taken into account.

- (b) [The positive limit maneuvering load factor “ n_{zc} ” for any speed up to V_D may not be less than $2.1 + \left(\frac{24000}{W+10000} \right)$ except that “ n_{zc} ” may not be less than 2.5 and need not be greater than 3.8—where “ W ” is the design maximum takeoff weight.]

- (c) The negative limit maneuvering load factor—

- (1) May not be less than -1.0 at speeds up to V_C ; and

- (2) Must vary linearly with speed from the value at V_C to zero at V_D .

- (d) Maneuvering load factors lower than those specified in this section may be used if the airplane has design features that make it impossible to exceed these values in flight.

Amdt. 25-23, Eff. 5/8/70

FAR 25.341 : Gust [and turbulence] loads.

- (a) [Discrete Gust Design Criteria. The airplane is assumed to be subjected to symmetrical vertical and lateral gusts in level flight. Limit gust loads must be determined in accordance with the following provisions :

- (1) Loads on each part of the structure must be determined by dynamic analysis. The analysis must take into account unsteady aerodynamic characteristics and all significant structural degrees of freedom including rigid body motions.

- (2) The shape of the gust must be :

$$U = \frac{U_{ds}}{2} \left(1 - \cos \left(\frac{\pi s}{H} \right) \right) \quad \text{for } 0 \leq s \leq 2H$$

where—

s : distance penetrated into the gust (feet) ;

U_{ds} : the design gust velocity in equivalent airspeed specified in paragraph (a)(4) of this section ; and

H : the gust gradient which is the distance (feet) parallel to the airplane's flight path for the gust to reach its peak velocity.

- (3) A sufficient number of gust gradient distances in the range 30 feet to 350 feet must be investigated to find the critical response for each load quantity.

- (4) The design gust velocity must be :

$$U_{ds} = U_{REF} F_g \left(\frac{H}{350} \right)^{1/6}$$

where—

U_{REF} : the reference gust velocity in equivalent airspeed defined in paragraph (a)(5) of this section.

F_g : the flight profile alleviation factor defined in paragraph (a)(6) of this section.

- (5) The following reference gust velocities apply :

(i) At the airplane design speed V_C : Positive and negative gusts with reference gust velocities of 56.0 feet/sec EAS must be considered at sea level. The reference gust velocity may be reduced linearly from 56.0 ft/sec EAS at sea level to 44.0 ft/sec EAS at 15000 feet. The reference gust velocity may be further reduced linearly from 44.0 ft/sec EAS at 15000 feet to 26.0 ft/sec ES at 50000 feet.

(ii) At the airplane design speed V_D : The reference gust velocity must be 0.5 times the value obtained under Sec. 25.341 (a)(5)(i).

- (6) The flight profile alleviation factor, F_g , must be increased linearly from the sea level value to a value of 1.0 at the maximum operating altitude defined in Sec. 25.1527. At sea level, the flight profile alleviation factor is determined by the following equation :

$$F_g = 0.5 (F_{gz} + F_{gm})$$

where—

$$F_{gz} = 1 - \frac{Z_{mo}}{25000}$$

$$F_{gm} = \sqrt{R_2 \tan \left(\frac{\pi}{4} R_1 \right)}$$

$$R_1 = \frac{\text{Maximum Landing Weight}}{\text{Maximum Take-Off Weight}}$$

$$R_2 = \frac{\text{Maximum Zero Fuel Weight}}{\text{Maximum Take-Off Weight}}$$

Z_{mo} = Maximum operating altitude defined in Sec. 25.1527.

- (7) When a stability augmentation system is included in the analysis, the effect of any significant system nonlinearities should be accounted for when deriving limit loads from limit gust conditions.

- (b) *Continuous Gust Design Criteria.* The dynamic response of the airplane to vertical and lateral continuous turbulence must be taken into account. The continuous gust design criteria of appendix G of this part must be used to establish the dynamic response unless more rational criteria are shown.]

Amdt. 25-86, Eff. 3/11/96

FAR 25.343 : Design fuel and oil loads.

- (a) The disposable load combinations must include each fuel and oil load in the range from zero fuel and oil to the selected maximum fuel and oil load. A structural reserve fuel condition, not exceeding 45 minutes of fuel under the operating conditions in Sec. 25.1001(e) and (f), as applicable, may be selected.
- (b) If a structural reserve fuel condition is selected, it must be used as the minimum fuel weight condition for showing compliance with the flight load requirements as prescribed in this subpart. In addition—
- (1) The structure must be designed for a condition of zero fuel in and oil the wing at limit loads corresponding to—

- (1) That part of the cowling is isolated from the engine accessory section by means of a fireproof diaphragm; or
- (2) For reciprocating engines, there are means to prevent the emergence of backfire flames.
- (d) For turbine engine powered airplanes and airplanes incorporating auxiliary power units—

(1) There must be means to prevent hazardous quantities of fuel leakage or overflow from drains, vents, or other components of flammable fluid systems from entering the engine or auxiliary power unit intake system; and

(2) The airplane must be designed to prevent water or slush on the runway, taxiway, or other airport operating surfaces from being directed into the engine or auxiliary power unit air inlet ducts in hazardous quantities, and the air inlet ducts must be located or protected so as to minimize the ingestion of foreign matter during takeoff, landing, and taxiing.

- (e) [If the engine induction system contains parts or components that could be damaged by foreign objects entering the air inlet, it must be shown by tests or, if appropriate, by analysis that the induction system design can withstand the foreign object ingestion test conditions of Secs. 33.76, 33.77 and 33.78(a)(1) of this chapter without failure of parts or components that could create a hazard.]

Amdt. 25-100, Eff. 12/13/2000

FAR 25.1093 : Induction system icing protection.

- (a) *Reciprocating engines.* Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of 30° F., each airplane with altitude engines using—

(1) Conventional venturi carburetors have a preheater that can provide a heat rise of 120° F. with the engine at 60 percent of maximum continuous power; or

(2) Carburetors tending to reduce the probability of ice formation has a preheater that can provide a heat rise of 100° F. with the engine at 60 percent of maximum continuous power.

- (b) *Turbine engines.*

(1) [Each turbine engine must operate throughout the flight power range of the engine (including idling), without the accumulation of ice on the engine, inlet system components, or airframe components that would adversely affect engine operation or cause a serious loss of power or thrust—

(i) Under the icing conditions specified in Appendix C, and

(ii) In falling and blowing snow within the limitations established for the airplane for such operation.]

(2) Each turbine engine must idle for 30 minutes on the ground, with the air bleed available for engine icing protection at its critical condition, without adverse affect, in an atmosphere that is at a temperature between 15° and 30° F. (between -9° and -1° C) and has a liquid water content not less than 0.3 grams per cubic meter in the form of drops having a mean effective diameter not less than 20 microns, followed by momentary operation at takeoff power or

The cooling tests must be conducted with the airplane in the configuration, and operating under the conditions, that are critical relative to cooling during each stage of flight. For the cooling tests, a temperature is "stabilized" when its rate of change is less than 2° F. per minute.

- (b) Temperatures must be stabilized under the conditions from which entry is made into each stage of flight being investigated, unless the entry condition normally is not one during which component and engine fluid temperatures would stabilize (in which case, operation through the full entry condition must be conducted before entry into the stage of flight being investigated in order to allow temperatures to reach their natural levels at the time of entry). The takeoff cooling test must be preceded by a period during which the powerplant component and engine fluid temperatures are stabilized with the engines at ground idle.

- (c) Cooling tests for each stage of flight must be continued until—

- (1) The component and engine fluid temperatures stabilize ;
- (2) The stage of flight is completed; or
- (3) An operating limitation is reached.

- (d) For reciprocating engine powered airplanes, it may be assumed, for cooling test purposes, that the takeoff stage of flight is complete when the airplane reaches an altitude of 1,500 feet above the takeoff surface or reaches a point in the takeoff where the transition from the takeoff to the en route configuration is completed and a speed is reached at which compliance with [Sec. 25.121(c)] is shown, whichever point is at a higher altitude. [The airplane must be in the following configuration :
- (1) Landing gear retracted.
 - (2) Wing flaps in the most favorable position.

- (3) Cowl flaps (or other means of controlling the engine cooling supply) in the position that provides adequate cooling in the hot-day condition.

- (4) Critical engine inoperative and its propeller stopped.

- (5) Remaining engines at the maximum continuous power available for the altitude.]

- (e) For hull seaplanes and amphibians, cooling must be shown during taxiing downwind for 10 minutes, at 5 knots above step speed.

Amdt. 25-57, Eff. 3/26/84

48.6 Induction System

FAR 25.1091 : Air induction.

- (a) The air induction system for each engine and auxiliary power unit must supply—

- (1) The air required by that engine and auxiliary power unit under each operating condition for which certification is requested ; and
- (2) The air for proper fuel metering and mixture distribution with the induction system valves in any position.

- (b) Each reciprocating engine must have an alternate air source that prevents the entry of rain, ice, or any other foreign matter.

- (c) Air intakes may not open within the cowlings, unless—

- (i) A maneuvering load factor of +2.25; and

- (ii) [The gust conditions of Sec. 25.341(a) but assuming 85% of the design velocities prescribed in Sec. 25.341(a)(4).]

- (2) Fatigue evaluation of the structure must account for any increase in operating stresses resulting from the design condition of paragraph (b)(1) of this section ; and

- (3) The flutter, deformation, and vibration requirements must also be met with zero fuel.

Amdt. 25-86, Eff. 3/11/96

FAR 25.345 : High lift devices.

- (a) If wing flaps are to be used during takeoff, approach, or landing, at the design flap speeds established for these stages of flight under Sec. 25.335(e) and with the wing flaps in the corresponding positions, the airplane is assumed to be subjected to symmetrical maneuvers and gusts. The resulting limit loads must correspond to the conditions determined as follows :

- (1) Maneuvering to a positive limit load factor of 2.0 ; and

- (2) Positive and negative gusts of 25 ft/sec EAS acting normal to the flight path in level flight. Gust loads resulting on each part of the structure must be determined by rational analysis. The analysis must take into account the unsteady aerodynamic characteristics and rigid body motions of the aircraft. The shape of the gust must be as described in Sec. 25.341(a)(2) except that—

$$Uds = 25 \text{ ft/sec EAS};$$

$$H = 12.5c; \text{ and}$$

$$c = \text{mean geometric chord of the wing (feet).} \quad (46.1)$$

- (b) The airplane must be designed for the conditions prescribed in paragraph (a) of this section, except that the airplane load factor need not exceed 1.0, taking into account, as separate conditions, the effects of—

- (1) Propeller slipstream corresponding to maximum continuous power at the design flap speeds V_F , and with takeoff power at not less than 1.4 times the stalling speed for the particular flap position and associated maximum weight ; and

- (2) A head-on gust of 25 feet per second velocity (EAS).

- (c) If flaps or other high lift devices are to be used in en route conditions, and with flaps in the appropriate position at speeds up the flap design speed chosen for these conditions, the airplane is assumed to be subjected to symmetrical maneuvers and gusts within the range determined by—

- (1) Maneuvering to a positive limit load factor as prescribed in Sec. 25.337(b) ; and

- (2) The discrete vertical gust criteria in Sec. 25.341(a).

- (d) [The airplane must be designed for a maneuvering load factor of 1.5g at the maximum take-off weight with the wing-flaps and similar high lift devices in the landing configurations.]

Amdt. 25-91, Eff. 7/29/97

FAR 25.349 : Rolling conditions.

The airplane must be designed for loads resulting from the rolling conditions specified in paragraphs (a) and (b) of this section. Unbalanced aerodynamic moments about the center of gravity must be reacted to in a rational or conservative manner, considering the principal masses furnishing the [reaching inertia forces]

- (a) *Maneuvering.* The following conditions, speeds, and aileron deflections (except as the deflections may be limited by pilot effort) must be considered in combination with an airplane load factor of zero and of two-thirds of the positive maneuvering factor used in design. In determining the required aileron deflections, the torsional flexibility of the wing must be considered in accordance with Sec. 25.301(b) :
- (1) Conditions corresponding to steady rolling velocities must be investigated. In addition, conditions corresponding to maximum angular acceleration must be investigated for airplanes with engines or other weight concentrations onboard of the fuselage. For the angular acceleration conditions, zero rolling velocity may be assumed in the absence of a rational time history investigation of the maneuver.
 - (2) At V_A , a sudden deflection of the aileron to the stop is assumed.
 - (3) At V_C , the aileron deflection must be that required to produce a rate of roll not less than that obtained in paragraph (a)(2) of this section.
 - (4) At V_D , the aileron deflection must be that required to produce a rate of roll not less than one-third of that in paragraph (a)(2) of this paragraph.
 - (b) *Unsymmetrical gusts.* The airplane is assumed to be subjected to unsymmetrical vertical gusts in level flight. The resulting limit loads must be determined from either the wing maximum airload derived directly from Sec. 25.341(a), or the wing maximum airload derived indirectly from the vertical load factor calculated from Sec. 25.341(a). It must be assumed that 100 percent of the wing air load acts on one side of the airplane and 80 percent of the wing air load acts on the other side. Amdt. 25-94, Eff. 3/25/98

FAR 25.351 : [Yaw maneuver] conditions.

[The airplane must be designed for loads resulting from yaw maneuver conditions specified in paragraphs (a) through (d) of this section at speeds from V_{MC} to V_D . Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner considering the airplane inertia forces. In computing the tail loads the yawing velocity may be assumed to be zero.

- (a) With the airplane in unaccelerated flight at zero yaw, it is assumed that the cockpit rudder control is suddenly displaced to achieve the resulting rudder deflection, as limited by :
- (1) The control system on control surface stops ; or
 - (2) A limit pilot force of 300 pounds from V_{MC} to V_A and 200 pounds from V_C/M_C to V_D/M_D , with a linear variation between V_A and V_C/M_C .
 - (b) With the cockpit rudder control deflected so as always to maintain the maximum rudder deflection available within the limitations specified in paragraph (a) of this section, it is assumed that the airplane yaws to the overswing sideslip angle.

48.5 Cooling**FAR 25.1041 : General.**

[The powerplant and auxiliary power unit cooling provisions must be able to maintain the temperatures of powerplant components, engine fluids, and auxiliary power unit components and fluids within the temperature limits established for these components and fluids, under ground, water, and flight operating conditions, and after normal engine or auxiliary power unit shutdown, or both.] Amdt. 25-38, Eff. 2/1/77

FAR 25.1043 : Cooling tests.

- (a) *General.* Compliance with Sec. 25.1041 must be shown by tests, under critical ground, water, and flight operating conditions. For these tests, the following apply :
- (1) If the tests are conducted under conditions deviating from the maximum ambient atmospheric temperature, the recorded powerplant temperatures must be corrected under paragraphs (c) and (d) of this section.
 - (2) No corrected temperatures determined under subparagraph (1) of this paragraph may exceed established limits.
 - (3) For reciprocating engines, the fuel used during the cooling tests must be the minimum grade approved for the engines, and the mixture settings must be those normally used in the flight stages for which the cooling tests are conducted. The test procedures must be as prescribed in Sec. 25.1045.
 - (b) *[Maximum ambient atmospheric temperature.* A maximum ambient atmospheric temperature corresponding to sea level conditions of at least 100 degrees F must be established. The assumed temperature lapse rate is 3.6 degrees F per thousand feet of altitude above sea level until a temperature of -69.7 degrees F is reached, above which altitude the temperature is considered constant at -69.7 degrees F. However, for winterization installations, the applicant may select a maximum ambient atmospheric temperature corresponding to sea level conditions of less than 100 degrees F.]
 - (c) *Correction factor (except cylinder barrels).* Unless a more rational correction applies, temperatures of engine fluids and powerplant components (except cylinder barrels) for which temperature limits are established, must be corrected by adding to them the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum component or fluid temperature recorded during the cooling test.
 - (d) *Correction factor for cylinder barrel temperatures.* Unless a more rational correction applies, cylinder barrel temperatures must be corrected by adding to them 0.7 times the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum cylinder barrel temperature recorded during the cooling test. Amdt. 25-42, Eff. 3/1/78

FAR 25.1045 : Cooling test procedures.

- (a) Compliance with Sec. 25.1041 must be shown for the takeoff, climb, en route, and landing stages of flight that correspond to the applicable performance requirements.

- (5) An oil strainer or filter that has no bypass, except one that is installed at an oil tank outlet, must have a means to connect it to the warning system required in Sec. 25.1305(c)(7).
- (b) Each oil strainer or filter in a powerplant installation using reciprocating engines must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.

Amdt. 25-57, Eff. 3/26/84

FAR 25.1021 : Oil [system drains.]

[A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must—

- (a) Be accessible; and
- (b) Have manual or automatic means for positive locking in the closed position.]

Amdt. 25-57, Eff. 3/26/84

FAR 25.1023 : Oil radiators.

- (a) Each oil radiator must be able to withstand, without failure, any vibration, inertia, and oil pressure load to which it would be subjected in operation.
- (b) Each oil radiator air duct must be located so that, in case of fire, flames coming from normal openings of the engine nacelle cannot impinge directly upon the radiator.

FAR 25.1025 : Oil valves.

- (a) Each oil shutoff must meet the requirements of Sec. 25.1189.
- (b) The closing of oil shutoff means may not prevent propeller feathering.
- (c) Each oil valve must have positive stops or suitable index provisions in the "on" and "off" positions and must be supported so that no loads resulting from its operation or from accelerated flight conditions are transmitted to the lines attached to the valve.

FAR 25.1027 : Propeller feathering system.

- (a) If the propeller feathering system depends on engine oil, there must be means to trap an amount of oil in the tank if the supply becomes depleted due to failure of any part of the lubricating system other than the tank itself.
- (b) The amount of trapped oil must be enough to accomplish the feathering operation and must be available only to the feathering pump.
- (c) The ability of the system to accomplish feathering with the trapped oil must be shown. This may be done on the ground using an auxiliary source of oil for lubricating the engine during operation.
- (d) [Provision must be made to prevent sludge or other foreign matter from affecting the safe operation of the propeller feathering system.]

Amdt. 25-38, Eff. 2/1/77

- (c) With the airplane yawed to the static equilibrium sideslip angle, it is assumed that the cockpit rudder control is held so as to achieve the maximum rudder deflection available within the limitations specified in paragraph (a) of this section.

- (d) With the airplane yawed to the static equilibrium sideslip angle of paragraph (c) of this section, it is assumed that the cockpit rudder control is suddenly returned to neutral.]

Amdt. 25-91, Eff. 7/29/97

46.4 Supplementary Conditions

FAR 25.361 : Engine torque.

- (a) [Each engine mount and its supporting structure must be designed for the effects of—

- (1) A limit engine torque corresponding to takeoff power and propeller speed acting simultaneously with 75 percent of the limit loads from flight condition A of Sec. 25.333(b);
- (2) [A limit torque corresponding to the maximum continuous power and propeller speed, acting simultaneously with the limit loads from flight condition A of Sec. 25.333(b); and]
- (3) For turbopropeller installations, in addition to the conditions specified in paragraphs (a)(1) and (2) of this section, a limit engine torque corresponding to takeoff power and propeller speed, multiplied by a factor accounting for propeller control system malfunction, including quick feathering, acting simultaneously with lg level flight loads. In the absence of a rational analysis, a factor of 1.6 must be used.

- (b) For turbine engine installations, the engine mounts and supporting structure must be designed to withstand each of the following :

- (1) A limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming).
- (2) A limit engine torque load imposed by the maximum acceleration of the engine.
- (c) [The limit engine torque to be considered under paragraph (a) of this section must be obtained by multiplying mean torque for the specified power and speed by a factor of—

- (1) 1.25 for turbopropeller installations ;
- (2) 1.33 for reciprocating engines with five or more cylinders; or
- (3) Two, three, or four, for engines with four, three, or two cylinders, respectively.

Amdt. 25-72, Eff. 8/20/90

FAR 25.363 : [Side load on engine and auxiliary power unit mounts.]

- (a) [Each engine and auxiliary power unit mount and its supporting structure must be designed for a limit load factor in lateral direction, for the side load on the engine and auxiliary power unit mount, at least equal to the maximum load factor obtained in the yawing conditions but not less than—

- (1) 1.33; or

- (2) One-third of the limit load factor for flight condition A as prescribed in Sec. 25.333(b).
- (b) The side load prescribed in paragraph (a) of this section may be assumed to be independent of other flight conditions.
- Amdt. 25-91, Eff. 7/29/97

FAR 25.365 : Pressurized compartment loads.

For airplanes with one or more pressurized compartments the following apply :

- (a) The airplane structure must be strong enough to withstand the flight loads combined with pressure differential loads from zero up to the maximum relief valve setting.
- (b) The external pressure distribution in flight, and stress concentrations and fatigue effects must be accounted for.
- (c) If landings may be made with the compartment pressurized, landing loads must be combined with pressure differential loads from zero up to the maximum allowed during landing.
- (d) [The airplane structure must be designed to be able to withstand the pressure differential loads corresponding to the maximum relief valve setting multiplied by a factor of 1.33 for airplanes to be approved for operation to 45,000 feet or by a factor of 1.67 for airplanes to be approved for operation above 45,000 feet, omitting other loads.]
- (e) Any structure, component or part, inside or outside a pressurized compartment, the failure of which could interfere with continued safe flight and landing, must be designed to withstand the effects of a sudden release of pressure through an opening in any compartment at any operating altitude resulting from each of the following conditions :
- (1) The penetration of the compartment by a portion of an engine following an engine disintegration :
- (2) Any opening in any pressurized compartment up to the size H_O in square feet ; however, small compartments may be combined with an adjacent pressurized compartment and both considered as a single compartment for openings that cannot be reasonably be expected to be confined to the small compartment. The size H_O must be computed by the following formula
- $$H_O = P A_s$$
- where—
- $$P = \frac{A_s}{6240} + 0.024$$
- H_O : Maximum opening in square feet, need not exceed 20 square feet.
 A_s : Maximum cross-sectional area of the pressurized shell normal to the longitudinal axis, in square feet ; and
- (3) The maximum opening caused by airplane or equipment failures not shown to be extremely improbable.

FAR 25.1015 : Oil tank tests.

Each oil tank must be designed and installed so that—

- (a) It can withstand, without failure, each vibration, inertia, and fluid load that it may be subjected to in operation ; and
- (b) It meets the provisions of Sec. 25.965, except—

(1) [The test pressure—

(i) For pressurized tanks used with a turbine engine, may not be less than 5 p.s.i. plus the maximum operating pressure of the tank instead of the pressure specified in Sec. 25.965(a) ; and

(ii) For all other tanks may not be less than 5 p.s.i. instead of the pressure specified in Sec. 25.965(a) ; and]

(2) The test fluid must be oil at 250° F. instead of the fluid specified in Sec. 25.965(c).

Amdt. 25-36, Eff. 10/31/74

FAR 25.1017 : Oil lines and fittings.

(a) Each oil line must meet the requirements of Sec. 25.993 and each oil line and fitting in any designated fire zone must meet the requirements of Sec. 25.1183.

(b) Breather lines must be arranged so that—

(1) Condensed water vapor that might freeze and obstruct the line cannot accumulate at any point ;

(2) The breather discharge does not constitute a fire hazard if foaming occurs or causes emitted oil to strike the pilot's windshield ; and

(3) The breather does not discharge into the engine air induction system.

FAR 25.1019 : Oil strainer or filter.

(a) Each turbine engine installation must incorporate an oil strainer or filter through which all of the engine oil flows and which meets the following requirements :

(1) Each oil strainer or filter that has a bypass, must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter completely blocked.

(2) [The oil strainer or filter must have the capacity (with respect to operating limitations established for the engine) to ensure that engine oil system functioning is not impaired when the oil is contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine under Part 33 of this chapter.

(3) The oil strainer or filter, unless it is installed at an oil tank outlet, must incorporate an indicator that will indicate contamination before it reaches the capacity established in accordance with subparagraph (2) of this paragraph.]

(4) The bypass of a strainer or filter must be constructed and installed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.

- (b) The usable oil capacity may not be less than the product of the endurance of the airplane under critical operating conditions and the approved maximum allowable oil consumption of the engine under the same conditions, plus a suitable margin to ensure system circulation. Instead of a rational analysis of airplane range for the purpose of computing oil requirements for reciprocating engine powered airplanes, the following fuel/oil ratios may be used :

- (1) For airplanes without a reserve oil or oil transfer system, a fuel/oil ratio of 30 :1 by volume.
- (2) For airplanes with either a reserve oil or oil transfer system, a fuel/oil ratio of 40 :1 by volume.
- (c) Fuel/oil ratios higher than those prescribed in paragraphs (b)(1) and (2) of this section may be used if substantiated by data on actual engine oil consumption.

FAR 25.1013 : Oil tanks.

- (a) *Installation.* [Each oil tank installation must meet the requirements of Sec. 25.967.]
- (b) *Expansion space.* Oil tank expansion space must be provided as follows :

- (1) Each oil tank used with a reciprocating engine must have an expansion space of not less than the greater of 10 percent of the tank capacity or 0.5 gallon, and each oil tank used with a turbine engine must have an expansion space of not less than 10 percent of the tank capacity.
- (2) Each reserve oil tank not directly connected to any engine may have an expansion space of not less than two percent of the tank capacity.
- (3) It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.

- (c) *Filler connection.* [Each recessed oil tank filler connection that can retain any appreciable quantity of oil must have a drain that discharges clear of each part of the airplane. In addition, each oil tank filler cap must provide an oil-tight seal.]

- (d) *Vent.* Oil tanks must be vented as follows :

- (1) Each oil tank must be vented from the top part of the expansion space so that venting is effective under any normal flight condition.
- (2) Oil tank vents must be arranged so that condensed water vapor that might freeze and obstruct the line cannot accumulate at any point.

- (e) *Outlet.* There must be means to prevent entrance into the tank itself, or into the tank outlet, of any object that might obstruct the flow of oil through the system. No oil tank outlet may be enclosed by any screen or guard that would reduce the flow of oil below a safe value at any operating temperature. There must be a shutoff valve at the outlet of each oil tank used with a turbine engine, unless the external portion of the oil system (including the oil tank supports) is fireproof.

- (f) *Flexible oil tank liners.* Each flexible oil tank liner must be approved or must be shown to be suitable for the particular application.

Amdt. 25-72, Eff. 8/20/90

- (f) In complying with paragraph (e) of this section, the fail-safe features of the design may be considered in determining the probability of failure or penetration and probable size of openings, provided that possible improper operation of closure devices and inadvertent door openings are also considered. Furthermore, the resulting differential pressure loads must be combined in a rational and conservative manner with 1-g level flight loads and any loads arising from emergency depressurization conditions. These loads may be considered as ultimate conditions ; however, any deformations associated with these conditions must not interfere with continued safe flight and landing. The pressure relief provided by intercompartment venting may also be considered.

- (g) Bulkheads, floors, and partitions in pressurized compartments for occupants must be designed to withstand the conditions specified in paragraph (e) of this section. In addition, reasonable design precautions must be taken to minimize the probability of parts becoming detached and injuring occupants while in their seats.

Amdt. 25-87, Eff. 7/5/96

FAR 25.367 : Unsymmetrical loads due to engine failure.

- (a) The airplane must be designed for the unsymmetrical loads resulting from the failure of the critical engine. Turbopropeller airplanes must be designed for the following conditions in combination with a single malfunction of the propeller drag limiting system, considering the probable pilot corrective action on the flight controls :

- (1) At speeds between V_{MC} and V_D , the loads resulting from power failure because of fuel flow interruption are considered to be limit loads.
- (2) At speeds between V_{MC} and V_C , the loads resulting from the disconnection of the engine compressor from the turbine or from loss of the turbine blades are considered to be ultimate loads.
- (3) The time history of the thrust decay and drag build-up occurring as a result of the prescribed engine failures must be substantiated by test or other data applicable to the particular engine-propeller combination.
- (4) The timing and magnitude of the probable pilot corrective action must be conservatively estimated, considering the characteristics of the particular engine-propeller-airplane combination.

- (b) Pilot corrective action may be assumed to be initiated at the time maximum yawing velocity is reached, but not earlier than two seconds after the engine failure. The magnitude of the corrective action may be based on the control forces specified in Sec. 25.397(b) except that lower forces may be assumed where it is shown by analysis or test that these forces can control the yaw and roll resulting from the prescribed engine failure conditions.

FAR 25.371 : Gyroscopic loads.

- [The structure supporting any engine or auxiliary power unit must be designed for the loads including the gyroscopic loads arising from the conditions specified in Secs. 25.331, 25.341(a), 25.349, 25.351, 25.473, 25.479, and 25.481, with the engine or auxiliary power unit at the maximum rpm appropriate to the condition. For the purposes of compliance with this section, the pitch maneuver in Sec. 25.331(c)(1) must be carried out until the positive limit maneuvering load factor (point A2 in Sec. 25.333(b)) is reached.]

Amdt. 25-91, Eff. 7/29/97

FAR 25.373 : Speed control devices.

If speed control devices (such as spoilers and drag flaps) are installed for use in en route conditions—

- (a) [The airplane must be designed for the symmetrical maneuvers prescribed in Sec. 25.333 and Sec. 25.337, the yawing maneuvers prescribed in Sec. 25.351, and the vertical and lateral gust conditions prescribed in Sec. 25.341(a), at each setting and the maximum speed associated with that setting; and]
- (b) If the device has automatic operating or load limiting features, the airplane must be designed for the maneuver and gust conditions prescribed in paragraph (a) of this section, at the speeds and corresponding device positions that the mechanism allows.

Amdt. 25-86, Eff. 3/11/96

46.5 Control Surface and System Loads

FAR 25.391 : Control surface loads : general.

[The control surfaces must be designed for the limit loads resulting from the flight conditions in Secs. 25.331, 25.341(a), 25.349 and 25.351 and the ground gust conditions in Sec. 25.415, considering the requirements for—]

- (a) Loads parallel to hinge line, in Sec. 25.393;
 - (b) Pilot effort effects, in Sec. 25.397;
 - (c) Trim tab effects, in Sec. 25.407;
 - (d) Unsymmetrical loads, in Sec. 25.427; and
 - (e) [Auxiliary aerodynamic surfaces, in Sec. 25.445.]
- Amdt. 25-86, Eff. 3/11/96

FAR 25.393 : Loads parallel to hinge line.

- (a) Control surfaces and supporting hinge brackets must be designed for inertia loads acting parallel to the hinge line.
- (b) In the absence of more rational data, the inertia loads may be assumed to be equal to KW , where—
 - (1) $K = 24$ for vertical surfaces;
 - (2) $K = 12$ for horizontal surfaces; and
 - (3) W = weight of the movable surfaces.

FAR 25.395 : Control system.

- (a) Longitudinal, lateral, directional and drag control systems and their supporting structures must be designed for loads corresponding to 125 percent of the computed hinge moments of the movable control surface in the conditions prescribed in Sec. 25.391.
- (b) [The system limit loads, except the loads resulting from ground gusts, need not exceed the loads that can be produced by the pilot (or pilots) and by automatic or power devices operating the controls.]

- (c) Fuel jettisoning must be demonstrated beginning at maximum takeoff weight with flaps and landing gear up and in—

- (1) [A power-off glide at $1.3 V_{SR1}$];
 - (2) A climb at the one-engine inoperative best rate-of-climb speed, with the critical engine inoperative and the remaining engines at maximum continuous power; and
 - (3) [Level flight at $1.3 V_{SR1}$, if the results of the tests in the conditions specified in paragraphs (c)(1) and (2) of this section show that this condition could be critical.];
 - (d) During the flight tests prescribed in paragraph (c) of this section, it must be shown that—
 - (1) The fuel jettisoning system and its operation are free from fire hazard;
 - (2) The fuel discharges clear of any part of the airplane;
 - (3) Fuel or fumes do not enter any parts of the airplane; and
 - (4) The jettisoning operation does not adversely affect the controllability of the airplane.
 - (e) For reciprocating engine powered airplanes, means must be provided to prevent jettisoning the fuel in the tanks used for takeoff and landing below the level allowing 45 minutes flight at 75 percent maximum continuous power. However, if there is an auxiliary control independent of the main jettisoning control, the system may be designed to jettison the remaining fuel by means of the auxiliary jettisoning control.
 - (f) For turbine engine powered airplanes, means must be provided to prevent jettisoning the fuel in the tanks used for takeoff and landing below the level allowing climb from sea level to 10,000 feet and thereafter allowing 45 minutes cruise at a speed for maximum range. However, if there is an auxiliary control independent of the main jettisoning control, the system may be designed to jettison the remaining fuel by means of the auxiliary jettisoning control.
 - (g) The fuel jettisoning valve must be designed to allow flight personnel to close the valve during any part of the jettisoning operation.
 - (h) Unless it is shown that using any means (including flaps, slots, and slats) for changing the airflow across or around the wings does not adversely affect fuel jettisoning, there must be a placard, adjacent to the jettisoning control, to warn flight crewmembers against jettisoning fuel while the means that change the airflow are being used.
 - (i) The fuel jettisoning system must be designed so that any reasonably probable single malfunction in the system will not result in a hazardous condition due to unsymmetrical jettisoning of, or inability to jettison fuel.
- Amdt. 25-108, Eff. 12/26/2002

48.4 Oil System

FAR 25.1011 : General.

- (a) Each engine must have an independent oil system that can supply it with an appropriate quantity of oil at a temperature not above that safe for continuous operation.

FAR 25.997 : Fuel strainer or filter.

There must be a fuel strainer or filter between the fuel tank outlet and the inlet of either the fuel metering device or an engine driven positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must—

- (a) Be accessible for draining and cleaning and must incorporate a screen or element which is easily removable;
- (b) Have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes;
- (c) [Be mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter itself, unless adequate strength margins under all loading conditions are provided in the lines and connections; and
- (d) Have the capacity (with respect to operating limitations established for the engine) to ensure that engine fuel system functioning is not impaired, with the fuel contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine in Part 33 of this chapter.]

Amdt. 25-57, Eff. 3/26/84

FAR 25.999 : Fuel system drains.

- (a) Drainage of the fuel system must be accomplished by the use of fuel strainer and fuel tank sump drains.

- (b) [Each drain required by paragraph (a) of this section must—

- (1) Discharge clear of all parts of the airplane ;
- (2) Have manual or automatic means for positive locking in the closed position; and
- (3) Have a drain valve—
 - (i) That is readily accessible and which can be easily opened and closed; and
 - (ii) That is either located or protected to prevent fuel spillage in the event of a landing with landing gear retracted.]

Amdt. 25-38, Eff. 2/1/77

FAR 25.1001 : Fuel jettisoning system.

- (a) A fuel jettisoning system must be installed on each airplane unless it is shown that the airplane meets the climb requirements of Secs. 25.119 and 25.121(d) at maximum takeoff weight, less the actual or computed weight of fuel necessary for a 15-minute flight comprised of a takeoff, go-around, and landing at the airport of departure with the airplane configuration, speed, power, and thrust the same as that used in meeting the applicable takeoff, approach, and landing climb performance requirements of this Part.
- (b) If a fuel jettisoning system is required it must be capable of jettisoning enough fuel within 15 minutes, starting with the weight given in paragraph (a) of this section, to enable the airplane to meet the climb requirements of Secs. 25.119 and 25.121(d), assuming that the fuel is jettisoned under the conditions, except weight, found least favorable during the flight tests prescribed in paragraph (c) of this section.

- (c) The loads must not be less than those resulting from application of the minimum forces prescribed in Sec. 25.397(c).]

Amdt. 25-72, Eff. 8/20/90

FAR 25.397 : Control system loads.

- (a) *General.* The maximum and minimum pilot forces, specified in paragraph (c) of this section, are assumed to act at the appropriate control grips or pads (in a manner simulating flight conditions) and to be reacted at the attachment of the control system to the control surface horn.
- (b) *Pilot effort effects.* In the control surface flight loading condition, the air loads on movable surfaces and the corresponding deflections need not exceed those that would result in flight from the application of any pilot force within the ranges specified in paragraph (c) of this section. Two-thirds of the maximum values specified for the aileron and elevator may be used if control surface hinge moments are based on reliable data. In applying this criterion, the effects of servo mechanisms, tabs, and automatic pilot systems, must be considered.
- (c) *Limit pilot forces and torques.* The limit pilot forces and torques are as follows :

Control	Maximum forces or torques Minimum	forces or torques
Aileron : Stick Wheel ¹	100 lbs 80 in.-lbs. ²	40 lbs. 40 D in.-lbs.
Elevator : Stick Wheel (symmetrical) Wheel (unsymmetrical) ³	250 lbs 300 lbs -	100 lbs. 100 lbs. 100 lbs.
Rudder	300 lbs	130 lbs.

¹ The critical parts of the aileron control system must be designed for a single tangential force with a limit value equal to 1.25 times the couple force determined from these criteria.

² D = wheel diameter (inches).

³ The unsymmetrical forces [must be] applied at one of the normal handgrip points on the periphery of the control wheel.

Amdt. 25-72, Eff. 8/20/90

FAR 25.399 : Dual control system.

- (a) Each dual control system must be designed for the pilots operating in opposition, using individual pilot forces not less than—
 - (1) 0.75 times those obtained under Sec. 25.395; or
 - (2) The minimum forces specified in Sec. 25.397(c).
- (b) The control system must be designed for pilot forces applied in the same direction, using individual pilot forces not less than 0.75 times those obtained under Sec. 25.395.

FAR 25.405 : Secondary control system.

Secondary controls, such as wheel brake, spoiler, and tab controls, must be designed for the maximum forces that a pilot is likely to apply to those controls. The following values may be used :

Pilot Control Force Limits (Secondary Controls)	
Control	Limit pilot forces
Miscellaneous : *Crank, wheel, or lever.	$(\frac{1+R}{3})$ 50 lbs., but not less than 50 lbs. nor more than 150 lbs. (R=radius). (Applicable to any angle within 20° of plane of control.)
Twist Push-pull	133 in.-lbs. To be chosen by applicant.

* Limited to flap, tab, stabilizer, spoiler, and landing gear operation controls.

FAR 25.407 : Trim tab effects.

The effects of trim tabs on the control surface design conditions must be accounted for only where the surface loads are limited by maximum pilot effort. In these cases, the tabs are considered to be deflected in the direction that would assist the pilot, and the deflections are—

- (a) For elevator trim tabs, those required to trim the airplane at any point within the positive portion of the pertinent flight envelope in Sec. 25.333(b), except as limited by the stops ; and
- (b) For aileron and rudder trim tabs, those required to trim the airplane in the critical unsymmetrical power and loading conditions, with appropriate allowance for rigging tolerances.

FAR 25.409 : Tabs.

- (a) *Trim tabs.* Trim tabs must be designed to withstand loads arising from all likely combinations of tab setting, primary control position, and airplane speed (obtainable without exceeding the flight load conditions prescribed for the airplane as a whole), when the effect of the tab is opposed by pilot effort forces up to those specified in Sec. 25.397(b).
- (b) *Balancing tabs.* Balancing tabs must be designed for deflections consistent with the primary control surface loading conditions.
- (c) *Servo tabs.* Servo tabs must be designed for deflections consistent with the primary control surface loading conditions obtainable within the pilot maneuvering effort, considering possible opposition from the trim tabs.

FAR 25.415 : Ground gust conditions.

- (a) The control system must be designed as follows for control surface loads due to ground gusts and taxiing downwind :
 - (1) The control system between the stops nearest the surfaces and the cockpit controls must be designed for loads corresponding to the limit hinge moments H of paragraph (a)(2) of this section. These loads need not exceed—

48.3 Fuel System Components**FAR 25.991 : Fuel pumps.**

- (a) *Main pumps.* Each fuel pump required for proper engine operation, or required to meet the fuel system requirements of this subpart (other than those in paragraph (b) of this section), is a main pump. For each main pump, provision must be made to allow the bypass of each positive displacement fuel pump other than a fuel injection pump (a pump that supplies the proper flow and pressure for fuel injection when the injection is not accomplished in a carburetor) approved as part of the engine.
- (b) *Emergency pumps.* There must be emergency pumps or another main pump to feed each engine immediately after failure of any main pump (other than a fuel injection pump approved as part of the engine).

FAR 25.993 : Fuel system lines and fittings.

- (a) Each fuel line must be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure and accelerated flight conditions.
- (b) Each fuel line connected to components of the airplane between which relative motion could exist must have provisions for flexibility.
- (c) Each flexible connection in fuel lines that may be under pressure and subjected to axial loading must use flexible hose assemblies.
- (d) Flexible hose must be approved or must be shown to be suitable for the particular application.
- (e) No flexible hose that might be adversely affected by exposure to high temperatures may be used where excessive temperatures will exist during operation or after engine shut-down.
- (f) [Each fuel line within the fuselage must be designed and installed to allow a reasonable degree of deformation and stretching without leakage.]

Amdt. 25-15, EFF. 10/24/67

FAR 25.994 : Fuel system components.

[Fuel system components in an engine nacelle or in the fuselage must be protected from damage which could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway.]

Amdt. 25-57, EFF. 3/26/84

FAR 25.995 : Fuel valves.

- In addition to the requirements of Sec. 25.1189 for shutoff means, each fuel valve must—
 - (a) [[Reserved.]]
 - (b) Be supported so that no loads resulting from their operation or from accelerated flight conditions are transmitted to the lines attached to the valve.
- Amdt. 25-40, EFF. 5/2/77

- (c) A means must be provided to prevent damage to the fuel system in the event of failure of the automatic shutoff means prescribed in paragraph (b) of this section.
- (d) The airplane pressure fueling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum pressures, including surge, that is likely to occur during fueling. The maximum surge pressure must be established with any combination of tank valves being either intentionally or inadvertently closed.
- (e) The airplane defueling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum permissible defueling pressure (positive or negative) at the airplane fueling connection.

Amdt. 25-72, Eff. 8/20/90

FAR 25.981 : Fuel tank [ignition prevention.]

- (a) [No ignition source may be present at each point in the fuel tank or fuel tank system where catastrophic failure could occur due to ignition of fuel or vapors. This must be shown by :

- (1) Determining the highest temperature allowing a safe margin below the lowest expected autoignition temperature of the fuel in the fuel tanks.
- (2) Demonstrating that no temperature at each place inside each fuel tank where fuel ignition is possible will exceed the temperature determined under paragraph (a)(1) of this section. This must be verified under all probable operating, failure, and malfunction conditions of each component whose operation, failure, or malfunction could increase the temperature inside the tank.
- (3) Demonstrating that an ignition source could not result from each single failure, from each single failure in combination with each latent failure condition not shown to be extremely remote, and from all combinations of failures not shown to be extremely improbable. The effects of manufacturing variability, aging, wear, corrosion, and likely damage must be considered.

- (b) Based on the evaluations required by this section, critical design configuration control limitations, inspections, or other procedures must be established, as necessary, to prevent development of ignition sources within the fuel tank system and must be included in the Airworthiness Limitations section of the Instructions for Continued Airworthiness required by Sec. 25.1529. Visible means to identify critical features of the design must be placed in areas of the airplane where maintenance actions, repairs, or alterations may be apt to violate the critical design configuration limitations (e.g., color-coding of wire to identify separation limitation).

- (c) The fuel tank installation must include either—

- (1) Means to minimize the development of flammable vapors in the fuel tanks (in the context of this rule, "minimize" means to incorporate practicable design methods to reduce the likelihood of flammable vapors); or
- (2) Means to mitigate the effects of an ignition of fuel vapors within fuel tanks such that no damage caused by an ignition will prevent continued safe flight and landing.]

Amdt. 25-102, Eff. 6/6/2001

- (i) The loads corresponding to the maximum pilot loads in Sec. 25.397(c) for each pilot alone ; or
- (ii) 0.75 times these maximum loads for each pilot when the pilot forces are applied in the same direction.

- (2) [The control system stops nearest the surfaces, the control system locks, and the parts of the systems (if any) between these stops and locks and the control surface horns, must be designed for limit hinge moments, H , in foot pounds, obtained from the formula, $H = .0034KV^2cS$, where—

$V = 65$: (wind speed in knots)

K : limit hinge moment factor for ground gusts derived in paragraph (b) of this section.

c : mean chord of the control surface aft of the hinge line (ft) ;

S : area of the control surface aft of the hinge line (sq ft) ;]

- (b) The limit hinge moment factor K for ground gusts must be derived as follows :

Surface	K	Position of controls
(a) Aileron	0.75	Control column locked or lashed in mid-position.
(b) Aileron	$* \pm 0.50$	Ailerons at full throw.
(c) Elevator	$* \pm 0.75$	(c) Elevator full down.
(d) Elevator	$* \pm 0.75$	(d) Elevator full up.
(e) Rudder	0.75	(e) Rudder in neutral.
(f) Rudder	0.75	(f) Rudder at full throw.

* A positive value of K indicates a moment tending to depress the surface, while a negative value of K indicates a moment tending to raise the surface.

Amdt. 25-91, Eff. 7/29/97

FAR 25.427 : Unsymmetrical loads.

- (a) [In designing the airplane for lateral gust, yaw maneuver and roll maneuver conditions, account must be taken of unsymmetrical loads on the empennage arising from effects such as slipstream and aerodynamic interference with the wing, vertical fin and other aerodynamic surfaces.

- (b) The horizontal tail must be assumed to be subjected to unsymmetrical loading conditions determined as follows :

- (1) 100 percent of the maximum loading from the symmetrical maneuver conditions of Sec. 25.331 and the vertical gust conditions of Sec. 25.341(a) acting separately on the surface on one side of the plane of symmetry ; and
- (2) 80 percent of these loadings acting on the other side.

- (c) For empennage arrangements where the horizontal tail surfaces have dihedral angles greater than plus or minus 10 degrees, or are supported by the vertical tail surfaces, the surfaces and the supporting structure must be designed for gust velocities specified in Sec. 25.341(a) acting in any orientation at right angles to the flight path.

- (d) Unsymmetrical loading on the empennage arising from buffet conditions of Sec. 25.305(e) must be taken into account.]

Amdt. 25-86, Eff. 3/11/96

FAR 25.445 : [Auxiliary aerodynamic surfaces.]

- (a) [When significant, the aerodynamic influence between auxiliary aerodynamic surfaces, such as outboard fins and winglets, and their supporting aerodynamic surfaces, must be taken into account for all loading conditions including pitch, roll, and yaw maneuvers, and gusts as specified in Sec. 25.341(a) acting at any orientation at right angles to the flight path.]
- (b) To provide for unsymmetrical loading when outboard fins extend above and below the horizontal surface, the critical vertical surface loading (load per unit area) determined under Sec. 25.391 must also be applied as follows :
 - (1) 100 percent to the area of the vertical surfaces above (or below) the horizontal surface.
 - (2) 80 percent to the area below (or above) the horizontal surface.

Amdt. 25-86, Eff. 3/11/96

FAR 25.457 : Wing flaps.

Wing flaps, their operating mechanisms, and their supporting structures must be designed for critical loads occurring in the conditions prescribed in Sec. 25.345, accounting for the loads occurring during transition from one flap position and airspeed to another.

FAR 25.459 : Special devices.

The loading for special devices using aerodynamic surfaces (such as slots [slats] and spoilers) must be determined from test data.

Amdt. 25-72, Eff. 8/20/90

46.6 Ground Loads**FAR 25.471 : General.**

- (a) *Loads and equilibrium.* For limit ground loads—
 - (1) Limit ground loads obtained under this subpart are considered to be external forces applied to the airplane structure; and
 - (2) In each specified ground load condition, the external loads must be placed in equilibrium with the linear and angular inertia loads in a rational or conservative manner.
- (b) [*Critical centers of gravity.* The critical centers of gravity within the range for which certification is requested must be selected so that the maximum design loads are obtained in each landing gear element. Fore and aft, vertical, and lateral airplane centers of gravity must be considered. Lateral displacements of the c.g. from the airplane centerline which would result in main gear loads not greater than 103 percent of the critical design load for symmetrical loading conditions may be selected without considering the effects of these lateral c.g. displacements on the loading of the main gear elements, or on the airplane structure provided—
 - (1) The lateral displacement of the c.g. results from random passenger or cargo disposition within the fuselage or from random unsymmetrical fuel loading or fuel usage; and

- (ii) Maximum rate of ascent and descent; and
- (iii) Refueling and defueling (where applicable);
- (4) Airspaces of tanks with interconnected outlets must be interconnected;
- (5) There may be no point in any vent line where moisture can accumulate with the airplane in the ground attitude or the level flight attitude, unless drainage is provided; and
- (6) No vent or drainage provision may end at any point—
 - (i) Where the discharge of fuel from the vent outlet would constitute a fire hazard; or
 - (ii) From which fumes could enter personnel compartments.
- (b) *Carburetor vapor vents.* Each carburetor with vapor elimination connections must have a vent line to lead vapors back to one of the fuel tanks. In addition—
 - (1) Each vent system must have means to avoid stoppage by ice; and
 - (2) If there is more than one fuel tank, and it is necessary to use the tanks in a definite sequence, each vapor vent return line must lead back to the fuel tank used for takeoff and landing.

FAR 25.977 : Fuel tank outlet.

- (a) There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must—
 - (1) For reciprocating engine powered airplanes, have 8 to 16 meshes per inch; and
 - (2) For turbine engine powered airplanes, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.
- (b) [[Reserved]]
- (c) The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line.
- (d) The diameter of each strainer must be at least that of the fuel tank outlet.
- (e) Each finger strainer must be accessible for inspection and cleaning.

Amdt. 25-36, Eff. 10/31/74

FAR 25.979 : Pressure fueling system.

For pressure fueling systems, the following apply :

- (a) Each pressure fueling system fuel manifold connection must have means to prevent the escape of hazardous quantities of fuel from the system if the fuel entry valve fails.
- (b) An automatic shutoff means must be provided to prevent the quantity of fuel in each tank from exceeding the maximum quantity approved for that tank. This means must—
 - (1) Allow checking for proper shutoff operation before each fueling of the tank; and
 - (2) Provide indication at each fueling station of failure of the shutoff means to stop the fuel flow at the maximum quantity approved for that tank.]

- (d) No engine nacelle skin immediately behind a major air outlet from the engine compartment may act as the wall of an integral tank.
- (e) Each fuel tank must be isolated from personnel compartments by a fireproof and fireproof enclosure.

FAR 25.969 : Fuel tank expansion space.

[Each fuel tank must have an expansion space of not less than 2 percent of the tank capacity. It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude. For pressure fueling systems, compliance with this section may be shown with the means provided to comply with Sec. 25.979(b).]

Amdt. 25-11, Eff. 6/4/67

FAR 25.971 : Fuel tank sump.

- (a) Each fuel tank must have a sump with an effective capacity, in the normal ground attitude, of not less than the greater of 0.10 percent of the tank capacity or one-sixteenth of a gallon unless operating limitations are established to ensure that the accumulation of water in service will not exceed the sump capacity.
- (b) Each fuel tank must allow drainage of any hazardous quantity of water from any part of the tank to its sump with the airplane in the ground attitude.
- (c) Each fuel tank sump must have an accessible drain that—
 - (1) Allows complete drainage of the sump on the ground;
 - (2) Discharges clear of each part of the airplane; and
 - (3) Has manual or automatic means for positive locking in the closed position.

FAR 25.973 : Fuel tank filler connection.

Each fuel tank filler connection must prevent the entrance of fuel into any part of the airplane other than the tank itself. In addition—

- (a) [[Reserved.]]
- (b) Each recessed filler connection that can retain any appreciable quantity of fuel must have a drain that discharges clear of each part of the airplane;
- (c) Each filler cap must provide a fuel-tight seal; and
- (d) Each fuel filling point, except pressure fueling connection points, must have a provision for electrically bonding the airplane to ground fueling equipment.

Amdt. 25-72, Eff. 8/20/90

FAR 25.975 : Fuel tank vents and carburetor vapor vents.

- (a) *Fuel tank vents.* Each fuel tank must be vented from the top part of the expansion space so that venting is effective under any normal flight condition. In addition—
 - (1) Each vent must be arranged to avoid stoppage by dirt or ice formation;
 - (2) The vent arrangement must prevent siphoning of fuel during normal operation;
 - (3) The venting capacity and vent pressure levels must maintain acceptable differences of pressure between the interior and exterior of the tank, during—
 - (i) Normal flight operation;

- (2) Appropriate loading instructions for random disposable loads are included under the provisions of Sec. 25.1583(c)(1) to ensure that the lateral displacement of the center of gravity is maintained within these limits.

- (c) *Landing gear dimension data.* Figure 1 of Appendix A contains the basic landing gear dimension data.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.473 : Landing load conditions and assumptions.

- (a) For the landing conditions specified in Sec. 25.479 to Sec. 25.485 the airplane is assumed to contact the ground—

- (1) In the attitudes defined in Sec. 25.479 and Sec. 25.481;
- (2) With a limit descent velocity of 10 fps at the design landing weight (the maximum weight for landing conditions at maximum descent velocity); and
- (3) With a limit descent velocity of 6 fps at the design take-off weight (the maximum weight for landing conditions at a reduced descent velocity).
- (4) The prescribed descent velocities may be modified if it is shown that the airplane has design features that make it impossible to develop these velocities.
- (b) Airplane lift, not exceeding airplane weight, may be assumed unless the presence of systems or procedures significantly affects the lift.
- (c) The method of analysis of airplane and landing gear loads must take into account at least the following elements :
 - (1) Landing gear dynamic characteristics.
 - (2) Spin-up and springback.
 - (3) Rigid body response.
 - (4) Structural dynamic response of the airframe, if significant.
- (d) [The landing gear dynamic characteristics must be validated by tests as defined in Sec. 25.723(a).]
- (e) The coefficient of friction between the tires and the ground may be established by considering the effects of skidding velocity and tire pressure. However, this coefficient of friction need not be more than 0.8.

Amdt. 25-103, Eff. 6/15/2001

FAR 25.477 : Landing gear arrangement.

Sections 25.479 through 25.485 apply to airplanes with conventional arrangements of main and nose gears, or main and tail gears, when normal operating techniques are used.

FAR 25.479 : Level landing conditions.

- (a) [In the level attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L1} to $1.25 V_{L2}$ parallel to the ground under the conditions prescribed in Sec. 25.473 with—
 - (1) V_{L1} equal to V_{S0} (TAS) at the appropriate landing weight and in standard sea level conditions; and

- (2) V_{L2} equal to V_{S0} (TAS) at the appropriate landing weight and altitudes in a hot day temperature of 41 degrees F. above standard.
- (3) The effects of increased contact speed must be investigated if approval of down-wind landings exceeding 10 knots is requested.
- (b) For the level landing attitude for airplanes with tail wheels, the conditions specified in this section must be investigated with the airplane horizontal reference line horizontal in accordance with Figure 2 of Appendix A of this part.
- (c) For the level landing attitude for airplanes with nose wheels, shown in Figure 2 of Appendix A of this part, the conditions specified in this section must be investigated assuming the following attitudes :
 - (1) An attitude in which the main wheels are assumed to contact the ground with the nose wheel just clear of the ground; and
 - (2) If reasonably attainable at the specified descent and forward velocities, an attitude in which the nose and main wheels are assumed to contact the ground simultaneously.
- (d) In addition to the loading conditions prescribed in paragraph (a) of this section, but with maximum vertical ground reactions calculated from paragraph (a), the following apply :
 - (1) The landing gear and directly affected attaching structure must be designed for the maximum vertical ground reaction combined with an aft acting drag component of not less than 25% of this maximum vertical ground reaction.
 - (2) The most severe combination of loads that are likely to arise during a lateral drift landing must be taken into account. In absence of a more rational analysis of this condition, the following must be investigated :
 - (i) A vertical load equal to 75% of the maximum ground reaction of Sec. 25.473 must be considered in combination with a drag and side load of 40% and 25% respectively of that vertical load.
 - (ii) The shock absorber and tire deflections must be assumed to be 75% of the deflection corresponding to the maximum ground reaction of Sec. 25.473(a)(2). This load case need not be considered in combination with flat tires.
 - (3) The combination of vertical and drag components is considered to be acting at the wheel axle centerline.]

Amdt. 25-91, Eff. 7/29/97

FAR 25.481 : Tail down landing conditions.

- (a) In the tail-down attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L1} to V_{L2} parallel to the ground under the conditions prescribed in Sec. 25.473 with—
 - (1) V_{L1} equal to V_{S0} (TAS) at the appropriate landing weight and in standard sea level conditions; and
 - (2) V_{L2} equal to V_{S0} (TAS) at the appropriate landing weight and altitudes in a hot day temperature of 41 degrees F. above standard.
- (3) [The combination of vertical and drag components considered to be acting at the main wheel axle centerline.]

- (i) If no frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical, the test frequency of vibration must be 2,000 cycles per minute.
 - (ii) If only one frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical, that frequency of vibration must be the test frequency.
 - (iii) If more than one frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical, the most critical of these frequencies must be the test frequency.
 - (4) Under subparagraph (3)(i) and (iii) of this paragraph, the time of test must be adjusted to accomplish the same number of vibration cycles that would be accomplished in 25 hours at the frequency specified in subparagraph (3)(i) of this paragraph.
 - (5) During the test, the tank assembly must be rocked at the rate of 16 to 20 complete cycles per minute, through an angle of 15° on both sides of the horizontal (30° total), about the most critical axis, for 25 hours. If motion about more than one axis is likely to be critical, the tank must be rocked about each critical axis for 12 1/2 hours.
 - (c) Except where satisfactory operating experience with a similar tank in a similar installation is shown, nonmetallic tanks must withstand the test specified in paragraph (b)(5) of this section, with fuel at a temperature of 110° F. During this test, a representative specimen of the tank must be installed in a supporting structure simulating the installation in the airplane.
 - (d) [For pressurized fuel tanks, it must be shown by analysis or tests that the fuel tanks can withstand the maximum pressure likely to occur on the ground or in flight.]
- Amdt. 25-40, Eff. 5/2/77

FAR 25.967 : Fuel tank installations.

- (a) Each fuel tank must be supported so that tank loads (resulting from the weight of the fuel in the tanks) are not concentrated on unsupported tank surfaces. In addition—
 - (1) There must be pads, if necessary, to prevent chafing between the tank and its supports;
 - (2) Padding must be nonabsorbent or treated to prevent the absorption of fluids;
 - (3) If a flexible tank liner is used, it must be supported so that it is not required to withstand fluid loads; and
 - (4) Each interior surface of the tank compartment must be smooth and free of projections that could cause wear of the liner unless—
 - (i) Provisions are made for protection of the liner at these points; or
 - (ii) The construction of the liner itself provides that protection.
- (b) Spaces adjacent to tank surfaces must be ventilated to avoid fume accumulation due to minor leakage. If the tank is in a sealed compartment, ventilation may be limited to drain holes large enough to prevent excessive pressure resulting from altitude changes.
- (c) The location of each tank must meet the requirements of Sec. 25.1185(a).

FAR 25.963 : Fuel tanks : general.

- (a) Each fuel tank must be able to withstand, without failure, the vibration, inertia, fluid, and structural loads that it may be subjected to in operation.
- (b) Flexible fuel tank liners must be approved or must be shown to be suitable for the particular application.
- (c) Integral fuel tanks must have facilities for interior inspection and repair.
- (d) Fuel tanks within the fuselage contour must be able to resist rupture, and to retain fuel, under the inertia forces prescribed for the emergency landing conditions in Sec. 25.561. In addition, these tanks must be in a protected position so that exposure of the tanks to scraping action with the ground is unlikely.
- (e) [Fuel tank access covers must comply with the following criteria in order to avoid loss of hazardous quantities of fuel :
 - (1) All covers located in an area where experience or analysis indicates a strike is likely must be shown by analysis or tests to minimize penetration and deformation by fire fragments, low energy engine debris, or other likely debris.
 - (2) All covers must be fire resistant as defined in Part 1 of this chapter.]
- (f) For pressurized fuel tanks, a means with fail-safe features must be provided to prevent the buildup of an excessive pressure difference between the inside and the outside of the tank.

Amdt. 25-69, Eff. 10/30/89

FAR 25.965 : Fuel tank tests.

- (a) It must be shown by tests that the fuel tanks, as mounted in the airplane can withstand, without failure or leakage, the more critical of the pressures resulting from the conditions specified in subparagraphs (1) and (2) of this paragraph. In addition, it must be shown by either analysis or tests, that tank surfaces subjected to more critical pressures resulting from the condition of subparagraph (3) and (4) of this paragraph, are able to withstand the following pressures :
 - (1) An internal pressure of 3.5 p.s.i.
 - (2) 125 percent of the maximum air pressure developed in the tank from ram effect.
 - (3) Fluid pressures developed during maximum limit accelerations, and deflections, of the airplane with a full tank.
 - (4) Fluid pressures developed during the most adverse combination of airplane roll and fuel load.
- (b) Each metallic tank with large unsupported or unstiffened flat surfaces, whose failure or deformation could cause fuel leakage, must be able to withstand the following test, or its equivalent, without leakage or excessive deformation of the tank walls :
 - (1) Each complete tank assembly and its supports must be vibration tested while mounted to simulate the actual installation.
 - (2) Except as specified in subparagraph (4) of this paragraph, the tank assembly must be vibrated for 25 hours at an amplitude of not less than 1/32 of an inch (unless another amplitude is substantiated) while 2/3 filled with water or other suitable test fluid.
 - (3) The test frequency of vibration must be as follows :

- (b) For the tail-down landing condition for airplanes with tail wheels, the main and tail wheels are assumed to contact the ground simultaneously, in accordance with figure 3 of Appendix A. Ground reaction conditions on the tail wheel are assumed to act—
 - (1) Vertically; and
 - (2) Up and aft through the axle at 45 degrees to the ground line.
- (c) For the tail-down landing condition for airplanes with nose wheels, the airplane is assumed to be at an attitude corresponding to either the stalling angle or the maximum angle allowing clearance with the ground by each part of the airplane other than the main wheels, in accordance with figure 3 of Appendix A, whichever is less.

Amdt. 25-94, Eff. 3/25/98

FAR 25.483 : [One-gear landing conditions.]

[For the one-gear landing conditions, the airplane is assumed to be in the level attitude and to contact the ground on one main landing gear, in accordance with Figure 4 of Appendix A of this part. In this attitude—

- (a) The ground reactions must be the same as those obtained on that side under Sec. 25.479(d)(1), and]
- (b) Each unbalanced external load must be reacted by airplane inertia in a rational or conservative manner.

Amdt. 25-91, Eff. 7/29/97

FAR 25.485 : Side load conditions.

[In addition to Sec. 25.479(d)(2) the following conditions must be considered :]

- (a) For the side load condition, the airplane is assumed to be in the level attitude with only the main wheels contacting the ground, in accordance with figure 5 of Appendix A.
- (b) Side loads of 0.8 of the vertical reaction (on one side) acting inward and 0.6 of the vertical reaction (on the other side) acting outward must be combined with one-half of the maximum vertical ground reactions obtained in the level landing conditions. These loads are assumed to be applied at the ground contact point and to be resisted by the inertia of the airplane. The drag loads may be assumed to be zero.

Amdt. 25-91, Eff. 7/29/97

FAR 25.487 : Rebound landing condition.

- (a) The landing gear and its supporting structure must be investigated for the loads occurring during rebound of the airplane from the landing surface.
- (b) With the landing gear fully extended and not in contact with the ground, a load factor of 20.0 must act on the unsprung weights of the landing gear. This load factor must act in the direction of motion of the unsprung weights as they reach their limiting positions in extending with relation to the sprung parts of the landing gear.

FAR 25.489 : Ground handling conditions.

[Unless otherwise prescribed, the landing gear and airplane structure must be investigated for the conditions in Secs. 25.491 through 25.509 with the airplane at the design ramp weight (the maximum weight for ground handling conditions).] No wing lift may be considered. The shock absorbers and tires may be assumed to be in their static position. Amdt. 25-23, Eff. 5/8/70

FAR 25.491 : [Taxi, takeoff and landing roll.]

[Within the range of appropriate ground speeds and approved weights, the airplane structure and landing gear are assumed to be subjected to loads not less than those obtained when the aircraft is operating over the roughest ground that may reasonably be expected in normal operation.] Amdt. 25-91, Eff. 7/29/97

FAR 25.493 : Braked roll conditions.

- (a) An airplane with a tail wheel is assumed to be in the level attitude with the load on the main wheels, in accordance with figure 6 of Appendix A. The limit vertical load factor is 1.2 at the design landing weight, and 1.0 at the design takeoff weight. A drag reaction equal to the vertical reaction multiplied by a coefficient of friction of 0.8, must be combined with the vertical ground reaction and applied at the ground contact point.
- (b) For an airplane with a nose wheel, the limit vertical load factor is 1.2 at the design landing weight, and 1.0 at the design takeoff weight. A drag reaction equal to the vertical reaction, multiplied by a coefficient of friction of 0.8, must be combined with the vertical reaction and applied at the ground contact point of each wheel with brakes. The following two attitudes, in accordance with figure 6 of Appendix A, must be considered :
 - (1) The level attitude with the wheels contacting the ground and the loads distributed between the main and nose gear. Zero pitching acceleration is assumed.
 - (2) The level attitude with only the main gear contacting the ground and with the pitching moment resisted by angular acceleration.
- (c) [A drag reaction lower than that prescribed in this section may be used if it is substantiated that an effective drag force of 0.8 times the vertical reaction cannot be attained under any likely loading condition.
- (d) An airplane equipped with a nose gear must be designed to withstand the loads arising from the dynamic pitching motion of the airplane due to sudden application of maximum braking force. The airplane is considered to be at design takeoff weight with the nose and main gears in contact with the ground, and with a steady-state vertical load factor of 1.0. The steady-state nose gear reaction must be combined with the maximum incremental nose gear vertical reaction caused by the sudden application of maximum braking force as described in paragraphs (b) and (c) of this section.
- (e) In the absence of a more rational analysis, the nose gear vertical reaction prescribed in paragraph (d) of this section must be calculated according to the following formula :

$$V_N = \frac{W_T}{A+B} \left(B + \frac{f \mu A E}{A+B+\mu E} \right)$$

FAR 25.959 : Unusable fuel supply.

The unusable fuel quantity for each fuel tank and its fuel system components must be established at not less than the quantity at which the first evidence of engine malfunction occurs under the most adverse fuel feed condition for all intended operations and flight maneuvers involving fuel feeding from that tank. [Fuel system component failure need not be considered.] Amdt. 25-40, Eff. 5/2/77

FAR 25.961 : Fuel system hot weather operation.

- (a) The fuel system must perform satisfactorily in hot weather operation. This must be shown by showing that the fuel system from the tank outlets to each engine is pressurized, under all intended operations, so as to prevent vapor formation, or must be shown by climbing from the altitude of the airport elected by the applicant to the maximum altitude established as an operating limitation under Sec. 25.1527. If a climb test is elected, there may be no evidence of vapor lock or other malfunctioning during the climb test conducted under the following conditions :
 - (1) For reciprocating engine powered airplanes, the engines must operate at maximum continuous power, except that takeoff power must be used for the altitudes from 1,000 feet below the critical altitude through the critical altitude. The time interval during which takeoff power is used may not be less than the takeoff time limitation.
 - (2) For turbine engine powered airplanes, the engines must operate at takeoff power for the time interval selected for showing the takeoff flight path, and at maximum continuous power for the rest of the climb.
 - (3) The weight of the airplane must be the weight with full fuel tanks, minimum crew, and the ballast necessary to maintain the center of gravity within allowable limits.
 - (4) The climb airspeed may not exceed—
 - (i) [For reciprocating engine powered airplanes, the maximum airspeed established for climbing from takeoff to the maximum operating altitude with the airplane in the following configuration :
 - (A) Landing gear retracted.
 - (B) Wing flaps in the most favorable position.
 - (C) Cowl flaps (or other means of controlling the engine cooling supply) in the position that provides adequate cooling in the hot-day condition.
 - (D) Engine operating within the maximum continuous power limitations.
 - (E) Maximum takeoff weight ; and]
 - (ii) For turbine engine powered airplanes, the maximum airspeed established for climbing from takeoff to the maximum operating altitude.
 - (5) The fuel temperature must be at least 110°F.
- (b) The test prescribed in paragraph (a) of this section may be performed in flight or on the ground under closely simulated flight conditions. If a flight test is performed in weather cold enough to interfere with the proper conduct of the test, the fuel tank surfaces, fuel lines, and other fuel system parts subject to cold air must be insulated to simulate, insofar as practicable, flight in hot weather. Amdt. 25-57, Eff. 3/26/84

FAR 25.953 : Fuel system independence.

Each fuel system must meet the requirements of Sec. 25.903(b) by—

- (a) Allowing the supply of fuel to each engine through a system independent of each part of the system supplying fuel to any other engine ; or
- (b) Any other acceptable method.

FAR 25.954 : [Fuel system lightning protection.]

[The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by—

- (a) Direct lightning strikes to areas having a high probability of stroke attachment ;
- (b) Swept lightning strokes to areas where swept strokes are highly probable; and
- (c) Corona and streamering at fuel vent outlets.]

Amdt. 25-14, Eff. 10/10/67

FAR 25.955 : Fuel flow.

- (a) Each fuel system must provide at least 100 percent of the fuel flow required under each intended operating condition and maneuver. Compliance must be shown as follows :

- (1) Fuel must be delivered to each engine at a pressure within the limits specified in the engine type certificate.
- (2) The quantity of fuel in the tank may not exceed the amount established as the unusable fuel supply for that tank under the requirements of Sec. 25.959 plus that necessary to show compliance with this section.
- (3) Each main pump must be used that is necessary for each operating condition and attitude for which compliance with this section is shown, and the appropriate emergency pump must be substituted for each main pump so used.
- (4) If there is a fuel flowmeter, it must be blocked and the fuel must flow through the meter or its bypass.

- (b) [If an engine can be supplied with fuel from more than one tank, the fuel system must—

- (1) For each reciprocating engine, supply the full fuel pressure to that engine in not more than 20 seconds after switching to any other fuel tank containing usable fuel when engine malfunctioning becomes apparent due to the depletion of the fuel supply in any tank from which the engine can be fed ; and
- (2) For each turbine engine, in addition to having appropriate manual switching capability, be designed to prevent interruption of fuel flow to that engine, without attention by the flight crew, when any tank supplying fuel to that engine is depleted of usable fuel during normal operation, and any other tank, that normally supplies fuel to that engine alone, contains usable fuel.]

Amdt. 25-11, Eff. 6/4/67

FAR 25.957 : Flow between interconnected tanks.

If fuel can be pumped from one tank to another in flight, the fuel tank vents and the fuel transfer system must be designed so that no structural damage to the tanks can occur because of overfilling.

Where :

V_N : Nose gear vertical reaction.

W_T : Design takeoff weight.

A : Horizontal distance between the c.g. of the airplane and the nose wheel.

B : Horizontal distance between the c.g. of the airplane and the line joining the centers of the main wheels.

E : Vertical height of the c.g. of the airplane above the ground in the 1.0 g static condition.

μ : Coefficient of friction of 0.80.

f : Dynamic response factor; 2.0 is to be used unless a lower factor is substantiated. In the absence of other information, the dynamic response factor f may be defined by the (Equation 46.2, p. 549).

ξ : is the effective critical damping ratio of the rigid body pitching mode about the main landing gear effective ground contact point.

$$f = 1 + \exp \left(\frac{-\pi \xi}{\sqrt{1 - \xi^2}} \right) \quad (46.2)$$

Amdt. 25-97, Eff. 5/27/98

FAR 25.495 : Turning.

In the static position, in accordance with figure 7 of Appendix A, the airplane is assumed to execute a steady turn by nose gear steering, or by application of sufficient differential power, so that the limit load factors applied at the center of gravity are 1.0 vertically and 0.5 laterally. The side ground reaction of each wheel must be 0.5 of the vertical reaction.

FAR 25.497 : Tail-wheel yawing.

- (a) A vertical ground reaction equal to the static load on the tail wheel, in combination with a side component of equal magnitude, is assumed.
- (b) If there is a swivel, the tail wheel is assumed to be swiveled 90° to the airplane longitudinal axis with the resultant load passing through the axle.
- (c) If there is a lock, steering device, or shimmy damper the tail wheel is also assumed to be in the trailing position with the side load acting at the ground contact point.

FAR 25.499 : [Nose-wheel yaw and steering.]

- (a) A vertical load factor of 1.0 at the airplane center of gravity, and a side component at the nose wheel ground contact equal to 0.8 of the vertical ground reaction at that point are assumed.
- (b) With the airplane assumed to be in static equilibrium with the loads resulting from the use of brakes on one side of the main landing gear, the nose gear, its attaching structure, and the fuselage structure forward of the center of gravity must be designed for the following loads :
 - (1) A vertical load factor at the center of gravity of 1.0.
 - (2) A forward acting load at the airplane center of gravity of 0.8 times the vertical load on one main gear.

- (3) Side and vertical loads at the ground contact point on the nose gear that are required for static equilibrium.
- (4) A side load factor at the airplane center of gravity of zero.
- (c) If the loads prescribed in paragraph (b) of this section result in a nose gear side load higher than 0.8 times the vertical nose gear load, the design nose gear side load may be limited to 0.8 times the vertical load, with unbalanced yawing moments assumed to be resisted by airplane inertia forces.
- (d) For other than the nose gear, its attaching structure, and the forward fuselage structure, the loading conditions are those prescribed in paragraph (b) of this section, except that—
 - (1) A lower drag reaction may be used if an effective drag force of 0.8 times the vertical reaction cannot be reached under any likely loading condition; and
 - (2) The forward acting load at the center of gravity need not exceed the maximum drag reaction on one main gear, determined in accordance with Sec. 25.493(b).
- (e) [With the airplane at design ramp weight, and the nose gear in any steerable position, the combined application of full normal steering torque and vertical force equal to 1.33 times the maximum static reaction on the nose gear must be considered in designing the nose gear, its attaching structure, and the forward fuselage structure.]

Amdt. 25-91, Eff. 7/29/97

FAR 25.503 : Pivoting.

- (a) The airplane is assumed to pivot about one side of the main gear with the brakes on that side locked. The limit vertical load factor must be 1.0 and the coefficient of friction 0.8.
- (b) The airplane is assumed to be in static equilibrium, with the loads being applied at the ground contact points, in accordance with figure 8 of Appendix A.

FAR 25.507 : Reversed braking.

- (a) The airplane must be in a three point static ground attitude. Horizontal reactions parallel to the ground and directed forward must be applied at the ground contact point of each wheel with brakes. The limit loads must be equal to 0.55 times the vertical load at each wheel or to the load developed by 1.2 times the nominal maximum static brake torque, whichever is less.
- (b) For airplanes with nose wheels, the pitching moment must be balanced by rotational inertia.
- (c) For airplanes with tail wheels, the resultant of the ground reactions must pass through the center of gravity of the airplane.

FAR 25.509 : Towing loads.

- (a) The towing loads specified in paragraph (d) of this section must be considered separately. These loads must be applied at the towing fittings and must act parallel to the ground. In addition—
 - (1) A vertical load factor equal to 1.0 must be considered acting at the center of gravity;

- (3) If a vent is provided, the venting must be effective under all normal flight conditions.
- (4) [[Reserved]]
- (c) Augmentation system drains must be designed and located in accordance with Sec. 25.1455 if—
 - (1) The augmentation system fluid is subject to freezing; and
 - (2) The fluid may be drained in flight or during ground operation.
- (d) The augmentation liquid tank capacity available for the use of each engine must be large enough to allow operation of the airplane under the approved procedures for the use of liquid-augmented power. The computation of liquid consumption must be based on the maximum approved rate appropriate for the desired engine output and must include the effect of temperature on engine performance as well as any other factors that might vary the amount of liquid required.
- (e) This section does not apply to fuel injection systems.

Amdt. 25-72, Eff. 8/20/90

48.2 Fuel System

FAR 25.951 : General.

- (a) Each fuel system must be constructed and arranged to ensure a flow of fuel at a rate and pressure established for proper engine and auxiliary power unit functioning under each likely operating condition, including any maneuver for which certification is requested and during which the engine or auxiliary power unit is permitted to be in operation.
- (b) Each fuel system must be arranged so that any air which is introduced into the system will not result in—
 - (1) Power interruption for more than 20 seconds for reciprocating engines; or
 - (2) Flameout for turbine engines.
- (c) Each fuel system for a turbine engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80° F and having 0.75cc of free water per gallon added and cooled to the most critical condition for icing likely to be encountered in operation.
- (d) [Each fuel system for a turbine engine powered airplane must meet the applicable fuel venting requirements of Part 34 of this chapter.]

Amdt. 25-73, Eff. 9/10/90

FAR 25.952 : [Fuel system analysis and test.]

- (a) [Proper fuel system functioning under all probable operating conditions must be shown by analysis and those tests found necessary by the Administrator. Tests, if required, must be made using the airplane fuel system or a test article that reproduces the operating characteristics of the portion of the fuel system to be tested.
- (b) The likely failure of any heat exchanger using fuel as one of its fluids may not result in a hazardous condition.]

Amdt. 25-40, Eff. 5/2/77

FAR 25.939 : Turbine engine operating characteristics.

(a) Turbine engine operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flameout) are present, to a hazardous degree, during normal and emergency operation within the range of operation limitations of the airplane and of the engine.

(b) [[Reserved.]]

(c) The turbine engine air inlet system may not, as a result of air flow distortion during normal operation, cause vibration harmful to the engine.

Amdt. 25-40, Eff. 5/2/77

FAR 25.941 : [Inlet, engine, and exhaust compatibility.]

[For airplanes using variable inlet or exhaust system geometry, or both—

(a) The system comprised of the inlet, engine (including thrust augmentation systems, if incorporated), and exhaust must be shown to function properly under all operating conditions for which approval is sought, including all engine rotating speeds and power settings, and engine inlet and exhaust configurations

(b) The dynamic effects of the operation of these (including consideration of probable malfunctions) upon the aerodynamic control of the airplane may not result in any condition that would require exceptional skill, alertness, or strength on the part of the pilot to avoid exceeding an operational or structural limitation of the airplane; and

(c) In showing compliance with paragraph (b) of this section, the pilot strength required may not exceed the limits set forth in Sec. 25.143(c), subject to the conditions set forth in paragraph (d) and (e) of Sec. 25.143.]

Amdt. 25-38, Eff. 2/1/77

FAR 25.943 : [Negative acceleration.]

[No hazardous malfunction of an engine, an auxiliary power unit approved for use in flight, or any component or system associated with the powerplant or auxiliary power unit may occur when the airplane is operated at the negative accelerations within the flight envelopes prescribed in Sec. 25.333. This must be shown for the greatest duration expected for the acceleration.]

Amdt. 25-40, Eff. 5/2/77

FAR 25.945 : Thrust or power augmentation system.

(a) *General.* Each fluid injection system must provide a flow of fluid at the rate and pressure established for proper engine functioning under each intended operating condition. If the fluid can freeze, fluid freezing may not damage the airplane or adversely affect airplane performance.

(b) *Fluid tanks.* Each augmentation system fluid tank must meet the following requirements :

(1) Each tank must be able to withstand without failure the vibration, inertia, fluid, and structural loads that it may be subject to in operation.

(2) The tanks as mounted in the airplane must be able to withstand without failure or leakage an internal pressure 1.5 times the maximum operating pressure.

(2) The shock struts and tires must be in their static positions ; and

(3) With W_T as the [design ramp weight], the towing load, F_{TOW} , is—

(i) $0.3 W_T$ for W_T less than 30,000 pounds ;

(ii) $\frac{6W_T+450000}{70}$ for W_T between 30,000 and 100,000 pounds ; and

(iii) $0.15 W_T$ for W_T over 100,000 pounds.

(b) For towing points not on the landing gear but near the plane of symmetry of the airplane, the drag and side tow load components specified for the auxiliary gear apply. For towing points located outboard of the main gear, the drag and side tow load components specified for the main gear apply. Where the specified angle of swivel cannot be reached, the maximum obtainable angle must be used.

(c) The towing loads specified in paragraph (d) of this section must be reacted as follows :

(1) The side component of the towing load at the main gear must be reacted by a side force at the static ground line of the wheel to which the load is applied.

(2) The towing loads at the auxiliary gear and the drag components of the towing loads at the main gear must be reacted as follows :

(i) A reaction with a maximum value equal to the vertical reaction must be applied at the axle of the wheel to which the load is applied. Enough airplane inertia to achieve equilibrium must be applied.

(ii) The loads must be reacted by airplane inertia.

(d) The prescribed towing loads are as follows :

Tow point	Position	Magnitude	No.	Load
Main gear.		$0.75 F_{TOW}$	1	Forward, parallel to drag axis.
		per main gear unit.	2	Forward, at 30° to drag axis.
			3	Aft, parallel to drag axis.
			4	Aft, at 30° to drag axis.
Auxiliary gear.	Swiveled forward.	$1.0 F_{TOW}$	5	Forward.
	Swiveled aft.	... do	6	Aft.
			7	Forward.
			8	Aft.
	Swiveled 45° from forward.	$0.5 F_{TOW}$	9	Forward, in plane of wheel.
	Swiveled 45° from aft.	... do	10	Aft, in plane of wheel.
			11	Forward, in plane of wheel.
			12	Aft, in plane of wheel.

Amdt. 25-23, Eff. 5/8/70

FAR 25.511 : Ground load : unsymmetrical loads on multiple-wheel units.

(a) *General.* Multiple-wheel landing gear units are assumed to be subjected to the limit ground loads prescribed in this subpart under paragraphs (b) through (f) of this section. In addition—

(1) A tandem strut gear arrangement is a multiple-wheel unit ; and

(2) In determining the total load on a gear unit with respect to the provisions of paragraphs (b) through (f) of this section, the transverse shift in the load centroid, due to unsymmetrical load distribution on the wheels, may be neglected.

(b) *Distribution of limit loads to wheels ; tires inflated.* The distribution of the limit loads among the wheels of the landing gear must be established for each landing, taxiing, and ground handling condition, taking into account the effects of the following factors :

- (1) The number of wheels and their physical arrangements. For truck type landing gear units, the effects of any seesaw motion of the truck during the landing impact must be considered in determining the maximum design loads for the fore and aft wheel pairs.
 - (2) Any differentials in tire diameters resulting from a combination of manufacturing tolerances, tire growth, and tire wear. A maximum tire-diameter differential equal to $\frac{3}{8}$ of the most unfavorable combination of diameter variations that is obtained when taking into account manufacturing tolerances, tire growth, and tire wear, may be assumed.
 - (3) Any unequal tire inflation pressure, assuming the maximum variation to be ± 5 percent of the nominal tire inflation pressure.
 - (4) A runway crown of zero and a runway crown having a convex upward shape that may be approximated by a slope of 1 *Demi* percent with the horizontal. Runway crown effects must be considered with the nose gear unit on either slope of the crown.
 - (5) The airplane altitude.
 - (6) Any structural deflections.
- (c) *Deflated tires.* The effect of deflated tires on the structure must be considered with respect to the loading conditions specified in paragraphs (d) through (f) of this section, taking into account the physical arrangement of the gear components. In addition—
- (1) The deflation of any one tire for each multiple wheel landing gear unit, and the deflation of any two critical tires for each landing gear unit using four or more wheels per unit, must be considered ; and
 - (2) The ground reactions must be applied to the wheels with inflated tires except that, for multiple-wheel gear units with more than one shock strut, a rational distribution of the ground reactions between the deflated and inflated tires, accounting for the differences in shock strut extensions resulting from a deflated tire, may be used.
 - (d) *Landing conditions.* For one and for two deflated tires, the applied load to each gear unit is assumed to be 60 percent and 50 percent, respectively, of the limit load applied to each gear for each of the prescribed landing conditions. However, for the drift landing condition of Sec. 25.485, 100 percent of the vertical load must be applied.
 - (e) *Taxiing and ground handling conditions.* For one and for two deflated tires—
 - (1) The applied side or drag load factor, or both factors, at the center of gravity must be the most critical value up to 50 percent and 40 percent, respectively, of the limit side or drag load factors, or both factors, corresponding to the most severe condition resulting from consideration of the prescribed taxiing and ground handling conditions ;
 - (2) For the braked roll conditions of Sec. 25.493 (a) and (b)(2), the drag loads on each inflated tire may not be less than those at each tire for the symmetrical load distribution with no deflated tires ;
 - (3) The vertical load factor at the center of gravity must be 60 percent and 50 percent, respectively, of the factor with no deflated tires, except that it may not be less than 1g ; and

FAR 25.933 : Reversing systems.

- (a) [For turbojet reversing systems—
- (1) Each system intended for ground operation only must be designed so that during any reversal in flight the engine will produce no more than flight idle thrust. In addition, it must be shown by analysis or test, or both, that—
 - (i) Each operable reverser can be restored to the forward thrust position ; and
 - (ii) The airplane is capable of contained safe flight and landing under any possible position of the thrust reverser.
 - (2) Each system intended for inflight use must be designed so that no unsafe condition will result during normal operation of the system, or from any failure (or reasonably likely combination of failures) of the reversing system, under any anticipated condition of operation of the airplane including ground operation. Failure of structural elements need not be considered if the probability of this kind of failure is extremely remote.
 - (3) Each system must have means to prevent the engine from producing more than idle thrust when the reversing system malfunctions, except that it may produce any greater forward thrust that is shown to allow directional control to be maintained, with aerodynamic means alone, under the most critical reversing condition expected in operation.
- (b) For propeller reversing systems—
- (1) Each system intended for ground operation only must be designed so that no single failure (or reasonably likely combination of failures) or malfunction of the system will result in unwanted reverse thrust under any expected operating condition. Failure of structural elements need not be considered if this kind of failure is extremely remote.
 - (2) Compliance with this section may be shown by failure analysis or testing, or both, for propeller systems that allow propeller blades to move from the flight low-pitch position to a position that is substantially less than that at the normal flight low-pitch position. The analysis may include or be supported by the analysis made to show compliance with the requirements of Sec. 35.21 of this chapter for the propeller and associated installation components.]
- Amdt. 25-72, Eff. 8/20/90
- FAR 25.934 : [Turbojet engine thrust reverser system tests.]**
- [Thrust reversers installed on turbojet engines must meet the requirements of Sec. 33.97 of this chapter.]
- Amdt. 25-23, Eff. 5/8/70
- FAR 25.937 : Turbopropeller-drag limiting systems.**
- Turbopropeller powered airplane propeller-drag limiting systems must be designed so that no single failure or malfunction of any of the systems during normal or emergency operation results in propeller drag in excess of that for which the airplane was designed under Sec. 25.367. Failure of structural elements of the drag limiting systems need not be considered if the probability of this kind of failure is extremely remote.

- (c) Each component of the propeller blade pitch control system must meet the requirements of Sec. 35.42 of this chapter
- (d) [Design precautions must be taken to minimize the hazards to the airplane in the event a propeller blade fails or is released by a hub failure. The hazards which must be considered include damage to structure and vital systems due to impact of a failed or released blade and the unbalance created by such failure or release.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.907 : Propeller vibration.

- (a) The magnitude of the propeller blade vibration stresses under any normal condition of operation must be determined by actual measurement or by comparison with similar installations for which these measurements have been made.
- (b) The determined vibration stresses may not exceed values that have been shown to be safe for continuous operation.

FAR 25.925 : Propeller clearance.

Unless smaller clearances are substantiated, propeller clearances with the airplane at maximum weight, with the most adverse center of gravity, and with the propeller in the most adverse pitch position, may not be less than the following :

- (a) *Ground clearance.* There must be a clearance of at least seven inches (for each airplane with nose wheel landing gear) or nine inches (for each airplane with tail wheel landing gear) between each propeller and the ground with landing gear statically deflected and in the level takeoff, or taxiing attitude, whichever is most critical. In addition, there must be positive clearance between the propeller and the ground when in the level takeoff attitude with the critical [tire(s)] completely deflated and the corresponding landing gear strut bottomed.
- (b) *Water clearance.* There must be a clearance of at least 18 inches between each propeller and the water, unless compliance with Sec. 25.239(a) can be shown with a lesser clearance.
- (c) *Structural clearance.* There must be—
- (1) At least one inch radial clearance between the blade tips and the airplane structure, plus any additional radial clearance necessary to prevent harmful vibration;
 - (2) At least one-half inch longitudinal clearance between the propeller blades or cuffs and stationary parts of the airplane; and
 - (3) Positive clearance between other rotating parts of the propeller or spinner and stationary parts of the airplane.

Amdt. 25-72, Eff. 8/20/90

FAR 25.929 : Propeller deicing.

- (a) For airplanes intended for use where icing may be expected, there must be a means to prevent or remove hazardous ice accumulation on propellers or on accessories where ice accumulation would jeopardize engine performance.
- (b) If combustible fluid is used for propeller deicing, Secs. 25.1181 through 25.1185 and 25.1189 apply.

- (4) Pivoting need not be considered.

- (f) *Towing conditions.* For one and for two deflated tires, the towing load, F_{TOW} , must be 60 percent and 50 percent, respectively, of the load prescribed.

FAR 25.519 : [Jacking and tie-down provisions.]

- (a) [General. The airplane must be designed to withstand the limit load conditions resulting from the static ground load conditions of paragraph (b) and, if applicable, paragraph (c) of this section at the most critical combinations of airplane weight and center of gravity. The maximum allowable limit load at each jacking pad must be specified.
- (b) *Jacking.* The airplane must have provisions for jacking and must withstand the following limit loads when the airplane is supported on jacks—
- (1) For jacking by the landing gear at the maximum ramp weight of the airplane, the airplane structure must be designed for a vertical load of 1.33 times the vertical static reaction at each jacking point acting singly and in combination with a horizontal load 0.33 times the vertical static reaction applied in any direction.
 - (2) For jacking by other airplane structure at maximum approved jacking weight :
 - (i) The airplane structure must be designed for a vertical load of 1.33 times the vertical static reaction at each jacking point acting singly and in combination with a horizontal load of 0.33 times the vertical static reaction applied in any direction.
 - (ii) The jacking pads and local structure must be designed for a vertical load of 2.0 times the vertical static reaction at each jacking point, acting singly and in combination with a horizontal load of 0.33 times the vertical static reaction applied in any direction.
 - (c) *Tie-down.* If tie-down points are provided, the main tie-down points and local structure must withstand the limit loads resulting from a 65-knot horizontal wind from any direction.]

Amdt. 25-81, Eff. 5/31/94

46.7 Water Loads

FAR 25.521 : General.

- (a) Seaplanes must be designed for the water loads developed during takeoff and landings, with the seaplane in any attitude likely to occur in normal operation, and at the appropriate forward and sinking velocities under the most severe sea conditions likely to be encountered.
- (b) Unless a more rational analysis of the water loads is made, or the standards in ANC-3 are used, Secs. 25.523 through 25.537 apply.
- (c) The requirements of this section and Secs. 25.523 through 25.537 apply also to amphibians.

FAR 25.523 : Design weights and center of gravity positions.

- (a) *Design weights.* The water load requirements must be met at each operating weight up to the design landing weight except that, for the takeoff condition prescribed in Sec. 25.531, [the design water takeoff weight (the maximum weight for water taxi and takeoff run)] must be used.
 - (b) *Center of gravity positions.* The critical centers of gravity within the limits for which certification is requested must be considered to reach maximum design loads for each part of the seaplane structure.
- Amdt. 25-23, Eff. 5/8/70

FAR 25.525 : Application of loads.

- (a) Unless otherwise prescribed, the seaplane as a whole is assumed to be subjected to the loads corresponding to the load factors specified in Sec. 25.527.
- (b) In applying the loads resulting from the load factors prescribed in Sec. 25.527, the loads may be distributed over the hull or main float bottom (in order to avoid excessive local shear loads and bending moments at the location of water load application) using pressures not less than those prescribed in Sec. 25.533(c).
- (c) For twin float seaplanes, each float must be treated as an equivalent hull on a fictitious seaplane with a weight equal to one-half the weight of the twin float seaplane.
- (d) Except in the takeoff condition of Sec. 25.531, the aerodynamic lift on the seaplane during the impact is assumed to be 2/3 of the weight of the seaplane.

FAR 25.527 : Hull and main float load factors.

- (a) Water reaction load factors n_W must be computed in the following manner :
 - (1) For the step landing case

$$n_W = \frac{C_1 V_{S0}^2}{(\tan \beta)^{\frac{2}{3}} W^{\frac{1}{3}}}$$

- (2) For the bow and stern landing cases

$$n_W = \frac{C_1 V_{S0}^2}{(\tan \beta)^{\frac{2}{3}} W^{\frac{1}{3}}} \frac{K_1}{(1 + r_x^2)^{\frac{2}{3}}}$$

- (b) The following values are used :
 - (1) n_W = water reaction load factor (that is, the water reaction divided by seaplane weight).
 - (2) C_1 = empirical seaplane operations factor equal to 0.012 (except that this factor may not be less than that necessary to obtain the minimum value of step load factor of 2.33).
 - (3) V_{S0} = seaplane stalling speed [(in knots)] with flaps extended in the appropriate landing position and with no slipstream effect.
 - (4) β = angle of dead rise at the longitudinal station at which the load factor is being determined, in accordance with figure 1 of Appendix B.
 - (5) W = seaplane design landing weight in pounds.

- (b) *Engine isolation.* The powerplants must be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any engine, or of any system that can affect the engine, will not—
 - (1) Prevent the continued safe operation of the remaining engines ; or
 - (2) Require immediate action by any crewmember for continued safe operation.
- (c) *Control of engine rotation.* There must be means for stopping the rotation of any engine individually in flight, except that, for turbine engine installations, the means for stopping the rotation of any engine need be provided only where continued rotation could jeopardize the safety of the airplane. Each component of the stopping system on the engine side of the firewall that might be exposed to fire must be at least fire-resistant. If hydraulic propeller feathering systems are used for this purpose, the feathering lines must be at least fire-resistant under the operating conditions that may be expected to exist during feathering.
- (d) *Turbine engine installations.* For turbine engine installations—
 - (1) Design precautions must be taken to minimize the hazards to the airplane in the event of an engine rotor failure or of a fire originating within the engine which burns through the engine case.
 - (2) The powerplant systems associated with engine control devices, systems, and instrumentation, must be designed to give reasonable assurance that those engine operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service.
- (e) *Restart capability.*
 - (1) Means to restart any engine in flight must be provided.
 - (2) An altitude and airspeed envelope must be established for in-flight engine restarting, and each engine must have a restart capability within that envelope.
 - (3) For turbine engine powered airplanes, if the minimum windmilling speed of the engines, following the in-flight shutdown of all engines, is insufficient to provide the necessary electrical power for engine ignition, a power source independent of the engine-driven electrical power generating system must be provided to permit in-flight engine ignition for restarting.
 - (f) *Auxiliary Power Unit.* Each auxiliary power unit must be approved or meet the requirements of the category for its intended use.

Amdt. 25-100, Eff. 12/13/2000

FAR 25.904 : [Automatic takeoff thrust control system (ATTCS).]

[Each applicant seeking approval for installation of an engine power control system that automatically resets the power or thrust on the operating engine(s) when any engine fails during the takeoff must comply with the requirements of Appendix I of this part.]

Amdt. 25-62, Eff. 12/9/87

FAR 25.905 : Propellers.

- (a) Each propeller must have a type certificate.
- (b) Engine power and propeller shaft rotational speed may not exceed the limits for which the propeller is certificated.

48.1 General

FAR 25.901 : Installation.

(a) For the purpose of this Part, the airplane powerplant installation includes each component that—

- (1) Is necessary for propulsion ;
- (2) Affects the control of the major propulsive units ; or
- (3) Affects the safety of the major propulsive units between normal inspections or overhauls.

(b) For each powerplant—

- (1) The installation must comply with—
 - (i) The installation instructions provided under Sec. 33.5 of this chapter ; and
 - (ii) The applicable provisions of this subpart ;
- (2) The components of the installation must be constructed, arranged, and installed so as to ensure their continued safe operation between normal inspections or overhauls ;
- (3) The installation must be accessible for necessary inspections and maintenance ; and
- (4) The major components of this installation must be electrically bonded to the other parts of the airplane.

(c) For each powerplant and auxiliary power unit installation, it must be established that no single failure or malfunction or probable combination of failures will jeopardize the safe operation of the airplane except that the failure of structural elements need not be considered if the probability of such failure is extremely remote.

(d) [Each auxiliary power unit installation must meet the applicable provisions of this subpart.]

Amdt. 25-46, Eff. 12/1/78

FAR 25.903 : Engines.

(a) *Engine type certificate.*

(1) Each engine must have a type certificate and must meet the applicable requirements of Part 34 of this chapter.

(2) [Each turbine engine must comply with one of the following :

- (i) Sections 33.76, 33.77 and 33.78 of this chapter in effect on December 13, 2000, or as subsequently amended ; or
- (ii) Sections 33.77 and 33.78 of this chapter in effect on April 30, 1998, or as subsequently amended before December 13, 2000 ; or
- (iii) Comply with Section 33.77 of this chapter in effect on October 31, 1974, or as subsequently amended prior to April 30, 1998, unless that engine's foreign object ingestion service history has resulted in an unsafe condition ; or
- (iv) Be shown to have a foreign object ingestion service history in similar installation locations which has not resulted in any unsafe condition.]

(6) K_1 = empirical hull station weighing factor, in accordance with figure 2 of Appendix B.

(7) r_x = ratio of distance, measured parallel to hull reference axis, from the center of gravity of the seaplane to the hull longitudinal station at which the load factor is being computed to the radius of gyration in pitch of the seaplane, the hull reference axis being a straight line, in the plane of symmetry, tangential to the keel at the main step.

(c) For a twin float seaplane, because of the effect of flexibility of the attachment of the floats to the seaplane, the factor K_1 may be reduced at the bow and stern to 0.8 of the value shown in figure 2 of Appendix B. This reduction applies only to the design of the carry-through and seaplane structure.

Amdt. 25-23, Eff. 5/8/70

FAR 25.529 : Hull and main float landing conditions.

(a) *Symmetrical step, bow, and stern landing.* For symmetrical step, bow, and stern landings, the limit water reaction load factors are those computed under Sec. 25.527. In addition—

- (1) For symmetrical step landings, the resultant water load must be applied at the keel, through the center of gravity, and must be directed perpendicularly to the keel line ;
- (2) For symmetrical bow landings, the resultant water load must be applied at the keel, one-fifth of the longitudinal distance from the bow to the step, and must be directed perpendicularly to the keel line ; and
- (3) For symmetrical stern landings, the resultant water load must be applied at the keel, at a point 85 percent of the longitudinal distance from the step to the stern post, and must be directed perpendicularly to the keel line.

(b) *Unsymmetrical landing for hull and single float seaplanes.* Unsymmetrical step, bow, and stern landing conditions must be investigated. In addition—

- (1) The loading for each condition consists of an upward component and a side component equal, respectively, to 0.75 and 0.25 tan times the resultant load in the corresponding symmetrical landing condition ; and
 - (2) The point of application and direction of the upward component of the load is the same as that in the symmetrical condition, and the point of application of the side component is at the same longitudinal station as the upward component but is directed inward perpendicularly to the plane of symmetry at a point midway between the keel and chine lines.
- (c) *Unsymmetrical landing ; twin float seaplanes.* The unsymmetrical loading consists of an upward load at the step of each float of 0.75 and a side load of $0.25 \tan \beta$ at one float times the step landing load reached under Sec. 25.527. The side load is directed inboard, perpendicularly to the plane of symmetry midway between the keel and chine lines of the float, at the same longitudinal station as the upward load.

FAR 25.531 : Hull and main float takeoff conditions.

For the wing and its attachment to the hull or main float—

- (a) The aerodynamic wing lift is assumed to be zero; and
 (b) A downward inertia load, corresponding to a load factor computed from the following formula, must be applied :

$$n = \frac{C_{T0} V_{S1}^2}{(\tan \beta)^{\frac{2}{3}} W^{\frac{1}{3}}}$$

where—

- n : inertia load factor;
 C_{T0} : empirical seaplane operations factor equal to 0.004;
 V_{S1} : seaplane stalling speed [(knots)] at the design takeoff weight within the flaps extended in the appropriate takeoff position;
 β : angle of dead rise at the main step (degrees); and
 W : [design water takeoff weight in pounds].

Amdt. 25-23, Eff. 5/8/70

FAR 25.533 : Hull and main float bottom pressures.

- (a) *General.* The hull and main float structure, including frames and bulkheads, stringers, and bottom plating, must be designed under this section.
 (b) *Local pressures.* For the design of the bottom plating and stringers and their attachments to the supporting structure, the following pressure distributions must be applied :
 (1) For an unflared bottom, the pressure at the chine is 0.75 times the pressure at the keel, and the pressures between the keel and chine vary linearly, in accordance with figure 3 of Appendix B. The pressure at the keel (psi) is computed as follows :

$$P_k = C_2 \frac{K_2 V_{S1}^2}{\tan \beta_k}$$

where—

- P_k : pressure [(p.s.i.)] at the keel;
 $C_2 = 0.00213$: hull station weighing factor, in accordance with figure 2 of Appendix B;
 K_2 : seaplane stalling speed [(knots)] at the design [water] takeoff weight with flaps extended in the appropriate takeoff position; and
 β_k : angle of dead rise at keel, in accordance with figure 1 of Appendix B.

- (2) For a flared bottom, the pressure at the beginning of the flare is the same as that for an unflared bottom, and the pressure between the chine and the beginning of the flare varies linearly, in accordance with figure 3 of Appendix B. The pressure distribution is the same as that prescribed in subparagraph (1) of this paragraph for an unflared bottom except that the pressure at the chine is computed as follows :

$$P_{ch} = C_3 \frac{K_2 V_{S1}^2}{\tan \beta}$$

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where—

P_{ch} : pressure [(p.s.i.)] at the chine;

$C_3 = 0.0016$;

K_2 : hull station weighing factor, in accordance with figure 2 of Appendix B;

V_{S1} : seaplane stalling speed [(knots)] at the design [water] takeoff weight with flaps extended in the appropriate takeoff position; and

β : angle of dead rise at appropriate station.

The area over which these pressures are applied must simulate pressures occurring during high localized impacts on the hull or float, but need not extend over an area that would induce critical stresses in the frames or in the overall structure.

(c) *Distributed pressures.* For the design of the frames, keel, and chine structure, the following pressure distributions apply :

(1) Symmetrical pressures are computed as follows :

$$P = C_4 \frac{K_2 V_{S0}^2}{\tan \beta}$$

where—

P : pressure [(p.s.i.)];

$C_4 = 0.078 C_1$: (with C_1 computed under Sec. 25.527);

K_2 : hull station weighing factor, determined in accordance with figure 2 of Appendix B;

V_{S0} : seaplane stalling speed [(knots)] with landing flaps extended in the appropriate position and with no slipstream effect; and

β : angle of dead rise at appropriate station.

(2) The unsymmetrical pressure distribution consists of the pressures prescribed in subparagraph (1) of this paragraph on one side of the hull or main float centerline and one-half of that pressure on the other side of the hull or main float centerline, in accordance with figure 3 of Appendix B.

These pressures are uniform and must be applied simultaneously over the entire hull or main float bottom. The loads obtained must be carried into the sidewall structure of the hull proper, but need not be transmitted in a fore and aft direction as shear and bending loads.

Amtdt. 25-23, Eff. 5/8/70

FAR 25.535 : Auxiliary float loads.

(a) *General.* Auxiliary floats and their attachments and supporting structures must be designed for the conditions prescribed in this section. In the cases specified in paragraphs (b) through (e) of this section, the prescribed water loads may be distributed over the float bottom to avoid excessive local loads, using bottom pressures not less than those prescribed in paragraph (g) of this section.

(b) *Step loading.* The resultant water load must be applied in the plane of symmetry of the float at a point three-fourths of the distance from the bow to the step and must be perpendicular to the keel. The resultant limit load is computed as follows,

except that the value of L need not exceed three times the weight of the displaced water when the float is completely submerged :

$$L = \frac{C_5 V_{S0}^2 W^{\frac{2}{3}}}{(\tan \beta_5)^{\frac{2}{3}} (1 + r_y^2)^{\frac{2}{3}}}$$

where—

L	: limit load [(lbs.)]:
$C_5 = 0.0053$:	
V_{S0}	: seaplane stalling speed [(knots)] with landing flaps extended in the appropriate position and with no slipstream effect;
W	: seaplane design landing weight in pounds;
β_5	: angle of dead rise at a station $\frac{3}{4}$ of the distance from the bow to the step, but need not be less than 15 degrees; and
r_y	: ratio of the lateral distance between the center of gravity and the plane of symmetry of the float to the radius of gyration in roll.

- (c) *Bow loading*. The resultant limit load must be applied in the plane of symmetry of the float at a point one-fourth of the distance from the bow to the step and must be perpendicular to the tangent to the keel line at that point. The magnitude of the resultant load is that specified in paragraph (b) of this section.
- (d) *Unsymmetrical step loading*. The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (a) of this section and a side component equal to 0.25 $\tan \beta$ times the load specified in paragraph (b) of this section. The side load must be applied perpendicularly to the plane of symmetry of the float at a point midway between the keel and the chine.
- (e) *Unsymmetrical bow loading*. The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (b) of this section and a side component equal to 0.25 $\tan \beta$ times the load specified in paragraph (c) of this section. The side load must be applied perpendicularly to the lane of symmetry at a point midway between the keel and the chine.
- (f) *Immersed float condition*. The resultant load must be applied at the centroid of the cross section of the float at a point one-third of the distance from the bow to the step. The limit load components are as follows :

$$\begin{aligned} \text{vertical} &= \rho g V \\ a_{ft} &= C_x \frac{1}{2} \rho V^{\frac{3}{2}} (K V_{S0})^2 \\ \text{side} &= C_y \frac{1}{2} \rho V^{\frac{3}{2}} (K V_{S0})^2 \end{aligned}$$

where—

Chapitre 48

Subpart E : Powerplant

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47.11 Miscellaneous

FAR 25.871 : Leveling [means.]

[There must be means for determining when the airplane is in a level position on the ground.]
Amdt. 25-23, Eff. 5/8/70

FAR 25.875 : Reinforcement near propellers.

- (a) Each part of the airplane near the propeller tips must be strong and stiff enough to withstand the effects of the induced vibration and of ice thrown from the propeller.
- (b) No window may be near the propeller tips unless it can withstand the most severe ice impact likely to occur.

- ρ : mass density of water [(slugs/ft.2)] ;
- V : volume of float [(ft.2)] ;
- C_x : coefficient of drag force, equal to 0.133 ;
- C_y : coefficient of side force, equal to 0.106 ;
- $K = 0.8$: except that lower values may be used if it is shown that the floats are incapable of submerging at a speed of $0.8 V_{S0}$ in normal operations ;
- V_{S0} : seaplane stalling speed [(knots)] with landing flaps extended in the appropriate position and with no slipstream effect ; and
- g : acceleration due to gravity (ft./sec.).

- (g) *Float bottom pressures.* The float bottom pressures must be established under Sec. 25.533 [except that the value of K_2 in the formulae may be taken as 1.0]. The angle of dead rise to be used in determining the float bottom pressures is set forth in paragraph (b) of this section.

Amdt. 25-23, Eff. 5/8/70

FAR 25.537 : Seawing loads.

Seawing design loads must be based on applicable test data.

46.8 Emergency Landing Conditions

FAR 25.561 : General.

- (a) The airplane, although it may be damaged in emergency landing conditions on land or water, must be designed as prescribed in this section to protect each occupant under those conditions.
- (b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a minor crash landing when—
 - (1) Proper use is made of seats, belts, and all other safety design provisions ;
 - (2) The wheels are retracted (where applicable) ; and
 - (3) The occupant experiences the following ultimate inertia forces relative to the surrounding structure :
 - (i) Upward, 3.0g.
 - (ii) Forward, 9.0g.
 - (iii) Sideward, 3.0g on the airframe ; and 4.0g on the seats and their attachments.
 - (iv) Downward, 6.0g.
 - (v) Rearward, 1.5g.
- (c) [For equipment, cargo in the passenger compartments and any other large masses, the following apply :
 - (1) Except as provided in paragraph (c)(2) of this section, these items must be positioned so that if they break loose, they will be unlikely to :
 - (i) Cause direct injury to occupants ;

- (ii) Penetrate fuel tanks or lines or cause fire or explosion hazard by damage to adjacent systems ; or
- (iii) Nullify any of the escape facilities provided for use after an emergency landing.
- (2) When such positioning is not practical (e.g. fuselage mounted engines or auxiliary power units) each such item of mass shall be restrained under all loads up to those specified in paragraph (b)(3) of this section. The local attachments for these items should be designed to withstand 1.33 times the specified loads if these items are subject to severe wear and tear through frequent removal (e.g. quick change interior items).]
- (d) Seats and items of mass (and their supporting structure) must not deform under any loads up to those specified in paragraph (b)(3) of this section in any manner that would impede subsequent rapid evacuation of occupants.

Amdt. 25-91, Eff. 7/29/97

FAR 25.562 : [Emergency landing dynamic conditions.]

- (a) [The seat and restraint system in the airplane must be designed as prescribed in this section to protect each occupant during an emergency landing condition when—
 - (1) Proper use is made of seats, safety belts, and shoulder harnesses provided for in the design; and
 - (2) The occupant is exposed to loads resulting from the conditions prescribed in this section.
- (b) Each seat type design approved for crew or passenger occupancy during takeoff and landing must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests of a similar type seat, in accordance with each of the following emergency landing conditions. The tests must be conducted with an occupant simulated by a 170-pound anthropomorphic test dummy, as defined by 49 CFR Part 572, Subpart B, or its equivalent, sitting in the normal upright position.
 - (1) A change in downward vertical velocity (Δv) of not less than 35 feet per second, with the airplane's longitudinal axis canted downward 30 degrees with respect to the horizontal plane and with the wings level. Peak floor deceleration must occur in not more than 0.08 seconds after impact and must reach a minimum of 1*g*.
 - (2) A change in forward longitudinal velocity (Δv) of not less than 44 feet per second, with the airplane's longitudinal axis horizontal and yawed 10 degrees either right or left, whichever would cause the greatest likelihood of the upper torso restraint system (where installed) moving off the occupant's shoulder, and with the wings level. Peak floor deceleration must occur in not more than 0.09 seconds after impact and must reach a minimum of 1*g*. Where floor rails or floor fittings are used to attach the seating devices to the test fixture, the rails or fittings must be misaligned with respect to the adjacent set of rails or fittings by at least 10 degrees vertically (i.e., out of parallel) with one rolled 10 degrees.
- (c) The following performance measures must not be exceeded during the dynamic tests conducted in accordance with paragraph (b) of this section :

FAR 25.865 : [Fire protection of flight controls, engine mounts, and other flight structure.]

[Essential flight controls, engine mounts, and other flight structures located in designated fire zones or in adjacent areas which would be subjected to the effects of fire in the fire zone must be constructed of fireproof material or shielded so that they are capable of withstanding the effects of fire.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.867 : [Fire protection : other components.]

- (a) [Surfaces to the rear of the nacelles, within one nacelle diameter of the nacelle centerline, must be at least fire-resistant.
- (b) Paragraph (a) of this section does not apply to tail surfaces to the rear of the nacelles that could not be readily affected by heat, flames, or sparks coming from a designated fire zone or engine compartment of any nacelle.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.869 : [Fire protection : systems.]

- (a) [Electrical system components :
 - (1) Components of the electrical system must meet the applicable fire and smoke protection requirements of Secs. 25.831(c) and 25.863.
 - (2) Electrical cables, terminals, and equipment in designated fire zones, that are used during emergency procedures, must be at least fire resistant.
 - (3) Main power cables (including generator cables) in the fuselage must be designed to allow a reasonable degree of deformation and stretching without failure and must be—
 - (i) Isolated from flammable fluid lines; or
 - (ii) Shrouded by means of electrically insulated, flexible conduit, or equivalent, which is in addition to the normal cable insulation.
 - (4) Insulation on electrical wire and electrical cable installed in any area of the fuselage must be self-extinguishing when tested in accordance with the applicable portions of Part I, Appendix F of this part.
- (b) Each vacuum air system line and fitting on the discharge side of the pump that might contain flammable vapors or fluids must meet the requirements of Sec. 25.1183 if the line or fitting is in a designated fire zone. Other vacuum air system components in designated fire zones must be at least fire resistant.
- (c) Oxygen equipment and lines must—
 - (1) Not be located in any designated fire zone.
 - (2) Be protected from heat that may be generated in, or escape from, any designated fire zone, and
 - (3) Be installed so that escaping oxygen cannot cause ignition of grease, fluid, or vapor accumulations that are present in normal operation or as a result of failure or malfunction of any system.]

Amdt. 25-72, Eff. 8/20/90

- (1) During normal operation; or
 - (2) As a result of the malfunctioning of any other component.
- (g) [Heater exhaust. Heater exhaust systems must meet the provisions of Secs. 25.1121 and 25.1123. In addition, there must be provisions in the design of the heater exhaust system to safely expel the products of combustion to prevent the occurrence of—
- (1) Fuel leakage from the exhaust to surrounding compartments;
 - (2) Exhaust gas impingement on surrounding equipment or structure;
 - (3) Ignition of flammable fluids by the exhaust, if the exhaust is in a compartment containing flammable fluid lines; and
 - (4) Restriction by the exhaust of the prompt relief of backfires that, if so restricted, could cause heater failure.
- (h) Heater fuel systems. Each heater fuel system must meet each powerplant fuel system requirement affecting safe heater operation. Each heater fuel system component within the ventilating airstream must be protected by shrouds so that no leakage from those components can enter the ventilating airstream.
- (i) Drains. There must be means to safely drain fuel that might accumulate within the combustion chamber or the heat exchanger. In addition—
- (1) Each part of any drain that operates at high temperatures must be protected in the same manner as heater exhausts; and
 - (2) Each drain must be protected from hazardous ice accumulation under any operating condition.

Amdt. 25-23, Eff. 5/8/70

FAR 25.863 : Flammable fluid fire protection.

- (a) [In each area where flammable fluids or vapors might escape by leakage of a fluid system, there must be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazards if ignition does occur.]
- (b) Compliance with paragraph (a) of this section must be shown by analysis or tests, and the following factors must be considered :
- (1) Possible sources and paths of fluid leakage, and means of detecting leakage.
 - (2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials.
 - (3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices.
 - (4) Means available for controlling or extinguishing a fire, such as a stopping flow of fluids, shutting down equipment, fire-proof containment, or use of extinguishing agents.
 - (5) Ability of airplane components that are critical to safety of flight to withstand fire and heat.
- (c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g. equipment shutdown or actuation of a fire extinguisher) quick acting means must be provided to alert the crew.
- (d) [Each area where flammable fluids or vapors might escape by leakage of a fluid system must be identified and defined.]

Amdt. 25-46, Eff. 12/1/78

- (1) Where upper torso straps are used for crewmembers, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.
- (2) The maximum compressive load measured between the pelvis and the lumbar column of the anthropomorphic dummy must not exceed 1,500 pounds.
- (3) The upper torso restraint straps (where installed) must remain on the occupant's shoulder during the impact.
- (4) The lap safety belt must remain on the occupant's pelvis during the impact.
- (5) Each occupant must be protected from serious head injury under the conditions prescribed in paragraph (b) of this section. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Injury Criterion (HIC) of 1,000 units. The level of HIC is defined by the equation :

$$HIC = \left\{ (t_2 - t_1) \left(\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t) dt \right)^{2.5} \right\}_{max}$$

Where :

- t_1 : is the initial integration time,
- t_2 : is the final integration time, and
- $a(t)$: is the total acceleration vs. time curve for the head strike, and where
- (t) : is in seconds, and
- (a) : is in units of gravity (g).

- (6) Where leg injuries may result from contact with seats or other structure, protection must be provided to prevent axially compressive loads exceeding 2,250 pounds in each femur.
- (7) The seat must remain attached at all points of attachment, although the structure may have yielded.
- (8) Seats must not yield under the tests specified in paragraphs (b)(1) and (b)(2) of this section to the extent they would impede rapid evacuation of the airplane occupants.]

Amdt. 25-64, Eff. 6/16/88

FAR 25.563 : Structural ditching provisions.

Structural strength considerations of ditching provisions must be in accordance with Sec. 25.801(c).

46.9 Fatigue Evaluation**FAR 25.571 : Damage-tolerance and fatigue evaluation of structure.**

- (a) [General. An evaluation of the strength, detail design, and fabrication must show that catastrophic failure due to fatigue, corrosion, manufacturing defects, or accidental damage, will be avoided throughout the operational life of the airplane. This evaluation must be conducted in accordance with the provisions of paragraphs (b)

and (e) of this section, except as specified in paragraph (c) of this section, for each part of the structure that could contribute to a catastrophic failure (such as wing, empennage, control surfaces and their systems, the fuselage, engine mounting, landing gear, and their related primary attachments). For turbojet powered airplanes, those parts that could contribute to a catastrophic failure must also be evaluated under paragraph (d) of this section. In addition, the following apply :

- (1) Each evaluation required by this section must include—
 - (i) The typical loading spectra, temperatures, and humidities expected in service;
 - (ii) The identification of principal structural elements and detail design points, the failure of which could cause catastrophic failure of the airplane ; and
 - (iii) An analysis, supported by test evidence, of the principal structural elements and detail design points identified in paragraph (a)(1)(i)(ii) of this section.
- (2) The service history of airplanes of similar structural design, taking due account of differences in operating conditions and procedures, may be used in the evaluations required by this section.
- (3) [Based on the evaluations required by this section, inspections or other procedures must be established, as necessary, to prevent catastrophic failure, and must be included in the Airworthiness Limitations Section of the Instructions for Continued Airworthiness required by Sec. 25.1529. Inspection thresholds for the following types of structure must be established based on crack growth analyses and/or tests, assuming the structure contains an initial flaw of the maximum probable size that could exist as a result of manufacturing or service-induced damage :
 - (i) Single load path structure, and
 - (ii) Multiple load path "fail-safe" structure and crack arrest "fail-safe" structure, where it cannot be demonstrated that load path failure, partial failure, or crack arrest will be detected and repaired during normal maintenance, inspection, or operation of an airplane prior to failure of the remaining structure.]

(b) Damage-tolerance evaluation. The evaluation must include a determination of the probable locations and modes of damage due to fatigue, corrosion, or accidental damage. [Repeated load and static analyses supported by test evidence and (if available) service experience must also be incorporated in the evaluation. Special consideration for widespread fatigue damage must be included where the design is such that this type of damage could occur. It must be demonstrated with sufficient full-scale fatigue test evidence that widespread fatigue damage will not occur within the design service goal of the airplane. The type certificate may be issued prior to completion of full-scale fatigue testing, provided the Administrator has approved a plan for completing the required tests, and the airworthiness limitations section of the instructions for continued airworthiness required by Sec. 25.1529 of this part specifies that no airplane may be operated beyond a number of cycles equal to $\frac{1}{2}$ the number of cycles accumulated on the fatigue test article, until such testing is completed. The extent of damage for residual strength evaluation at any time within the operational life of the airplane must be consistent with the initial detectability and subsequent growth under repeated loads. The residual strength evaluation must

- (3) The part of the ventilating air passage that surrounds the combustion chamber. However, no fire extinguishment is required in cabin ventilating air passages.
- (b) *Ventilating air ducts.* Each ventilating air duct passing through any fire zone must be fireproof. In addition—
 - (1) Unless isolation is provided by fireproof valves or by equally effective means, the ventilating air duct downstream of each heater must be fireproof for a distance great enough to ensure that any fire originating in the heater can be contained in the duct ; and
 - (2) Each part of any ventilating duct passing through any region having a flammable fluid system must be constructed or isolated from that system so that the malfunctioning of any component of that system cannot introduce flammable fluids or vapors into the ventilating airstream.
- (c) *Combustion air ducts.* Each combustion air duct must be fireproof for a distance great enough to prevent damage from backfiring or reverse flame propagation. In addition—
 - (1) No combustion air duct may have a common opening with the ventilating airstream unless flames from backfires or reverse burning cannot enter the ventilating airstream under any operating condition, including reverse flow or malfunctioning of the heater or its associated components ; and
 - (2) No combustion air duct may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.
- (d) *Heater controls ; general.* Provision must be made to prevent the hazardous accumulation of water or ice on or in any heater control component, control system tubing, or safety control.
- (e) *Heater safety controls.* For each combustion heater there must be the following safety control means :
 - (1) Means independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow must be provided, for each heater, to automatically shut off the ignition and fuel supply to that heater at a point remote from that heater when any of the following occurs :
 - (i) The heat exchanger temperature exceeds safe limits.
 - (ii) The ventilating air temperature exceeds safe limits.
 - (iii) The combustion airflow becomes inadequate for safe operation.
 - (iv) The ventilating airflow becomes inadequate for safe operation.
 - (2) [The means of complying with subparagraph (1) of this paragraph for any individual heater must—
 - (i) Be independent of components serving any other heater whose heat output is essential for safe operation ; and
 - (ii) Keep the heater off until restarted by the crew.]
 - (3) There must be means to warn the crew when any heater whose heat output is essential for safe operation has been shut off by the automatic means prescribed in subparagraph (1) of this paragraph.
 - (f) *Air intakes.* Each combustion and ventilating air intake must be located so that no flammable fluids or vapors can enter the heater system under any operating condition—

- (4) There are means to control ventilation and drafts within the compartment so that the extinguishing agent used can control any fire that may start within the compartment; and

(5) [Reserved.]

(d) [Reserved.]

(e) *Class E*. A Class E cargo compartment is one on airplanes used only for the carriage of cargo and in which—

(1) [Reserved]

(2) There is a separate approved smoke or fire detector system to give warning at the pilot or flight engineer station;

(3) There are means to shut off the ventilating airflow to, or within, the compartment, and the controls for these means are accessible to the flight crew in the crew compartment;

(4) There are means to exclude hazardous quantities of smoke, flames, or noxious gases, from the flight crew compartment; and

(5) The required crew emergency exits are accessible under any cargo loading condition.

Amdt. 25-93, Eff. 3/19/98

FAR 25.858 : Cargo [or baggage compartment smoke or fire detection systems.]

[If certification with cargo or baggage compartment smoke or fire detection provisions is requested, the following must be met for each cargo or baggage compartment with those provisions:]

(a) The detection system must provide a visual indication to the flight crew within one minute after the start of a fire.

(b) The system must be capable of detecting a fire at a temperature significantly below that at which the structural integrity of the airplane is substantially decreased.

(c) There must be means to allow the crew to check in flight, the functioning of each fire detector circuit.

(d) The effectiveness of the detection system must be shown for all approved operating configurations and conditions.

Amdt. 25-93, Eff. 3/19/98

FAR 25.859 : Combustion heater fire protection.

(a) *Combustion heater fire zones*. The following combustion heater fire zones must be protected from fire in accordance with the applicable provisions of Secs. 25.1181 through 25.1191 and 25.1195 through 25.1203 :

(1) The region surrounding the heater, if this region contains any flammable fluid system components (excluding the heater fuel system), that could—

(i) Be damaged by heater malfunctioning; or

(ii) Allow flammable fluids or vapors to reach the heater in case of leakage.

(2) The region surrounding the heater, if the heater fuel system has fittings that, if they leaked, would allow fuel or vapors to enter this region.

show that the remaining structure is able to withstand loads (considered as static ultimate loads) corresponding to the following conditions :

(1) The limit symmetrical maneuvering conditions specified in Sec. 25.337 at all speeds up to V_C and in Sec. 25.345.]

(2) The limit gust conditions specified in Sec. 25.341 at the specified speeds up to V_C and in Sec. 25.345.

(3) The limit rolling conditions specified in Sec. 25.349 and the limit unsymmetrical conditions specified in Secs. 25.367 and 25.427(a) through (c), at speeds up to V_C .

(4) The limit yaw maneuvering conditions specified in Sec. 25.351(a) at the specified speeds up to V_C .

(5) For pressurized cabins, the following conditions :

(i) The normal operating differential pressure combined with the expected external aerodynamic pressures applied simultaneously with the flight loading conditions specified in paragraphs (b)(1) through (4) of this section, if they have a significant effect.

(ii) [The maximum value of normal operating differential pressure (including the expected external aerodynamic pressures during 1g level flight) multiplied by a factor of 1.15, omitting other loads.]

(6) For landing gear and directly-affected airframe structure, the limit ground loading conditions specified in Secs. 25.473, 25.491, and 25.493.

If significant changes in structural stiffness of geometry, or both, follow from a structural failure, or partial failure, the effect on damage tolerance must be further investigated.

(c) *Fatigue (safe-life) evaluation*. Compliance with the damage-tolerance requirements of paragraph (b) of this section is not required if the applicant establishes that their application for particular structure is impractical. This structure must be shown by analysis, supported by test evidence, to be able to withstand the repeated loads of variable magnitude expected during its service life without detectable cracks. Appropriate safe-life scatter factors must be applied.

(d) *Sonic fatigue strength*. It must be shown by analysis, supported by test evidence, or by the service history of airplanes of similar structural design and sonic excitation environment, that—

(1) Sonic fatigue cracks are not probable in any part of the flight structure subject to sonic excitation; or

(2) Catastrophic failure caused by sonic cracks is not probable assuming that the loads prescribed in paragraph (b) of this section are applied to all areas affected by those cracks.

(e) *Damage-tolerance (discrete source) evaluation*. The airplane must be capable of successfully completing a flight during which likely structural damage occurs as a result of—

(1) [Impact with a 4-pound bird when the velocity of the airplane relative to the bird along the airplane's flight path is equal to V_C at sea level or 0.85 V_C at 8,000 feet, whichever is more critical.]

(2) Uncontained fan blade impact;

- (3) Uncontained engine failure ; or

- (4) Uncontained high energy rotating machinery failure.

The damaged structure must be able to withstand the static loads (considered as ultimate loads) which are reasonably expected to occur on the flight. Dynamic effects on these static loads need not be considered. Corrective action to be taken by the pilot following the incident, such as limiting maneuvers, avoiding turbulence, and reducing speed, must be considered. If significant changes in structural stiffness or geometry, or both, follow from a structural failure or partial failure, the effect on damage tolerance must be further investigated.

Amdt. 25-96, Eff. 3/31/98

FAR 25.573 : [Reserved.]

[Reserved.]

Amdt. 25-45, Eff. 12/1/78

46.10 Lightning Protection

FAR 25.581 : [Lightning protection.]

- (a) [The airplane must be protected against catastrophic effects from lightning.

- (b) For metallic components, compliance with paragraph (a) of this section may be shown by—

- (1) Bonding the components properly to the airframe ; or

- (2) Designing the components so that a strike will not endanger the airplane.

- (c) For nonmetallic components, compliance with paragraph (a) of this section may be shown by—

- (1) Designing the components to minimize the effect of a strike ; or

- (2) Incorporating acceptable means of diverting the resulting electrical current so as not to endanger the airplane.]

Amdt. 25-23, Eff. 5/8/70

- (e) No compartment may contain any controls, wiring, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that—

- (1) They cannot be damaged by the movement of cargo in the compartment, and

- (2) Their breakage or failure will not create a fire hazard.

- (f) There must be means to prevent cargo or baggage from interfering with the functioning of the fire protective features of the compartment.

- (g) Sources of heat within the compartment must be shielded and insulated to prevent igniting the cargo or baggage.

- (h) Flight tests must be conducted to show compliance with the provisions of Sec. 25.857 concerning—

- (1) Compartment accessibility,

- (2) The entries of hazardous quantities of smoke or extinguishing agent into compartments occupied by the crew or passengers, and

- (3) The dissipation of the extinguishing agent in Class C compartments.

- (i) During the above tests, it must be shown that no inadvertent operation of smoke or fire detectors in any compartment would occur as a result of fire contained in any other compartment, either during or after extinguishment, unless the extinguishing system floods each such compartment simultaneously.

Amdt. 25-93, Eff. 3/19/98

FAR 25.857 : Cargo compartment classification.

- (a) *Class A.* A Class A cargo or baggage compartment is one in which—

- (1) The presence of a fire would be easily discovered by a crewmember while at his station ; and

- (2) Each part of the compartment is easily accessible in flight.

- (b) *Class B.* A Class B cargo or baggage compartment is one in which—

- (1) There is sufficient access in flight to enable a crew member to effectively reach any part of the compartment with the contents of a hand fire extinguisher ;

- (2) When the access provisions are being used, no hazardous quantity of smoke, flames, or extinguishing agent, will enter any compartment occupied by the crew or passengers ;

- (3) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station ; and

- (4) [Reserved.]

- (c) *Class C.* A Class C cargo or baggage compartment is one not meeting the requirements for either a Class A or B compartment but in which—

- (1) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station.

- (2) [There is an approved built-in fire extinguishing or suppression system controllable from the cockpit.]

- (3) There are means to exclude hazardous quantities of smoke, flames, or extinguishing agent, from any compartment occupied by the crew or passengers ;

- (e) The interiors of compartments, such as pilot compartments, galleys, lavatories, crew rest quarters, cabinets and stowage compartments, need not meet the standards of paragraph (d) of this section, provided the interiors of such compartments are isolated from the main passenger cabin by doors or equivalent means that would normally be closed during an emergency landing condition.
- (f) Smoking is not to be allowed in lavatories. If smoking is to be allowed in any other compartment occupied by the crew or passengers, an adequate number of self-contained, removable ashtrays must be provided for all seated occupants.
- (g) Regardless of whether smoking is allowed in any other part of the airplane, lavatories must have self-contained, removable ashtrays located conspicuously on or near the entry side of each lavatory door, except that one ashtray may serve more than one lavatory door if the ashtray can be seen readily from the cabin side of each lavatory served.
- (h) Each receptacle used for the disposal of flammable waste material must be fully enclosed, constructed of at least fire resistant materials, and must contain fires likely to occur in it under normal use. The capability of the receptacle to contain those fires under all probable conditions of wear, misalignment, and ventilation expected in service must be demonstrated by test.]

Amdt. 25-83, Eff. 3/6/95

FAR 25.854 : [Lavatory fire protection.]

[For airplanes with a passenger capacity of 20 or more :

- (a) Each lavatory must be equipped with a smoke detector system or equivalent that provides a warning light in the cockpit, or provides a warning light or audible warning in the passenger cabin that would be readily detected by a flight attendant ; and
- (b) Each lavatory must be equipped with a built-in fire extinguisher for each disposal receptacle for towels, paper, or waste, located within the lavatory. The extinguisher must be designed to discharge automatically into each disposal receptacle upon occurrence of a fire in that receptacle.]

Amdt. 25-74, Eff. 5/16/91

FAR 25.855 : Cargo or baggage compartments.

For each cargo and baggage compartment not occupied by crew or passengers, the following apply :

- (a) The compartment must meet one of the class requirements of Sec. 25.857.
- (b) Class B through E cargo or baggage compartments, as defined in Sec. 25.857, must have a liner, and the liner must be separate from (but may be attached to) the airplane structure.
- (c) [Ceiling and sidewall liner panels of Class C compartments must meet the test requirements of Part III of Appendix F of this part or other approved equivalent methods.]
- (d) All other materials used in the construction of the cargo or baggage compartment must meet the applicable test criteria prescribed in Part I of Appendix F of this part or other approved equivalent methods.

Chapitre 47

Subpart D : Design and Construction

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- (6) At least one of the required fire extinguishers located in the passenger compartment of an airplane with a passenger capacity of at least 31 and not more than 60, and at least two of the fire extinguishers located in the passenger compartment of an airplane with a passenger capacity of 61 or more must contain Halon 1211 (bromochlorodifluoromethane CBrClF₂), or equivalent, as the extinguishing agent. The type of extinguishing agent used in any other extinguisher required by the section must be appropriate for the kinds of fires likely to occur where used.
 - (7) The quantity of extinguishing agent used in each extinguisher required by this section must be appropriate for the kinds of fires likely to occur where used.
 - (8) Each extinguisher intended for use in a personnel compartment must be designed to minimize the hazard of toxic gas concentration.
 - (b) *Built-in fire extinguishers.* If a built-in fire extinguisher is provided—
 - (1) Each built-in fire extinguishing system must be installed so that—
 - (i) No extinguishing agent likely to enter personnel compartments will be hazardous to the occupants; and
 - (ii) No discharge of the extinguisher can cause structural damage.
 - (2) The capacity of each required built-in extinguishing system must be adequate for any fire likely to occur in the compartment where used, considering the volume of the compartment and the ventilation rate.]
- Amdt. 25-74, Eff. 5/16/91

FAR 25.853 : Compartment interiors.

- [For each compartment occupied by the crew or passengers, the following apply :
- (a) Materials (including finishes or decorative surfaces applied to the materials) must meet the applicable test criteria prescribed in part I of appendix F of this part, or other approved equivalent methods, regardless of the passenger capacity of the airplane.
 - (b) [Reserved.]
 - (c) In addition to meeting the requirements of paragraph (a) of this section, seat cushions, except those on flight crewmember seats, must meet the test requirements of part II of appendix F of this part, or other equivalent methods, regardless of the passenger capacity of the airplane.
 - (d) Except as provided in paragraph (e) of this section, the following interior components of airplanes with passenger capacities of 20 or more must also meet the test requirements of parts IV and V of appendix F of this part, or other approved equivalent method, in addition to the flammability requirements prescribed in paragraph (a) of this section :
 - (1) Interior ceiling and wall panels, other than lighting lenses and windows;
 - (2) Partitions, other than transparent panels needed to enhance cabin safety ;
 - (3) Galley structure, including exposed surfaces of stowed carts and standard containers and the cavity walls that are exposed when a full complement of such carts or containers is not carried ; and
 - (4) Large cabinets and cabin storage compartments, other than underseat storage compartments for stowing small items such as magazines and maps.

FAR 25.843 : Tests for pressurized cabins.

- (a) *Strength test.* The complete pressurized cabin, including doors, windows and valves, must be tested as a pressure vessel for the pressure differential specified in Sec. 25.365(d).
- (b) *Functional tests.* The following functional tests must be performed :
 - (1) Tests of the functioning and capacity of the positive and negative pressure differential valves, and of the emergency release valve, to simulate the effects of closed regulator valves.
 - (2) Tests of the pressurization system to show proper functioning under each possible condition of pressure, temperature, and moisture, up to the maximum altitude for which certification is requested.
 - (3) Flight tests, to show the performance of the pressure supply, pressure and flow regulators, indicators, and warning signals, in steady and stepped climbs and descents at rates corresponding to the maximum attainable within the operating limitations of the airplane, up to the maximum altitude for which certification is requested.
 - (4) Tests of each door and emergency exit, to show that they operate properly after being subjected to the flight tests prescribed in subparagraph (3) of this paragraph.

47.10 Fire Protection

FAR 25.851 : Fire extinguishers.

- (a) *Hand fire extinguishers.*

- (1) [The following minimum number of hand fire extinguishers must be conveniently located and evenly distributed in passenger compartments :

<i>Passenger Capacity</i>	<i>Number of Extinguishers</i>
7 through 30	1
31 through 60	2
61 through 200	3
201 through 300	4
301 through 400	5
401 through 500	6
501 through 600	7
601 through 700	8

- (2) At least one hand fire extinguisher must be conveniently located in the pilot compartment.
- (3) At least one readily accessible hand fire extinguisher must be available for use in each Class A or Class B cargo or baggage compartment and in each Class E cargo or baggage compartment that is accessible to crewmembers in flight.
- (4) At least one hand fire extinguisher must be located in, or readily accessible for use in, each galley located above or below the passenger compartment.
- (5) Each hand fire extinguisher must be approved.

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47.1 General

FAR 25.601 : General.

The airplane may not have design features or details that experience has shown to be hazardous or unreliable. The suitability of each questionable design detail and part must be established by tests.

FAR 25.603 : Materials.

The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must—

- (a) Be established on the basis of experience or tests ;
- (b) Conform to approved specifications (such as industry or military specifications, or Technical Standard Orders) that ensure their having the strength and other properties assumed in the design data [and
- (c) Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.]

Amdt. 25-46, Eff. 12/1/78

FAR 25.605 : Fabrication methods.

[(a)] The methods of fabrication used must produce a consistently sound structure. If a fabrication process (such as gluing, spot welding, or heat treating) requires close control to reach this objective, the process must be performed under an approved process specification.

(b) [Each new aircraft fabrication method must be substantiated by a test program.]

Amdt. 25-46, Eff. 12/1/78

FAR 25.607 : [Fasteners.]

(a) [Each removable bolt, screw, nut, pin, or other removable fastener must incorporate two separate locking devices if—

- (1) Its loss could preclude continued flight and landing within the design limitations of the airplane using normal pilot skill and strength ; or
- (2) Its loss could result in reduction in pitch, yaw, or roll control capability or response below that required by Subpart B of this chapter.

(b) The fasteners specified in paragraph (a) of this section and their locking devices may not be adversely affected by the environmental conditions associated with the particular installation.

(c) No self-locking nut may be used on any bolt subject to rotation in operation unless a nonfriction locking device is used in addition to the selflocking device.]

Amdt. 25-23, Eff. 5/8/70

altitude of the airplane under normal operating conditions.

(1) If certification for operation above 25,000 feet is requested, the airplane must be designed so that occupants will not be exposed to cabin pressure altitudes in excess of 15,000 feet after any probable failure condition in the pressurization system.

(2) The airplane must be designed so that occupants will not be exposed to a cabin pressure altitude that exceeds the following after decompression from any failure condition not shown to be extremely improbable :

- (i) Twenty-five thousand (25,000) feet for more than 2 minutes ; or
- (ii) Forty thousand (40,000) feet for any duration.

(3) Fuselage structure, engine and system failures are to be considered in evaluating the cabin decompression.]

(b) Pressurized cabins must have at least the following valves, controls, and indicators for controlling cabin pressure :

(1) Two pressure relief valves to automatically limit the positive pressure differential to a predetermined value at the maximum rate of flow delivered by the pressure source. The combined capacity of the relief valves must be large enough so that the failure of any one valve would not cause an appreciable rise in the pressure differential. The pressure differential is positive when the internal pressure is greater than the external.

(2) Two reverse pressure differential relief valves (or their equivalents) to automatically prevent a negative pressure differential that would damage the structure. One valve is enough, however, if it is of a design that reasonably precludes its malfunctioning.

(3) A means by which the pressure differential can be rapidly equalized.

(4) An automatic or manual regulator for controlling the intake or exhaust airflow, or both, for maintaining the required internal pressures and airflow rates.

(5) Instruments at the pilot or flight engineer station to show the pressure differential, the cabin pressure altitude, and the rate of change of the cabin pressure altitude.

(6) Warning indication at the pilot or flight engineer station to indicate when the safe or preset pressure differential and cabin pressure altitude limits are exceeded. Appropriate warning markings on the cabin pressure differential indicator meet the warning requirement for pressure differential limits and an aural or visual signal (in addition to cabin altitude indicating means) meets the warning requirement for cabin pressure altitude limits if it warns the flight crew when the cabin pressure altitude exceeds 10,000 feet.

(7) A warning placard at the pilot or flight engineer station if the structure is not designed for pressure differentials up to the maximum relief value setting in combination with landing loads.

(8) The pressure sensors necessary to meet the requirements of paragraphs (b)(5) and (b)(6) of this section and Sec. 25.1447(c), must be located and the sensing system designed so that, in the event of loss of cabin pressure in any passenger or crew compartment (including upper and lower lobe galleys), the warning and automatic presentation devices, required by those provisions, will be actuated without any delay that would significantly increase the hazards resulting from decompression.

Amdt. 25-87, Eff. 7/5/96

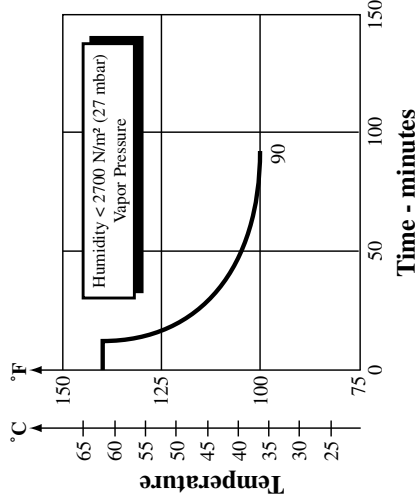


FIG. 47.2 – Time - Temperature relationship.

- (1) 0.25 parts per million by volume, sea level equivalent, at any time above flight level 320 ; and
- (2) [0.1 parts per million by volume, sea level equivalent, time-weighted average during any 3-hour interval above flight level 270.]
- (b) For the purpose of this section, "sea level equivalent" refers to conditions of 25° C and 760 millimeters of mercury pressure.
- (c) Compliance with this section must be shown by analysis or tests based on airplane operational procedures and performance limitation, that demonstrate that either—
 - (1) The airplane cannot be operated at an altitude which would result in cabin ozone concentrations exceeding the limits prescribed by paragraph (a) of this section ; or
 - (2) The airplane ventilation system, including any ozone control equipment, will maintain cabin ozone concentrations at or below the limits prescribed by paragraph (a) of this section.

Amdt. 25-94, Eff. 3/25/98

FAR 25.833 : [Combustion heating systems.]

[Combustion heaters must be approved.]

Amdt. 25-72, Eff. 8/20/90

47.9 Pressurization

FAR 25.841 : Pressurized cabins.

- (a) [Pressurized cabins and compartments to be occupied must be equipped to provide a cabin pressure altitude of not more than 8,000 feet at the maximum operating

FAR 25.609 : Protection of structure.

Each part of the structure must—

- (a) Be suitably protected against deterioration or loss of strength in service due to any cause, including—
 - (1) Weathering ;
 - (2) Corrosion ; and
 - (3) Abrasion ; and
- (b) Have provisions for ventilation and drainage where necessary for protection.

FAR 25.611 : [Accessibility provisions.]

[Means must be provided to allow inspection (including inspection of principal structural elements and control systems), replacement of parts normally requiring replacement, adjustment, and lubrication as necessary for continued airworthiness. The inspection means for each item must be practicable for the inspection interval for the item. Nondestructive inspection aids may be used to inspect structural elements where it is impracticable to provide means for direct visual inspection if it is shown that the inspection is effective and the inspection procedures are specified in the maintenance manual required by Sec. 25.1529.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.613 : Material strength properties and design values.

- (a) Material strength properties must be based on enough tests of material meeting approved specifications to establish design values on a statistical basis.
- (b) [Design values must be chosen to minimize the probability of structural failures due to material variability. Except as provided in paragraph (c) of this section, compliance with this paragraph must be shown by selecting design values which assure material strength with the following probability :
 - (1) Where applied loads are eventually distributed through a single member within an assembly, the failure of which would result in loss of structural integrity of the component, 99 percent probability with 95 percent confidence.
 - (2) For redundant structure, in which the failure of individual elements would result in applied loads being safely distributed to other load carrying members, 90 percent probability with 95 percent confidence.]
- (c) The effects of temperature on allowable stresses used for design in an essential component or structure must be considered where thermal effects are significant under normal operating conditions.
- (d) The strength, detail design, and fabrication of the structure must minimize the probability of disastrous fatigue failure, particularly at points of stress concentration.
- (e) [Greater design values may be used if a "premium selection" of the material is made in which a specimen of each individual item is tested before use to determine that the actual strength properties of that particular item will equal or exceed those used in design.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.615 : [Removed.]

[Removed.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.619 : Special factors.

[The factor of safety prescribed in Sec. 25.303 must be multiplied by the highest pertinent special factor of safety prescribed in Secs. 25.621 through 25.625 for each part of the structure whose strength is—]

- (a) Uncertain ;
 - (b) Likely to deteriorate in service before normal replacement ; or
 - (c) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.
- Amdt. 25-23, Eff. 5/8/70

FAR 25.621 : Casting factors.

- (a) *General.* The factors, tests, and inspections specified in paragraphs (b) through (d) of this section must be applied in addition to those necessary to establish foundry quality control. The inspections must meet approved specifications. Paragraphs (c) and (d) of this section apply to any structural castings except castings that are pressure tested as parts of hydraulic or other fluid systems and do not support structural loads.
- (b) *Bearing stresses and surfaces.* The casting factors specified in paragraphs (c) and (d) of this section—
 - (1) Need not exceed 1.25 with respect to bearing stresses regardless of the method of inspection used ; and
 - (2) Need not be used with respect to the bearing surfaces of a part whose bearing factor is larger than the applicable casting factor.
- (c) *Critical castings.* For each casting whose failure would preclude continued safe flight and landing of the airplane or result in serious injury to occupants, the following apply :
 - (i) Each critical casting must—
 - (i) Have a casting factor of not less than 1.25 ; and
 - (ii) Receive 100 percent inspection by visual, radiographic, and magnetic particle or penetrant inspection methods or approved equivalent nondestructive inspection methods.
 - (2) For each critical casting with a casting factor less than 1.50, three sample castings must be static tested and shown to meet—
 - (i) The strength requirements of Sec. 25.305 at an ultimate load corresponding to a casting factor of 1.25 ; and
 - (ii) The deformation requirements of Sec. 25.305 at a load of 1.15 times the limit load.
 - (3) Examples of these castings are structural attachment fittings, parts of flight control systems, control surface hinges and balance weight attachments, seat, berth, safety belt, and fuel and oil tank supports and attachments, and cabin pressure valves.

system must be designed to provide a sufficient amount of uncontaminated air to enable the crewmembers to perform their duties without undue discomfort or fatigue and to provide reasonable passenger comfort. For normal operating conditions, the ventilation system must be designed to provide each occupant with an airflow containing at least 0.35 pounds of fresh air per minute.

- (b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapors. In meeting this requirement, the following apply :
 - (1) Carbon monoxide concentrations in excess of one part in 20,000 parts of air are considered hazardous. For test purposes, any acceptable carbon monoxide detection method may be used.
 - (2) [Carbon dioxide concentration during flight must be shown not to exceed 0.5 percent by volume (sea level equivalent) in compartments normally occupied by passengers or crewmembers.]
 - (c) There must be provisions made to ensure that the conditions prescribed in paragraph (b) of this section are met after reasonably probable failures or malfunctioning of the ventilating, heating, pressurization, or other systems and equipment.
 - (d) If accumulation of hazardous quantities of smoke in the cockpit area is reasonably probable, smoke evacuation must be readily accomplished, starting with full pressurization and without depressurizing beyond safe limits.
 - (e) Except as provided in paragraph (f) of this section, means must be provided to enable the occupants of the following compartments and areas to control the temperature and quantity of ventilating air supplied to their compartment or area independently of the temperature and quantity of air supplied to other compartments and areas :
 - (1) The flight crew compartment.
 - (2) Crewmember compartments and areas other than the flight crew compartment unless the crewmember compartment or area is ventilated by air interchange with other compartments or areas under all operating conditions.
 - (f) Means to enable the flight crew to control the temperature and quantity of ventilating air supplied to the flight crew compartment independently of the temperature and quantity of ventilating air supplied to other compartments are not required if all of the following conditions are met :
 - (1) The total volume of the flight crew and passenger compartments is 800 cubic feet or less.
 - (2) The air inlets and passages for air to flow between the flight crew and passenger compartment are arranged to provide compartment temperatures within 5 degrees F. of each other and adequate ventilation to occupants in both compartments.
 - (3) The temperature and ventilation controls are accessible to the flight crew.
 - (g) The exposure time at any given temperature must not exceed the values shown in the following graph after any improbable failure condition.
- Amdt. 25-89, Eff. 1/2/97

FAR 25.832 : Cabin ozone concentration.

- (a) [The airplane cabin ozone concentration during flight must be shown not to exceed—]

FAR 25.819 : [Lower deck service compartments (including galleys.)]

[For airplanes with a service compartment located below the main deck, which may be occupied during taxi or flight but not during takeoff or landing, the following apply :

- (a) There must be at least two emergency evacuation routes, one at each end of lower deck service compartment or two having sufficient separation within each compartment, which could be used by each occupant or the lower deck service compartment to rapidly evacuate to the main deck under normal and emergency lighting conditions. The routes must provide for the evacuation of incapacitated persons, with assistance. The use of the evacuation routes may not be dependent on any powered device. The routes must be designed to minimize the possibility of blockage which might result from fire, mechanical or structural failure, or persons standing on top of or against the escape routes. In the event the airplane's main power system or compartment main lighting system should fail, emergency illumination for each lower deck service compartment must be automatically provided.

- (b) There must be a means for two-way voice communication between the flight deck and each lower deck service compartment.
- (c) There must be an aural emergency alarm system, audible during normal and emergency conditions, to enable crewmembers on the flight deck and at each required floor level emergency conditions, to enable crewmembers on the flight deck and at each required floor level emergency exit to alert occupants of each lower deck service compartment of an emergency situation.
- (d) There must be a means, readily detectable by occupants of each lower deck service compartment, that indicates when seat belts should be fastened.
- (e) If a public address system is installed in the airplane, speakers must be provided in each lower deck service compartment.
- (f) For each occupant permitted in a lower deck service compartment, there must be a forward or aft facing seat which meets the requirements of Sec. 25.785(c) and must be able to withstand maximum flight loads when occupied.

- (g) For each powered lift system installed between a lower deck service compartment and the main deck for the carriage of persons or equipment, or both, the system must meet the following requirements :

- (1) Each lift control switch outside the lift, except emergency stop buttons, must be designed to prevent the activation of the lift if the lift door, or the hatch required by paragraph (g)(3) of this section, or both are open.
- (2) An emergency stop button, that when activated will immediately stop the lift, must be installed within the lift and at each entrance to the lift.
- (3) There must be a hatch capable of being used for evacuating persons from the lift that is openable from the inside and outside the lift without tools, with the lift in any position.]

Amdt. 25-53, Eff. 8/31/80

47.8 Ventilation and Heating

FAR 25.831 : Ventilation.

- (a) Under normal operating conditions and in the event of any probable failure conditions of any system which would adversely affect the ventilating air, the ventilation

- (d) *Noncritical castings.* For each casting other than those specified in paragraph (c) of this section, the following apply :

- (1) Except as provided in subparagraphs (2) and (3) of this paragraph, the casting factors and corresponding inspections must meet the following table :

<i>Casting factor</i>	<i>Inspection</i>
2.0 or more	100 percent visual
Less than 2.0 but more than 1.5	100 percent visual, and magnetic particle or penetrant or equivalent nondestructive inspection methods.
1.25 through 1.50	100 percent visual, magnetic particle or penetrant, and radiographic, or approved equivalent nondestructive inspection methods.

- (2) The percentage of castings inspected by nonvisual methods may be reduced below that specified in subparagraph (1) of this paragraph when an approved quality control procedure is established.
- (3) For castings procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis—
 - (i) A casting factor of 1.0 may be used ; and
 - (ii) The castings must be inspected as provided in subparagraph (1) of this paragraph for casting factors of "1.25 through 1.50" and tested under paragraph (c)(2) of this section.

FAR 25.623 : Bearing factors.

- (a) Except as provided in paragraph (b) of this section, each part that has clearance (free fit), and that is subject to pounding or vibration, must have a bearing factor large enough to provide for the effects of normal relative motion.
- (b) No bearing factor need be used for a part for which any larger special factor is prescribed.

FAR 25.625 : Fitting factors.

For each fitting (a part or terminal used to join one structural member to another), the following apply :

- (a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1.15 must be applied to each part of—

- (1) The fitting ;
- (2) The means of attachment ; and
- (3) The bearing on the joined members.
- (b) No fitting factor need be used—

- (1) For joints made under approved practices and based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood) ; or
- (2) With respect to any bearing surface for which a larger special factor is used.
- (c) For each integral fitting, the part must be treated as a fitting up to the point at which the section properties become typical of the member.
- (d) [For each seat, berth, safety belt, and harness, the fitting factor specified in Sec. 25.785(f)(3) applies.]
Amdt. 25-72, Eff. 8/20/90

FAR 25.629 : [Aeroelastic stability requirements.]

- (a) [General. The aeroelastic stability evaluations required under this section include flutter, divergence, control reversal and any undue loss of stability and control as a result of structural deformation. The aeroelastic evaluation must include whirl modes associated with any propeller or rotating device that contributes significant dynamic forces. Compliance with this section must be shown by analyses, wind tunnel tests, ground vibration tests, flight tests, or other means found necessary by the Administrator.
- (b) *Aeroelastic stability envelopes.* The airplane must be designed to be free from aeroelastic instability for all configurations and design conditions within the aeroelastic stability envelopes as follows :
 - (1) For normal conditions without failures, malfunctions, or adverse conditions, all combinations of altitudes and speeds encompassed by the V_D/M_D versus altitude envelope enlarged at all points by an increase of 15 percent in equivalent airspeed at both constant Mach number and constant altitude. In addition, a proper margin of stability must exist at all speeds up to V_D/M_D and, there must be no large and rapid reduction in stability as V_D/M_D is approached. The enlarged envelope may be limited to Mach 1.0 when M_D is less than 1.0 at all design altitudes, and
 - (2) For the conditions described in Sec. 25.659(d) below, for all approved altitudes, any airspeed up to the greater airspeed defined by :
 - (i) The V_D/M_D envelope determined by Sec. 25.335(b) ; or
 - (ii) An altitude-airspeed envelope defined by a 15 percent increase in equivalent airspeed above V_C at constant altitude, from sea level to the altitude of the intersection of 1.15 V_C with the extension of the constant cruise Mach number line, M_C , then a linear variation in equivalent airspeed to $M_C + 0.05$ at the altitude of the lowest V_C/M_C intersection; then, at higher altitudes, up to the maximum flight altitude, the boundary defined by a .05 Mach increase in M_C at constant altitude.
 - (c) *Balance weights.* If concentrated balance weights are used, their effectiveness and strength, including supporting structure, must be substantiated.
 - (d) *Failures, malfunctions, and adverse conditions.* The failures, malfunctions, and adverse conditions which must be considered in showing compliance with this section are :
 - (1) Any critical fuel loading conditions, not shown to be extremely improvable, which may result from mismanagement of fuel.

- (2) In addition to the access--
 - (i) For airplanes that have a passenger seating configuration of 20 or more, the projected opening of the exit provided must not be obstructed and there must be no interference in opening the exit by seats, berths, or other protrusions (including any seatback in the most adverse position) for a distance from that exit not less than the width of the narrowest passenger seat installed on the airplane.
 - (ii) For airplanes that have a passenger seating configuration of 19 or fewer, there may be minor obstructions in this region, if there are compensating factors to maintain the effectiveness of the exit.
- (3) For each Type III exit, regardless of the passenger capacity of the airplane in which it is installed, there must be placards that--
 - (i) Are readable by all persons seated adjacent to and facing a passageway to the exit ;
 - (ii) Accurately state or illustrate the proper method of opening the exit, including the use of handholds ; and
 - (iii) If the exit is a removable hatch, state the weight of the hatch and indicate an appropriate location to place the hatch after removal.
- (d) If it is necessary to pass through a passageway between passenger compartments to reach any required emergency exit from any seat in the passenger cabin, the passageway must be unobstructed. However, curtains may be used if they allow free entry through the passageway.
- (e) No door may be installed in any partition between passenger compartments.
- (f) If it is necessary to pass through a doorway separating the passenger cabin from other areas to reach any required emergency exit from any passenger seat, the door must have a means to latch it in open position. The latching means must be able to withstand the loads imposed upon it when the door is subjected to the ultimate inertia forces, relative to the surrounding structure, listed in Sec. 25.561(b).
Amdt. 25-88, Eff. 12/9/96

FAR 25.815 : Width of aisle.

The passenger aisle width at any point between seats must equal or exceed the values in the following table :

Passenger seating capacity	Minimum passenger aisle width (inches)	
	Less than 25 inches from floor	25 inches and more from floor
10 or less	12	15
11 through 19	12	20
20 or more	15	20

^[1] A narrower width not less than 9 inches may be approved when substantiated by tests found necessary by the Administrator.]
Amdt. 25-38, Eff. 2/1/77

FAR 25.817 : [Maximum number of seats abreast.]

[On airplanes having only one passenger aisle, no more than 3 seats abreast may be placed on each side of the aisle in any one row.]
Amdt. 25-15, 10/24/67

unobstructed and at least 36 inches wide. Passageways between individual passenger areas and those leading to Type I, Type II, or Type C emergency exits must be unobstructed and at least 20 inches wide. Unless there are two or more main aisles, each Type A or B exit must be located so that there is passenger flow along the main aisle to that exit from both the forward and aft directions. If two or more main aisles are provided, there must be unobstructed cross-aisles at least 20 inches wide between main aisles. There must be—

- (1) A cross-aisle which leads directly to each passageway between the nearest main aisle and a Type A or B exit; and
 - (2) A cross-aisle which leads to the immediate vicinity of each passageway between the nearest main aisle and a Type I, Type II, or Type III exit; except that when two Type III exits are located within three passenger rows of each other, a single cross-aisle may be used if it leads to the vicinity between the passageways from the nearest main aisle to each exit.
- (b) [Adequate space to allow crewmember(s) to assist in the evacuation of passengers must be provided as follows :
- (1) The assist space must not reduce the unobstructed width of the passageway below that required for the exit.
 - (2) For each Type A or Type B exit, assist space must be provided at each side of the exit regardless of whether a means is required by Sec. 25.810(a) to assist passengers in descending to the ground from that exit.
 - (3) Assist space must be provided at one side of any other type exit required by Sec. 25.810(a) to have a means to assist passengers in descending to the ground from that exit.]
- (c) The following must be provided for each Type III or Type IV exit—
- (1) There must be access from the nearest aisle to each exit. In addition, for each Type III exit in an airplane that has a passenger seating configuration of 60 or more—

- (i) Except as provided in paragraph (c)(1)(ii), the access must be provided by an unobstructed passageway that is at least 10 inches in width for interior arrangements in which the adjacent seat rows on the exit side of the aisle contain no more than two seats, or 20 inches in width for interior arrangements in which those rows contain three seats. The width of the passageway must be measured with adjacent seats adjusted to their most adverse position. The centerline of the required passageway width must not be displaced more than 5 inches horizontally from that of the exit.
- (ii) In lieu of one 10- or 20-inch passageway, there may be two passageways, between seat rows only, that must be at least 6 inches in width and lead to an unobstructed space adjacent to each exit. (Adjacent exits must not share a common passageway.) The width of the passageways must be measured with adjacent seats adjusted to their most adverse position. The unobstructed space adjacent to the exit must extend vertically from the floor to the ceiling (or bottom of sidewall stowage bins), inboard from the exit for a distance not less than the width of the narrowest passenger seat installed on the airplane, and from the forward edge of the forward passageway to the aft edge of the aft passageway. The exit opening must be totally within the fore and aft bounds of the unobstructed space.

- (2) Any single failure in any flutter damper system.
- (3) For airplanes not approved for operation in icing conditions, the maximum likely ice accumulation expected as a result of an inadvertent encounter.
- (4) Failure of any single element of the structure supporting any engine, independently mounted propeller shaft, large auxiliary power unit, or large externally mounted aerodynamic body (such as an external fuel tank).
- (5) For airplanes with engines that have propellers or large rotating devices capable of significant dynamic forces, any single failure of the engine structure that would reduce the rigidity of the rotational axis.
- (6) The absence of aerodynamic or gyroscopic forces resulting from the most adverse combination of feathered propellers or other rotating devices capable of significant dynamic forces. In addition, the effect of a single feathered propeller or rotating device must be coupled with the failures of paragraphs (d)(4) and (d)(5) of this section.

- (7) Any single propeller or rotating device capable of significant dynamic forces rotating at the highest likely overspeed.

- (8) Any damage or failure condition, required or selected for investigation by Sec. 25.571. The single structural failures described in paragraphs (d)(4) and (d)(5) of this section need not be considered in showing compliance with this section if :

- (i) The structural element could not fail due to discrete source damage resulting from the conditions described in Sec. 25.571(e), and :

- (ii) A damage tolerance investigation in accordance with Sec. 25.571(b) shows that the maximum extent of damage assumed for the purpose of residual strength evaluation does not involve complete failure of the structural element.

- (9) Any damage, failure, or malfunction considered under Secs. 25.631, 25.671, 25.672, and 25.1309.

- (10) Any other combination of failures, malfunctions, or adverse conditions not shown to be extremely improbable.

- (e) *Flight flutter testing.* Full scale flight flutter tests at speeds up to V_{DF}/M_{DF} must be conducted for new type designs and for modifications to a type design unless the modifications have been shown to have an insignificant effect on the aeroelastic stability. These tests must demonstrate that the airplane has a proper margin of damping at all speeds up to V_{DF}/M_{DF} , and that there is no large and rapid reduction in damping as V_{DF}/M_{DF} is approached. If a failure, malfunction, or adverse condition is simulated during flight test in showing compliance with paragraph (d) of this section, the maximum speed investigated need not exceed V_{FC}/M_{FC} if it is shown, by correlation of the flight test data with other test data or analyses, that the airplane is free from any aeroelastic instability at all speeds within the altitude-airspeed envelope described in paragraph (b)(2) of this section.]

Amdt. 25-77, Eff. 7/29/92

FAR 25.631 : [Bird strike damage.]

[The empennage structure must be designed to assure capability of continued safe flight and landing of the airplane after impact with an 8-pound bird when the ve-

locity of the airplane (relative to the bird along the airplane's flight path) is equal to V_C at sea level, selected under Sec. 25.335(a). Compliance with this section by provision of redundant structure and protected location of control system elements or protective devices such as splitter plates or energy absorbing material is acceptable. Where compliance is shown by analysis, tests, or both, use of data on airplanes having similar structural design is acceptable.]

Amdt. 25-23, Eff. 5/8/70

47.2 Control Surfaces

FAR 25.651 : Proof of strength.

- (a) Limit load tests of control surfaces are required. These tests must include the horn or fitting to which the control system is attached.
- (b) Compliance with the special factors requirements of Secs. 25.619 through 25.625 and 25.657 for control surface hinges must be shown by analysis or individual load tests.

FAR 25.655 : Installation.

- (a) Movable tail surfaces must be installed so that there is no interference between any surfaces when one is held in its extreme position and the others are operated through their full angular movement.
- (b) If an adjustable stabilizer is used, it must have stops that will limit its range of travel to the maximum for which the airplane is shown to meet the trim requirements of Sec. 25.161.

FAR 25.657 : Hinges.

- (a) [For control surface hinges, including ball, roller, and self-lubricated bearing hinges, the approved rating of the bearing may not be exceeded. For non-standard bearing hinge configurations, the rating must be established on the basis of experience or tests and, in the absence or a rational investigation, a factor of safety of not less than 6.67 must be used with respect to the ultimate bearing strength of the softest material used as a bearing.]
- (b) Hinges must have enough strength and rigidity for loads parallel to the hinge line.]

Amdt. 25-23, Eff. 5/8/70

47.3 Control Systems

FAR 25.671 : General.

- (a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function.
- (b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimize the probability of incorrect assembly that could result in the malfunctioning of the system.

- (2) If the emergency lighting subsystem illuminating the assist means serves no other assist means, is independent of the airplane's main emergency lighting system, and is automatically activated when the assist means is erected, the lighting provisions—
 - (i) May not be adversely affected by stowage; and
 - (ii) Must provide illumination of not less than 0.03 foot-candle (measured normal to the direction of incident light) at the ground end of the erected assist means where an evacuee would normally make first contact with the ground, with the airplane in each of the attitudes corresponding to the collapse of one or more legs of the landing gear.
- (i) The energy supply to each emergency lighting unit must provide the required level of illumination for at least 10 minutes at the critical ambient conditions after emergency landing.
- (j) If storage batteries are used as the energy supply for the emergency lighting system, they may be recharged from the airplane's main electric power system : Provided, That, the charging circuit is designed to preclude inadvertent battery discharge into charging circuit faults.
- (k) Components of the emergency lighting system, including batteries, wiring relays, lamps, and switches must be capable of normal operation after having been subjected to the inertia forces listed in Sec. 25.561(b).
- (l) The emergency lighting system must be designed so that after any single transverse vertical separation of the fuselage during crash landing—
 - (1) Not more than 25 percent of all electrically illuminated emergency lights required by this section are rendered inoperative, in addition to the lights that are directly damaged by the separation;
 - (2) Each electrically illuminated exit sign required under Sec. 25.811 (4)(2) remains operative exclusive of those that are directly damaged by the separation; and
 - (3) At least one required exterior emergency light for each side of the airplane remains operative exclusive of those that are directly damaged by the separation.

Amdt. 25-88, Eff. 12/9/96

FAR 25.813 : Emergency exit access.

Each required emergency exit must be accessible to the passengers and located where it will afford an effective means of evacuation. Emergency exit distribution must be as uniform as practical, taking passenger distribution into account; however, the size and location of exits on both sides of the cabin need not be symmetrical. If only one floor level exit per side is prescribed, and the airplane does not have a tailcone or ventral emergency exit, the floor level exit must be in the rearward part of the passenger compartment, unless another location affords a more effective means of passenger evacuation. Where more than one floor level exit per side is prescribed, at least one floor level exit per side must be located near each end of the cabin, except that this provision does not apply to combination cargo/passenger configurations. In addition—

- (a) [There must be a passageway leading from the nearest main aisle to each Type A, Type B, Type C, Type I, or Type II emergency exit and between individual passenger areas. Each passageway leading to a Type A or Type B exit must be

- (1) After leaving the passenger seat, visually identify the emergency escape path along the cabin aisle floor to the first exits or pair of exits forward and aft of the seat ; and
- (2) Readily identify each exit from the emergency escape path by reference only to markings and visual features not more than 4 feet above the cabin floor.
- (f) Except for subsystems provided in accordance with paragraph (h) of this section that serve no more than one assist means, are independent of the airplane's main emergency lighting system, and are automatically activated when the assist means is erected, the emergency lighting system must be designed as follows :
- (1) The lights must be operable manually from the flight crew station and from a point in the passenger compartment that is readily accessible to a normal flight attendant seat.
- (2) There must be a flight crew warning light which illuminates when power is on in the airplane and the emergency lighting control device is not armed.
- (3) The cockpit control device must have an "on," "off," and "armed" position so that when armed in the cockpit or turned on at either the cockpit or flight attendant station the lights will either light or remain lighted upon interruption (except an interruption caused by a transverse vertical separation of the fuselage during crash landing) of the airplane's normal electric power. There must be a means to safeguard against inadvertent operation of the control device from the "armed" or "on" positions.
- (g) Exterior emergency lighting must be provided as follows :
- (1) At each overwing emergency exit the illumination must be—
- (i) Not less than 0.03 foot-candle (measured normal to the direction of the incident light) on a two-square-foot area where an evacuee is likely to make his first step outside the cabin ;
- (ii) [Not less than 0.05 foot-candle (measured normal to the direction of incident light) along the 30 percent of the slip-resistant portion of the escape route required in Sec. 25.810(c) that is farthest from the exit for the minimum required width of the escape route ; and]
- (iii) Not less than 0.03 foot-candle on the ground surface with the landing gear extended (measured normal to the direction of the incident light) where an evacuee using the established escape route would normally make first contact with the ground.
- (2) At each non-overwing emergency exit not required by Sec. 25.809(f) to have descent assist means the illumination must be not less than 0.03 foot-candle (measured normal to the direction of the incident light) on the ground surface with the landing gear extended where an evacuee is likely to make his first contact with the ground outside the cabin.
- (h) The means required in Sec. 25.809(f)(1) and (h) to assist the occupants in descending to the ground must be illuminated so that the erected assist means is visible from the airplane.
- (1) If the assist means is illuminated by exterior emergency lighting, it must provide illumination of not less than 0.03 foot-candle (measured normal to the direction of the incident light) at the ground end of the erected assist means where an evacuee using the established escape route would normally make first contact with the ground, with the airplane in each of the attitudes corresponding to the collapse of one or more legs of the landing gear.

- (c) [The airplane must be shown by analysis, tests, or both, to be capable of continued safe flight and landing after any of the following failures or jamming in the flight control system and surfaces (including trim, lift, drag, and feel systems), within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable malfunctions must have only minor effects on control system operation and must be capable of being readily counteracted by the pilot.

- (1) Any single failure, excluding jamming (for example, disconnection or failure of mechanical elements, or structural failure of hydraulic components, such as actuators, control spool housing, and valves).
- (2) Any combination of failures not shown to be extremely improbable, excluding jamming (for example, dual electrical or hydraulic system failures, or any single failure in combination with any probable hydraulic or electrical failure).
- (3) Any jam in a control position normally encountered during takeoff, climb, cruise, normal turns, descent, and landing unless the jam is shown to be extremely improbable, or can be alleviated. A runaway of a flight control to an adverse position and jam must be accounted for if such runaway and subsequent jamming is not extremely improbable.
- (d) The airplane must be designed so that it is controllable if all engines fail. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.]

Amdt. 25-23, Eff 5/8/70

FAR 25.672 : [Stability augmentation and automatic and power-operated systems.]

[If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this part, such systems must comply with Sec. 25.671 and the following :

- (a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring his attention must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system which could result in an unsafe condition if the pilot were not aware of the failure. Warning systems must not activate the control systems.
- (b) The design of the stability augmentation system or of any other automatic or power-operated system must permit initial counteraction of failures of the type specified in Sec. 25.671(c) without requiring exceptional pilot skill or strength, by either the deactivation of the system, or a failed portion thereof, or by overriding the failure by movement of the flight controls in the normal sense.
- (c) It must be shown that after any single failure of the stability augmentation system or any other automatic or power-operated system—
- (1) The airplane is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations that is critical for the type of failure being considered ;

- (2) The controllability and maneuverability requirements of this part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and airplane configurations) which is described in the Airplane Flight Manual ; and
- (3) The trim, stability, and stall characteristics are not impaired below a level needed to permit continued safe flight and landing.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.673 : [Removed.]

[Removed.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.675 : Stops.

- (a) [Each control system must have stops that positively limit the range of motion of each movable aerodynamic surface controlled by the system.]
- (b) Each stop must be located so that wear, slackness, or take-up adjustments will not adversely affect the control characteristics of the airplane because of a change in the range of surface travel.
- (c) Each stop must be able to withstand any loads corresponding to the design conditions for the control system.

Amdt. 25-38, Eff. 2/1/77

FAR 25.677 : Trim systems.

- (a) Trim controls must be designed to prevent inadvertent or abrupt operation and to operate in the plane, and with the sense of motion, of the airplane.
- (b) There must be means adjacent to the trim control to indicate the direction of the control movement relative to the airplane motion. In addition, there must be clearly visible means to indicate the position of the trim device with respect to the range of adjustment.
- (c) [Trim control systems must be designed to prevent creeping in flight. Trim tab controls must be irreversible unless the tab is appropriately balanced and shown to be free from flutter.]
- (d) If an irreversible tab control system is used, the part from the tab to the attachment of the irreversible unit to the airplane structure must consist of a rigid connection.

Amdt. 25-23, Eff. 5/8/70

FAR 25.679 : Control system gust locks.

- (a) There must be a device to prevent damage to the control surfaces (including tabs), and to the control system, from gusts striking the airplane while it is on the ground or water. If the device, when engaged, prevents normal operation of the control surfaces by the pilot, it must—

- (1) Illuminated emergency exit marking and locating signs, sources of general cabin illumination, interior lighting in emergency exit areas, and floor proximity escape path marking.
- (2) Exterior emergency lighting.
- (b) Emergency exit signs—

- (1) For airplanes that have a passenger seating configuration, excluding pilot seats, of 10 seats or more must meet the following requirements :
- (i) Each passenger emergency exit locator sign required by Sec. 25.811(d)(1) and each passenger emergency exit marking sign required by Sec. 25.811(d)(2) must have red letters at least $1\frac{1}{2}$ inches high on an illuminated white background, and must have an area of at least 21 square inches excluding the letters. The lighted background-to-letter contrast must be at least 10 : 1. The letter height to stroke-width ratio may not be more than 7 : 1 nor less than 6 : 1. These signs must be internally electrically illuminated with a background brightness of at least 25 foot-lamberts and a high-to-low background contrast no greater than 3 : 1.
- (ii) Each passenger emergency exit sign required by Sec. 25.811(d)(3) must have red letters at least $1\frac{1}{2}$ inches high on a white background having an area of at least 21 square inches excluding the letters. These signs must be internally electrically illuminated or self-illuminated by other than electrical means and must have an initial brightness of at least 400 microlamberts. The colors may be reversed in the case of a sign that is self-illuminated by other than electrical means.
- (2) For airplanes that have a passenger seating configuration, excluding pilot seats, of nine seats or less, that are required by Sec. 25.811(d)(1), (2), and (3) must have red letters at least 1 inch high on a white background at least 2 inches high. These signs may be internally electrically illuminated, or self-illuminated by other than electrical means, with an initial brightness of at least 160 microlamberts. The colors may be reversed in the case of a sign that is self-illuminated by other than electrical means.
- (c) General illumination in the passenger cabin must be provided so that when measured along the centerline of main passenger aisle(s), and cross aisle(s) between main aisles, at seat armrest height and at 40-inch intervals, the average illumination is not less than 0.05 foot-candle and the illumination at each 40-inch interval is not less than 0.01 foot-candle. A main passenger aisle(s) is considered to extend along the fuselage from the most forward passenger emergency exit or cabin occupant seat, whichever is farther forward, to the most rearward passenger emergency exit or cabin occupant seat, whichever is farther left.
- (d) The floor of the passageway leading to each floor-level passenger emergency exit, between the main aisles and the exit openings, must be provided with illumination that is not less than 0.02 foot-candle measured along a line that is within six inches of and parallel to the floor and is centered on the passenger evacuation path.
- (e) Floor proximity emergency escape path marking must provide emergency evacuation guidance for passengers when all sources of illumination more than 4 feet above the cabin aisle floor are totally obscured. In the dark of the night, the floor proximity emergency escape path marking must enable each passenger to—

- (i) Be self-illuminated with an initial brightness of at least 160 microlamberts ; or
- (ii) Be conspicuously located and well illuminated by the emergency lighting even in conditions of occupant crowding at the exit.
- (3) Reserved.
- (4) [Each Type A, Type B, Type C, Type I, or Type II passenger emergency exit with a locking mechanism released by rotary motion of the handle must be marked—]
 - (i) With a red arrow, with a shaft at least three-fourths of an inch wide and a head twice the width of the shaft, extending along at least 70 degrees of arc at a radius approximately equal to three-fourths of the handle length.
 - (ii) So that the centerline of the exit handle is within ± 1 inch of the projected point of the arrow when the handle has reached full travel and has released the locking mechanism, and
 - (iii) With the word "open" in red letters 1 inch high, placed horizontally near the head of the arrow.
- (f) Each emergency exit that is required to be openable from the outside, and its means of opening, must be marked on the outside of the airplane. In addition, the following apply :

- (1) The outside marking for each passenger emergency exit in the side of the fuselage must include a 2-inch colored band outlining the exit.
- (2) Each outside marking including the band, must have color contrast to be readily distinguishable from the surrounding fuselage surface. The contrast must be such that if the reflectance of the darker color is 15 percent or less, the reflectance of the lighter color must be at least 45 percent. "Reflectance" is the ratio of the luminous flux reflected by a body to the luminous flux it receives. When the reflectance of the darker color is greater than 15 percent, at least a 30-percent difference between its reflectance and the reflectance of the lighter color must be provided.

- (3) In the case of exits other than those in the side of the fuselage, such as ventral or tailcone exits, the external means of opening, including instructions if applicable, must be conspicuously marked in red, or bright chrome yellow if the background color is such that red is inconspicuous. When the opening means is located on only one side of the fuselage, a conspicuous marking to that effect must be provided on the other side.

- (g) Each sign required by paragraph (d) of this section may use the word "exit" in its legend in place of the term "emergency exit".

Amdt. 25-88, Eff. 12/9/96

FAR 25.812 : Emergency lighting.

- (a) An emergency lighting system, independent of the main lighting system, must be installed. However, the sources of general cabin illumination may be common to both the emergency and the main lighting systems if the power supply to the emergency lighting system is independent of the power supply to the main lighting system. The emergency lighting system must include :

- (1) Automatically disengage when the pilot operates the primary flight controls in a normal manner ; or
- (2) Limit the operation of the airplane so that the pilot receives unmistakable warning at the start of takeoff.
- (b) The device must have means to preclude the possibility of it becoming inadvertently engaged in flight.

FAR 25.681 : Limit load static tests.

- (a) Compliance with the limit load requirements of this Part must be shown by tests in which—
 - (1) The direction of the test loads produces the most severe loading in the control system ; and
 - (2) Each fitting, pulley, and bracket used in attaching the system to the main structure is included.
- (b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

FAR 25.683 : Operation tests.

[It must be shown by operation tests that when portions of the control system subject to pilot effort loads are loaded to 80 percent of the limit load specified for the system and the powered portions of the control system are loaded to the maximum load expected in normal operation, the system is free from—]

- (a) Jamming ;
- (b) Excessive friction ; and
- (c) Excessive deflection.

Amdt. 25-23, Eff. 5/8/70

FAR 25.685 : Control system details.

- (a) [Each detail of each control system must be designed and installed to prevent jamming, chafing, and interference from cargo, passengers, loose objects, or the freezing of moisture.]
- (b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system.
- (c) There must be means to prevent the slapping of cables or tubes against other parts.
- (d) Sections 25.689 and 25.693 apply to cable systems and joints.

Amdt. 25-38, Eff. 2/1/77

FAR 25.689 : Cable systems.

- (a) Each cable, cable fitting, turnbuckle, splice, and pulley must be approved. In addition—

- (1) No cable smaller than $\frac{1}{8}$ inch in diameter may be used in the aileron, elevator, or rudder systems; and
- (2) Each cable system must be designed so that there will be no hazardous change in cable tension throughout the range of travel under operating conditions and temperature variations.
- (b) Each kind and size of pulley must correspond to the cable with which it is used. Pulleys and sprockets must have closely fitted guards to prevent the cables and chains from being displaced or fouled. Each pulley must lie in the plane passing through the cable so that the cable does not rub against the pulley flange.
- (c) Fairleads must be installed so that they do not cause a change in cable direction of more than three degrees.
- (d) Clevis pins subject to load or motion and retained only by cotter pins may not be used in the control system.
- (e) Turnbuckles must be attached to parts having angular motion in a manner that will positively prevent binding throughout the range of travel.
- (f) There must be provisions for visual inspection of fairleads, pulleys, terminals, and turnbuckles.

FAR 25.693 : Joints.

[Control system joints (in push-pull systems) that are subject to angular motion, except those in ball and roller bearing systems, must have a special factor of safety of not less than 3.33 with respect to the ultimate bearing strength of the softest material used as a bearing. This factor may be reduced to 2.0 for joints in cable control systems. For ball or roller bearings, the approved ratings may not be exceeded.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.695 : [Revoked.]

[Revoked.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.697 : Lift and drag devices, controls.

- (a) Each lift device control must be designed so that the pilots can place the device in any takeoff, en route, approach, or landing position [established under Sec. 25.101(d).] Lift and drag devices must maintain the selected positions, except for movement produced by an automatic positioning or load limiting device, without further attention by the pilots.
- (b) Each lift and drag device control must be designed and located to make inadvertent operation improbable. Lift and drag devices intended for ground operation only must have means to prevent the inadvertent operation of their controls in flight if that operation could be hazardous.
- (c) The rate of motion of the surfaces in response to the operation of the control and the characteristics of the automatic positioning or load limiting device must give satisfactory flight and performance characteristics under steady or changing conditions of airspeed, engine power, and airplane attitude.

the ground with the airplane on the ground and the landing gear extended, for all other exit types.

- (1) If the escape route is over the flap, the height of the terminal edge must be measured with the flap in the takeoff or landing position, whichever is higher from the ground.
- (2) The assisting means must be usable and self-supporting with one or more landing gear legs collapsed and under a 25-knot wind directed from the most critical angle.
- (3) The assisting means provided for each escape route leading from a Type A or B emergency exit must be capable of carrying simultaneously two parallel lines of evacuees; and, the assisting means leading from any other exit type must be capable of carrying as many parallel lines of evacuees as there are required escape routes.
- (4) The assisting means provided for each escape route leading from a Type C exit must be automatically erected within 10 seconds from the time the opening means of the exit is actuated, and that provided for the escape route leading from any other exit type must be automatically erected within 10 seconds after actuation of the erection system.]

Amdt. 25-88, Eff. 12/9/96

FAR 25.811 : Emergency exit marking.

- (a) Each passenger emergency exit, its means of access, and its means of opening must be conspicuously marked.
- (b) The identity and location of each passenger emergency exit must be recognizable from a distance equal to the width of the cabin.
- (c) Means must be provided to assist the occupants in locating the exits in conditions of dense smoke.
- (d) The location of each passenger emergency exit must be indicated by a sign visible to occupants approaching along the main passenger aisle (or aisles). There must be—
 - (1) A passenger emergency exit locator sign above the aisle (or aisles) near each passenger emergency exit, or at another overhead location if it is more practical because of low headroom, except that one sign may serve more than one exit if each exit can be seen readily from the sign;
 - (2) A passenger emergency exit marking sign next to each passenger emergency exit, except that one sign may serve two such exits if they both can be seen readily from the sign; and
 - (3) A sign on each bulkhead or divider that prevents fore and aft vision along the passenger cabin to indicate emergency exits beyond and obscured by the bulkhead or divider, except that if this is not possible the sign may be placed at another appropriate location.
- (e) The location of the operating handle and instructions for opening exits from the inside of the airplane must be shown in the following manner:
 - (1) Each passenger emergency exit must have, on or near the exit, a marking that is readable from a distance of 30 inches.
 - (2) [Each Type A, Type B, Type C or Type I passenger emergency exit operating handle must—]

- (iii) It must be of such length after full deployment that the lower end is self-supporting on the ground and provides safe evacuation of occupants to the ground after collapse of one or more legs of the landing gear.
- (iv) It must have the capability, in 25-knot winds directed from the most critical angle, to deploy and, with the assistance of only one person, to remain usable after full deployment to evacuate occupants safely to the ground.
- (v) For each system installation (mockup or airplane installed), five consecutive deployment and inflation tests must be conducted (per exit) without failure, and at least three tests of each such five-test series must be conducted using a single representative sample of the device. The sample devices must be deployed and inflated by the system's primary means after being subjected to the inertia forces specified in Sec. 25.561(b). If any part of the system fails or does not function properly during the required tests, the cause of the failure or malfunction must be corrected by positive means and after that, the full series of five consecutive deployment and inflation tests must be conducted without failure.
- (2) The assisting means for flightcrew emergency exits may be a rope or any other means demonstrated to be suitable for the purpose. If the assisting means is a rope, or an unapproved device equivalent to a rope, it must be—
- (i) Attached to the fuselage structure at or above the top of the emergency exit opening, or, for a device at a pilot's emergency exit window, at another approved location if the stowed device, or its attachment, would reduce the pilot's view in flight ;
- (ii) Able (with its attachment) to withstand a 400-pound static load.
- (b) [Assist means from the cabin to the wing are required for each Type A or Type B exit located above the wing and having a stepdown unless the exit without an assist-means can be shown to have a rate of passenger egress at least equal to that of the same type of non over-wing exit. If an assist means is required, it must be automatically deployed and automatically erected concurrent with the opening of the exit. In the case of assist means installed at Type C exits, it must be self-supporting within 10 seconds from the time the opening means of the exits is actuated. For all other exit types, it must be self-supporting 6 seconds after deployment is begun.]
- (c) An escape route must be established from each overwing emergency exit, and (except for flap surfaces suitable as slides) covered with a slip resistant surface. Except where a means for channelling the flow of evacuees is provided—
- (1) [The escape route from each Type A or Type B passenger emergency exit, or any common escape route from two Type III passenger emergency exits, must be at least 42 inches wide; that from any other passenger emergency exit must be at least 24 inches wide ; and]
- (2) The escape route surface must have a reflectance of at least 80 percent, and must be defined by markings with a surface-to-marking contrast ratio of at least 5 :1.
- (d) [Means must be provided to assist evacuees to reach the ground for all Type C exits located over the wing and, if the place on the airplane structure at which the escape route required in paragraph (c) of this section terminates is more than 6 feet from

- (d) The lift device control must be designed to retract the surfaces from the fully extended position, during steady flight at maximum continuous engine power at any speed below $V_F + 9.0$ (knots).

Amdt. 25-57, Eff. 3/26/84

FAR 25.699 : [Lift and drag device indicator.]

- (a) [There must be means to indicate to the pilots the position of each lift or drag device having a separate control in the cockpit to adjust its position. In addition, an indication of unsymmetrical operation or other malfunction in the lift or drag device systems must be provided when such indication is necessary to enable the pilots to prevent or counteract an unsafe flight or ground condition, considering the effects on flight characteristics and performance.
- (b) There must be means to indicate to the pilots the takeoff, en route, approach, and landing lift device positions.
- (c) If any extension of the lift and drag devices beyond the landing position is possible, the controls must be clearly marked to identify this range of extension.]

Amdt. 25-23, Eff. 5/8/70

FAR 25.701 : [Flap and slat interconnection.]

- (a) [Unless the airplane has safe flight characteristics with the flaps or slats retracted on one side and extended on the other, the motion of flaps or slats on opposite sides of the plane of symmetry must be synchronized by a mechanical interconnection or approved equivalent means.
- (b) If a wing flap or slat interconnection or equivalent means is used, it must be designed to account for the applicable unsymmetrical loads, including those resulting from flight with the engines on one side of the plane of symmetry inoperative and the remaining engines at takeoff power.
- (c) For airplanes with flaps or slats that are not subjected to slipstream conditions, the structure must be designed for the loads imposed when the wing flaps or slats on one side are carrying the most severe load occurring in the prescribed symmetrical conditions and those on the other side are carrying not more than 80 percent of that load.
- (d) The interconnection must be designed for the loads resulting when interconnected flap or slat surfaces on one side of the plane of symmetry are jammed and immovable while the surfaces on the other side are free to move and the full power of the surface actuating system is applied.]

Amdt. 25-72, Eff. 8/20/90

FAR 25.703 : [Takeoff warning system.]

- [A takeoff warning system must be installed and must meet the following requirements :
- (a) The system must provide to the pilots an aural warning that is automatically activated during the initial portion of the takeoff roll if the airplane is in a configuration, including any of the following, that would not allow a safe takeoff :

- (1) The wing flaps or leading edge devices are not within the approved range of takeoff positions.
 - (2) Wing spoilers (except lateral control spoilers meeting the requirements of Sec. 25.671), speed brakes, or longitudinal trim devices are in a position that would not allow a safe takeoff.
 - (b) The warning required by paragraph (a) of this section must continue until—
 - (1) The configuration is changed to allow a safe takeoff;
 - (2) Action is taken by the pilot to terminate the takeoff roll;
 - (3) The airplane is rotated for takeoff; or
 - (4) The warning is manually deactivated by the pilot.
 - (c) The means used to activate the system must function properly throughout the ranges of takeoff weights, altitudes, and temperatures for which certification is requested.]
- Amdt. 25-42, Eff. 3/1/78

47.4 Landing Gear

FAR 25.721 : General.

- (a) [The main landing gear system must be designed so that if it fails due to overloads during takeoff and landing (assuming the overloads to act in the upward and aft directions), the failure mode is not likely to cause—
 - (1) For airplanes that have a passenger seating configuration, excluding pilots seats, of nine seats or less, the spillage of enough fuel from any fuel system in the fuselage to constitute a fire hazard ; and
 - (2) For airplanes that have a passenger seating configuration, excluding pilots seats, of 10 seats or more, the spillage of enough fuel from any part of the fuel system to constitute a fire hazard.
 - (b) Each airplane that has a passenger seating configuration excluding pilot seats, of 10 or more must be designed so that with the airplane under control it can be landed on a paved runway with any one or more landing gear legs not extended without sustaining a structural component failure that is likely to cause the spillage of enough fuel to constitute a fire hazard.
 - (c) Compliance with the provisions of this section may be shown by analysis or tests, or both.]
- Amdt. 25-32, Eff. 5/1/72

FAR 25.723 : Shock absorption tests.

- (a) [The analytical representation of the landing gear dynamic characteristics that is used in determining the landing loads must be validated by energy absorption tests. A range of tests must be conducted to ensure that the analytical representation is valid for the design conditions specified in Sec. 25.473.
- (1) The configurations subjected to energy absorption tests at limit design conditions must include at least the design landing weight or the design takeoff weight, whichever produces the greater value of landing impact energy.

- (c) The means of opening emergency exits must be simple and obvious and may not require exceptional effort. Internal exit-opening means involving sequence operations (such as operation of two handles or latches or the release of safety catches) may be used for flight crew emergency exits if it can be reasonably established that these means are simple and obvious to crewmembers trained in their use.
 - [(d)] If a single power-boost or single power-operated system is the primary system for operating more than one exit in an emergency, each exit must be capable of meeting the requirements of paragraph (b) of this section in the event of failure of the primary system. Manual operation of the exit (after failure of the primary system) is acceptable.
 - [(e)] Each emergency exit must be shown by tests, or by a combination of analysis and tests, to meet the requirements of paragraphs (b) and (c) of this section.
 - [(f)] There must be a means to lock each emergency exit and to safeguard against its opening in flight, either inadvertently by persons or as a result of mechanical failure. In addition, there must be a means for direct visual inspection of the locking mechanism by crewmembers to determine that each emergency exit, for which the initial opening movement is outward, is fully locked.
 - [(g)] There must be provisions to minimize the probability of jamming of the emergency exits resulting from fuselage deformation in a minor crash landing.
 - [(h)] When required by the operating rules for any large passenger-carrying turbojet-powered airplane, each ventral exit and tailcone exit must be—
 - (1) Designed and constructed so that it cannot be opened during flight ; and
 - (2) Marked with a placard readable from a distance of 30 inches and installed at a conspicuous location near the means of opening the exit, stating that the exit has been designed and constructed so that it cannot be opened during flight.
- Amdt. 25-72, Eff. 8/20/90

FAR 25.810 : Emergency egress assist means and escape routes.

- (a) [Each non over-wing Type A, Type B or Type C exit, and any other non over-wing airplane emergency exit more than 6 feet from the ground with the airplane on the ground and the landing gear extended, must have an approved means to assist the occupants in descending to the ground.
- (1) The assisting means for each passenger emergency exit must be a self-supporting slide or equivalent ; and, in the case of a Type A exits, it must be capable of carrying simultaneously two parallel lines of evacuees. In addition, the assisting means must be designed to meet the following requirements—
 - (i) It must be automatically deployed and deployment must begin during the interval between the time the exit opening means is actuated from inside the airplane and the time the exit is fully opened. However, each passenger emergency exit which is also a passenger entrance door or a service door must be provided with means to prevent deployment of the assisting means when it is opened from either the inside or the outside under nonemergency conditions for normal use.
 - (ii) [Except for assisting means installed at Type C exits, it must be automatically erected within 6 seconds after deployment is begun. Assisting means installed at Type C exits must be automatically erected within 10 seconds from the time the opening means of the exit is actuated.]

(h) *Excess exits.* Each emergency exit in the passenger compartment in excess of the minimum number of required emergency exits must meet the applicable requirements of Sec. 25.809 through 25.812, and must be readily accessible.

(i) *Ditching emergency exits for passengers.* Whether or not ditching certification is requested, ditching emergency exits must be provided in accordance with the following requirements, unless the emergency exits required by paragraph (g) of this section already meet them :

- (1) For airplanes that have a passenger seating configuration of nine or fewer seats, excluding pilot seats, one exit above the waterline in each side of the airplane, meeting at least the dimensions of a Type IV exit.
- (2) For airplanes that have a passenger seating configuration of 10 or more seats, excluding pilot seats, one exit above the waterline in a side of the airplane, meeting at least the dimensions of a Type III exit for each unit (or part of a unit) of 35 passenger seats, but no less than two such exits in the passenger cabin, with one on each side of the airplane. The passenger seat/exit ratio may be increased through the use of larger exits, or other means, provided it is shown that the evacuation capability during ditching has been improved accordingly.

(3) If it is impractical to locate side exits above the waterline, the side exits must be replaced by an equal number of readily accessible overhead hatches of not less than the dimensions of a Type III exit, except that for airplanes with a passenger configuration of 35 or fewer seats, excluding pilot seats, the two required Type III side exits need be replaced by only one overhead hatch.

(j) *Flightcrew emergency exits.* For airplanes in which the proximity of passenger emergency exits to the flightcrew area does not offer a convenient and readily accessible means of evacuation of the flightcrew, and for all airplanes having a passenger seating capacity greater than 20, flightcrew exits shall be located in the flightcrew area. Such exits shall be of sufficient size and so located as to permit rapid evacuation by the crew. One exit shall be provided on each side of the airplane; or, alternatively, a top hatch shall be provided. Each exit must encompass an unobstructed rectangular opening of at least 19 by 20 inches unless satisfactory exit utility can be demonstrated by a typical crewmember.]

Amdt. 25-94, Eff. 3/25/98

FAR 25.809 : Emergency exit arrangement.

(a) Each emergency exit, including a flight crew emergency exit, must be a movable door or hatch in the external walls of the fuselage, allowing unobstructed opening to the outside.

(b) Each emergency exit must be openable from the inside and the outside except that sliding window emergency exits in the flight crew area need not be openable from the outside if other approved exits are convenient and readily accessible to the flight crew area. Each emergency exit must be capable of being opened, when there is no fuselage deformation—

- (1) With the airplane in the normal ground attitude and in each of the attitudes corresponding to collapse of one or more legs of the landing gear ; and
- (2) Within ten seconds measured from the time when the opening means is actuated to the time when the exit is fully opened.

(2) The test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of rational or conservative limit loads.

(b) The landing gear may not fail in a test, demonstrating its reserve energy absorption capacity, simulating a descent velocity of 12 f.p.s. at design landing weight, assuming airplane lift not greater than airplane weight acting during the landing impact.

(c) In lieu of the tests prescribed in this section, changes in previously approved design weights and minor changes in design may be substantiated by analyses based on previous tests conducted on the same basic landing gear system that has similar energy absorption characteristics.]

Amdt. 25-103, Eff. 6/15/2001

FAR 25.725 : [Reserved.]

Reserved.

Amdt. 25-103, Eff. 6/15/2001

FAR 25.727 : [Reserved.]

Reserved.

Amdt. 25-103, Eff. 6/15/2001

FAR 25.729 : Retracting mechanism.

(a) *General.* For airplanes with retractable landing gear, the following apply :

(1) The landing gear retracting mechanism, wheel well doors, and supporting structure, must be designed for—

- (i) The loads occurring in the flight conditions when the gear is in the retracted position ;
- (ii) The combination of friction loads, inertia loads, brake torque loads, air loads, and gyroscopic loads resulting from the wheels rotating at a peripheral speed equal to $1.3 V_S$ (with the flaps in takeoff position at design takeoff weight), occurring during retraction and extension at any airspeed up to $1.6 V_{S1}$ (with the flaps in the approach position at design landing weight), and
- (iii) Any load factor up to those specified in Sec. 25.345(a) for the flaps extended condition.

(2) Unless there are other means to decelerate the airplane in flight at this speed, the landing gear, the retracting mechanism, and the airplane structure (including wheel well doors) must be designed to withstand the flight loads occurring with the landing gear in the extended position at any speed up to $0.67 V_C$.

(3) Landing gear doors, their operating mechanism, and their supporting structures must be designed for the yawing maneuvers prescribed for the airplane in addition to the conditions of airspeed and load factor prescribed in paragraphs (a)(1) and (2) of this section.

- (b) *Landing gear lock.* There must be positive means to keep the landing gear extended, in flight and on the ground.
 - (c) *Emergency operation.* There must be an emergency means for extending the landing gear in the event of—
 - (1) Any reasonably probable failure in the normal retraction system ; or
 - (2) The failure of any single source of hydraulic, electric, or equivalent energy supply.
 - (d) *Operation test.* The proper functioning of the retracting mechanism must be shown by operation tests.
 - (e) *Position indicator and warning device.* If a retractable landing gear is used, there must be a landing gear position indicator (as well as necessary switches to actuate the indicator) or other means to inform the pilot that the gear is secured in the extended (or retracted) position. This means must be designed as follows :
 - (1) If switches are used, they must be located and coupled to the landing gear mechanical systems in a manner that prevents an erroneous indication of "down and locked" if the landing gear is not in a fully extended position, or of "up and locked" if the landing gear is not in the fully retracted position. The switches may be located where they are operated by the actual landing gear locking latch or device.
 - (2) [The flightcrew must be given an aural warning that functions continuously, or is periodically repeated, if a landing is attempted when the landing gear is not locked down.
 - (3) The warning must be given in sufficient time to allow the landing gear to be locked down or a go-around to be made.
 - (4) There must not be a manual shut-off means readily available to the flightcrew for the warning required by paragraph (e) (2) of this section such that it could be operated instinctively, inadvertently, or by habitual reflexive action.
 - (5) The system used to generate the aural warning must be designed to eliminate false or inappropriate alerts.
 - (6) Failures of systems used to inhibit the landing gear aural warning, that would prevent the warning system from operating, must be improbable.]
 - (f) *Protection of equipment in wheel wells.* Equipment that is essential to safe operation of the airplane and that is located in wheel wells must be protected from the damaging effects of—
 - (1) A bursting tire, unless it is shown that a tire cannot burst from overheat ; and
 - (2) A loose tire tread, unless it is shown that a loose tire tread cannot cause damage.
- Amtd. 25-75, Eff. 1/6/92
- FAR 25.731 : Wheels.**
- (a) Each main and nose wheel must be approved.

Type A	110
Type B	75
Type C	55
Type I	45
Type II	40
Type III	35
Type IV	9

- (1) For a passenger seating configuration of 1 to 9 seats, there must be at least one Type IV or larger overwing exit in each side of the fuselage or, if overwing exits are not provided, at least one exit in each side that meets the minimum dimensions of a Type III exit.
- (2) For a passenger seating configuration of more than 9 seats, each exit must be a Type III or larger exit.
- (3) For a passenger seating configuration of 10 to 19 seats, there must be at least one Type III or larger exit in each side of the fuselage.
- (4) For a passenger seating configuration of 20 to 40 seats, there must be at least two exits, one of which must be a Type II or larger exit, in each side of the fuselage.
- (5) For a passenger seating configuration of 41 to 110 seats, there must be at least two exits, one of which must be a Type I or larger exit, in each side of the fuselage.
- (6) For a passenger seating configuration of more than 110 seats, the emergency exits in each side of the fuselage must include at least two Type I or larger exits.
- (7) The combined maximum number of passenger seats permitted for all Type III exits is 70, and the combined maximum number of passenger seats permitted for two Type III exits in each side of the fuselage that are separated by fewer than three passenger seat rows in 65.
- (8) If a Type A, Type B, or Type C exit is installed, there must be at least two Type C or larger exits in each side of the fuselage.
- (9) If a passenger ventral or tailcone exit is installed and that exit provides at least the same rate of egress as a Type III exit with the airplane in the most adverse exit opening condition that would result from the collapse of one or more legs of the landing gear, an increase in the passenger seating configuration is permitted as follows :
 - (i) For a ventral exit, 12 additional passenger seats.
 - (ii) For a tailcone exit incorporating a floor level opening of not less than 20 inches wide by 60 inches high, with corner radii not greater than seven inches, in the pressure shell and incorporating an approved assist means in accordance with Sec. 25.810(a), 25 additional passenger seats.
 - (iii) For a tailcone exit incorporating an opening in the pressure shell which is at least equivalent to a Type III emergency exit with respect to dimensions, step-up and step-down distance, and with the top of the opening not less than 56 inches from the passenger compartment floor, 15 additional passenger seats.

- (6) *Tailcone.* This type is an aft exit from the passenger compartment through the pressure shell and through an openable cone of the fuselage aft of the pressure shell. The means of opening the tailcone must be simple and obvious and must employ a single operation.
- (7) *Type A.* This type is a floor-level exit with a rectangular opening of not less than 42 inches wide by 72 inches high, with corner radii not greater than seven inches.
- (8) *Type B.* This type is a floor-level exit with a rectangular opening of not less than 32 inches wide by 72 inches high, with corner radii not greater than six inches.
- (9) *Type C.* This type is a floor-level exit with a rectangular opening of not less than 30 inches wide by 48 inches high, with corner radii not greater than 10 inches.
- (b) *Step down distance.* Step down distance, as used in this section, means the actual distance between the bottom of the required opening and a usable foot hold, extending out from the fuselage, that is large enough to be effective without searching by sight or feel.
- (c) *Over-sized exits.* Openings larger than those specified in this section, whether or not of rectangular shape, may be used if the specified rectangular opening can be inscribed within the opening and the base of the inscribed rectangular opening meets the specified step-up and step-down heights.
- (d) *Asymmetry.* Exits of an exit pair need not be diametrically opposite each other nor of the same size; however, the number of passenger seats permitted under paragraph (g) of this section is based on the smaller of the two exits.
- (e) *Uniformity.* Exits must be distributed as uniformly as practical, taking into account passenger seat distribution.
- (f) *Location.*

- (1) Each required passenger emergency exit must be accessible to the passengers and located where it will afford the most effective means of passenger evacuation.
- (2) If only one floor-level exit per side is prescribed, and the airplane does not have a tailcone or ventral emergency exit, the floor-level exits must be in the rearward part of the passenger compartment unless another location affords a more effective means of passenger evacuation.
- (3) If more than one floor-level exit per side is prescribed, and the airplanes does not have a combination cargo and passenger configuration, at least one floor-level exit must be located in each side near each end of the cabin.
- (4) [For an airplane that is required to have more than one passenger emergency exit for each side of the fuselage, no passenger emergency exit shall be more than 60 feet from any adjacent passenger emergency exit on the same side of the same deck of the fuselage, as measured parallel to the airplane's longitudinal axis between the nearest exit edges.]
- (g) *Type and number required.* The maximum number of passenger seats permitted depends on the type and number of exits installed in each side of the fuselage. Except as further restricted in paragraphs (g)(1) through (g)(9) of this section, the maximum number of passenger seats permitted for each exit of a specific type installed in each side of the fuselage is as follows :

- (b) The maximum static load rating of each wheel may not be less than the corresponding static ground reaction with—
- (1) Design maximum weight ; and
 - (2) Critical center of gravity.
- (c) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the applicable ground load requirements of this part.
- (d) *Overpressure burst prevention.* Means must be provided in each wheel to prevent wheel failure and tire burst that may result from excessive pressurization of the wheel and tire assembly.
- (e) Braked wheels. Each braked wheel must meet the applicable requirements of Sec. 25.735.]

Amdt. 25-107, Eff. 5/24/2002

FAR 25.733 : Tires.

- (a) When a landing gear axle is fitted with a single wheel and tire assembly, the wheel must be fitted with a suitable tire of proper fit with a speed rating approved by the Administrator that is not exceeded under critical conditions and with a load rating approved by the Administrator that is not exceeded under—
- (1) The loads on the main wheel tire, corresponding to the most critical combination of airplane weight (up to the maximum weight) and center of gravity position, and
 - (2) The loads corresponding to the ground reactions in paragraph (b) of this section, on the nose wheel tire, except as provided in paragraphs (b)(2) and (b)(3) of this section.
- (b) The applicable ground reactions for nose wheel tires are as follows :
- (1) The static ground reaction for the tire corresponding to the most critical combination of airplane weight (up to maximum ramp weight) and center of gravity position with a force of 1.0g acting downward at the center of gravity. This load may not exceed the load rating of the tire.
 - (2) The ground reaction of the tire corresponding to the most critical combination of airplane weight (up to maximum landing weight) and center of gravity position combined with forces of 1.0g downward and 0.31g forward acting at the center of gravity. The reactions in this case must be distributed to the nose and main wheels by the principles of statics with a drag reaction equal to 0.31 times the vertical load at each wheel with brakes capable of producing this ground reaction. This nose tire load may not exceed 1.5 times the load rating of the tire.
 - (3) The ground reaction of the tire corresponding to the most critical combination of airplane weight (up to maximum ramp weight) and center of gravity position combined with forces of 1.0g downward and 0.20g forward acting at the center of gravity. The reactions in this case must be distributed to the nose and main wheels by the principles of statics with a drag reaction equal to 0.20 times the vertical load at each wheel with brakes capable of producing this ground reaction. This nose tire load may not exceed 1.5 times the load rating of the tire.

- (c) When a landing gear axle is fitted with more than one wheel and tire assembly, such as dual or dual-tandem, each wheel must be fitted with a suitable tire of proper fit with a speed rating approved by the Administrator that is not exceeded under critical conditions, and with a load rating approved by the Administrator that is not exceeded by—
 - (1) The loads on each main wheel tire, corresponding to the most critical combination of airplane weight (up to the maximum weight) and center of gravity position, when multiplied by a factor of 1.07; and
 - (2) Loads specified in paragraphs (a)(2), (b)(1), (b)(2), and (b)(3) of this section on each nose wheel tire.
 - (d) Each tire installed in a retractable landing gear system must, at the maximum size of the tire type expected in service, have a clearance to surrounding structure and systems that is adequate to prevent unintended contact between the tire and any part of the structure or systems.
 - (e) [For an airplane with a maximum certificated takeoff weight of more than 75,000 pounds, tires mounted on braked wheels must be inflated with dry nitrogen or other gases shown to be inert so that the gas mixture in the tire does not contain oxygen in excess of 5 percent by volume, unless it can be shown that the tire liner material will not produce a volatile gas when heated or that means are provided to prevent tire temperatures from reaching unsafe levels.]
- Amdt. 25-78, Eff. 3/29/93

FAR 25.735 : Brakes.

- (a) [Approval. Each assembly consisting of a wheel(s) and brake(s) must be approved.
- (b) *Brake system capability.* The brake system, associated systems and components must be designed and constructed so that :
 - (1) If any electrical, pneumatic, hydraulic, or mechanical connecting or transmitting element fails, or if any single source of hydraulic or other brake operating energy supply is lost, it is possible to bring the airplane to rest with a braked roll stopping distance of not more than two times that obtained in determining the landing distance as prescribed in Sec. 25.125.
 - (2) Fluid lost from a brake hydraulic system following a failure in, or in the vicinity of, the brakes is insufficient to cause or support a hazardous fire on the ground or in flight.
- (c) *Brake controls.* The brake controls must be designed and constructed so that :
 - (1) Excessive control force is not required for their operation.
 - (2) If an automatic braking system is installed, means are provided to :
 - (i) Arm and disarm the system, and
 - (ii) Allow the pilot(s) to override the system by use of manual braking.
- (d) *Parking brake.* The airplane must have a parking brake control that, when selected on, will, without further attention, prevent the airplane from rolling on a dry and level paved runway when the most adverse combination of maximum thrust on one engine and up to maximum ground idle thrust on any, or

FAR 25.803 : Emergency evacuation.

- (a) [Each crew and passenger area must have emergency means to allow rapid evacuation in crash landings, with the landing gear extended as well as with the landing gear retracted, considering the possibility of the airplane being on fire.
 - (b) [Reserved.]
 - (c) For airplanes having a seating capacity of more than 44 passengers, it must be shown that the maximum seating capacity, including the number of crewmembers required by the operating rules for which certification is requested, can be evacuated from the airplane to the ground under simulated emergency conditions within 90 seconds. Compliance with this requirement must be shown by actual demonstration using the test criteria outlined in Appendix J of this part unless the Administrator finds that a combination of analysis and testing will provide data equivalent to that which would be obtained by actual demonstration.
 - (d) [Reserved.]
 - (e) [Reserved.]
- Amdt. 25-72, Eff. 8/20/90

FAR 25.805 : [Removed.]

[Removed.]
Amdt. 25-72, Eff. 8/20/90

FAR 25.807 : Emergency exits.

- (a) *Type.* For the purpose of this part, the types of exits are defined as follows :
 - (1) *Type I.* This type is a floor-level exit with a rectangular opening of not less than 24 inches wide by 48 inches high, with corner radii not greater than eight inches.
 - (2) *Type II.* This type is a rectangular opening of not less than 20 inches wide by 44 inches high, with corner radii not greater than seven inches. Type II exits must be floor-level exits unless located over the wing, in which case they must not have a step-up inside the airplane of more than 10 inches nor a step-down outside the airplane of more than 17 inches.
 - (3) *Type III.* This type is a rectangular opening of not less than 20 inches wide by 36 inches high with corner radii not greater than seven inches, and with a step-up inside the airplane of not more than 20 inches. If the exit is located over the wing, the step-down outside the airplane may not exceed 27 inches.
 - (4) *Type IV.* This type is a rectangular opening of not less than 19 inches wide by 26 inches high, with corner radii not greater than 6.3 inches, located over the wing, with a step-up inside the airplane of not more than 29 inches and a step-down outside the airplane of not more than 36 inches.
 - (5) *Ventral.* This type is an exit from the passenger compartment through the pressure shell and the bottom of the fuselage skin. The dimensions and physical configuration of this type of exit must allow at least the same rate of egress as a Type I exit with the airplane in the normal ground attitude, with landing gear extended.

FAR 25.793 : [Floor surfaces.]

[The floor surface of all areas which are likely to become wet in service must have slip resistant properties.]
Amdt. 25-51, Eff. 3/6/80

FAR 25.795 : [Security considerations.]

- (a) [Protection of flightdeck. If a flightdeck door is required by operating rules, the door installation must be designed to :
- (1) Resist forcible intrusion by unauthorized persons and be capable of withstanding impacts of 300 Joules (221.3 foot-pounds) at the critical locations on the door, as well as a 250 pound (1113 Newtons) constant tensile load on the knob or handle, and
 - (2) Resist penetration by small arms fire and fragmentation devices to a level equivalent to level IIIa of the National Institute of Justice Standard (NIJ) 0101.04.
- (b) [Reserved]
- Amdt. 25-106; Eff. 1/15/2002.

47.7 Emergency Provisions**FAR 25.801 : Ditching.**

- (a) If certification with ditching provisions is requested, the airplane must meet the requirements of this section and Secs. 25.807[(e)], 25.1411, and 25.1415(a).
- (b) Each practicable design measure, compatible with the general characteristics of the airplane, must be taken to minimize the probability that in an emergency landing on water, the behavior of the airplane would cause immediate injury to the occupants or would make it impossible for them to escape.
- (c) The probable behavior of the airplane in a water landing must be investigated by model tests or by comparison with airplanes of similar configuration for which the ditching characteristics are known. Scoops, flaps, projections, and any other factor likely to affect the hydrodynamic characteristics of the airplane, must be considered.
- (d) It must be shown that, under reasonably probable water conditions, the flotation time and trim of the airplane will allow the occupants to leave the airplane and enter the life rafts required by Sec. 25.1415. If compliance with this provision is shown by buoyancy and trim computations, appropriate allowances must be made for probable structural damage and leakage. If the airplane has fuel tanks (with fuel jettisoning provisions) that can reasonably be expected to withstand a ditching without leakage, the jettisonable volume of fuel may be considered as buoyancy volume.
- (e) Unless the effects of the collapse of external doors and windows are accounted for in the investigation of the probable behavior of the airplane in a water landing (as prescribed in paragraphs (c) and (d) of this section), the external doors and windows must be designed to withstand the probable maximum local pressures.

Amdt. 25-72, Eff. 8/20/90

all, other engine(s) is applied. The control must be suitably located or be adequately protected to prevent inadvertent operation. There must be indication in the cockpit when the parking brake is not fully released.

- (e) *Antiskid system.* If an antiskid system is installed :

(1) It must operate satisfactorily over the range of expected runway conditions, without external adjustment.

(2) It must, at all times, have priority over the automatic braking system, if installed.

(f) Kinetic energy capacity—(1) Design landing stop. The design landing stop is an operational landing stop at maximum landing weight. The design landing stop brake kinetic energy absorption requirement of each wheel, brake, and tire assembly must be determined. It must be substantiated by dynamometer testing that the wheel, brake and tire assembly is capable of absorbing not less than this level of kinetic energy throughout the defined wear range of the brake. The energy absorption rate derived from the airplane manufacturer's braking requirements must be achieved. The mean deceleration must not be less than 10 fps^2 .

(2) Maximum kinetic energy accelerate-stop. The maximum kinetic energy accelerate-stop is a rejected takeoff for the most critical combination of airplane takeoff weight and speed. The accelerate-stop brake kinetic energy absorption requirement of each wheel, brake, and tire assembly must be determined. It must be substantiated by dynamometer testing that the wheel, brake, and tire assembly is capable of absorbing not less than this level of kinetic energy throughout the defined wear range of the brake. The energy absorption rate derived from the airplane manufacturer's braking requirements must be achieved. The mean deceleration must not be less than 6 fps^2 .

(3) Most severe landing stop. The most severe landing stop is a stop at the most critical combination of airplane landing weight and speed. The most severe landing stop brake kinetic energy absorption requirement of each wheel, brake, and tire assembly must be determined. It must be substantiated by dynamometer testing that, at the declared fully worn limit(s) of the brake heat sink, the wheel, brake and tire assembly is capable of absorbing not less than this level of kinetic energy. The most severe landing stop need not be considered for extremely improbable failure conditions or if the maximum kinetic energy accelerate-stop energy is more severe.

(g) Brake condition after high kinetic energy dynamometer stop(s). Following the high kinetic energy stop demonstration(s) required by paragraph (f) of this section, with the parking brake promptly and fully applied for at least 3 minutes, it must be demonstrated that for at least 5 minutes from application of the parking brake, no condition occurs (or has occurred during the stop), including fire associated with the tire or wheel and brake assembly, that could prejudice the safe and complete evacuation of the airplane.

(h) Stored energy systems. An indication to the flightcrew of the usable stored energy must be provided if a stored energy system is used to show compliance with paragraph (b)(1) of this section. The available stored energy must be sufficient for :

- (1) At least 6 full applications of the brakes when an antiskid system is not operating ; and

- (2) Bringing the airplane to a complete stop when an antiskid system is operating, under all runway surface conditions for which the airplane is certificated.
- (i) Brake wear indicators. Means must be provided for each brake assembly to indicate when the heat sink is worn to the permissible limit. The means must be reliable and readily visible.
- (j) Overtemperature burst prevention. Means must be provided in each braked wheel to prevent a wheel failure, a tire burst, or both, that may result from elevated brake temperatures. Additionally, all wheels must meet the requirements of Sec. 25.731(d).
- (k) Compatibility. Compatibility of the wheel and brake assemblies with the airplane and its systems must be substantiated.]

Amdt. 25-107, EFF. 5/24/2002

FAR 25.737 : Skis.

Each ski must be approved. The maximum limit load rating of each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements of this Part.

47.5 Floats and Hulls

FAR 25.751 : Main float buoyancy.

Each main float must have—

- (a) A buoyancy of 80 percent in excess of that required to support the maximum weight of the seaplane or amphibian in fresh water; and
- (b) Not less than five watertight compartments approximately equal in volume.

FAR 25.753 : Main float design.

Each main float must be approved and must meet the requirements of Sec. 25.521.

FAR 25.755 : Hulls.

- (a) Each hull must have enough watertight compartments so that, with any two adjacent compartments flooded, the buoyancy of the hull and auxiliary floats (and wheel tires, if used) provides a margin of positive stability great enough to minimize the probability of capsizing in rough, fresh water.
- (b) Bulkheads with watertight doors may be used for communication between compartments.

47.6 Personnel and Cargo Accommodations

FAR 25.771 : Pilot compartment.

- (a) Each pilot compartment and its equipment must allow the minimum flight crew (established under Sec. 25.1523) to perform their duties without unreasonable concentration or fatigue.

- seats or more, each stowage compartment in the passenger cabin, except for undensest and overhead compartments for passenger convenience, must be completely enclosed.
- (b) There must be a means to prevent the contents in the compartments from becoming a hazard by shifting, under the loads specified in paragraph (a) of this section. [For stowage compartments in the passenger and crew cabin, if the means used is a latched door, the design must take into consideration the wear and deterioration expected in service.]
- (c) If cargo compartment lamps are installed, each lamp must be installed so as to prevent contact between lamp bulb and cargo.

Amdt. 25-51, EFF. 3/6/80

FAR 25.789 : Retention of items of mass in passenger and crew compartments [and galleys.]

- [(a)] Means must be provided to prevent each item of mass (that is part of the airplane type design) in a passenger or crew compartment [or galley] from becoming a hazard by shifting under the appropriate maximum load factors corresponding to the specified flight and ground load conditions, and to the emergency landing conditions of Sec. 25.561(b).
- (b) [Each interphone restraint system must be designed so that when subjected to the load factors specified in Sec. 25.561(b)(3), the interphone will remain in its stowed position.]

Amdt. 25-46, EFF. 12/1/78

FAR 25.791 : Passenger information signs [and placards.]

- (a) [If smoking is to be prohibited, there must be at least one placard so stating that is legible to each person seated in the cabin. If smoking is to be allowed, and if the crew compartment is separated from the passenger compartment, there must be at least one sign notifying when smoking is prohibited. Signs which notify when smoking is prohibited must be operable by a member of the flightcrew and, when illuminated, must be legible under all probable conditions of cabin illumination to each person seated in the cabin.]
- (b) Signs that notify when seat belts should be fastened and that are installed to comply with the operating rules of this chapter must be operable by a member of the flightcrew and, when illuminated, must be legible under all probable conditions of cabin illumination to each person seated in the cabin.
- (c) A placard must be located on or adjacent to the door of each receptacle used for the disposal of flammable waste materials to indicate that use of the receptacle for disposal of cigarettes, etc., is prohibited.
- (d) Lavatories must have "No Smoking" or "No Smoking in Lavatory" placards conspicuously located on or adjacent to each side of the entry door.
- (e) Symbols that clearly express the intent of the sign or placard may be used in lieu of letters.]

Amdt. 25-72, EFF. 8/20/90

flight deck occupant, when seated with the restraint system fastened, to perform all of the occupant's necessary flight deck functions. There must be a means to secure each combined restraint system when not in use to prevent interference with the operation of the airplane and with rapid egress in an emergency.

- (h) Each seat located in the passenger compartment and designated for use during takeoff and landing by a flight attendant required by the operating rules of this chapter must be :

- (1) [Near a required floor level emergency exit, except that another location is acceptable if the emergency egress of passengers would be enhanced with that location. A flight attendant seat must be located adjacent to each Type A or B emergency exit. Other flight attendant seats must be evenly distributed among the required floor-level emergency exits to the extent feasible.]
- (2) To the extent possible, without compromising proximity to a required floor level emergency exit, located to provide a direct view of the cabin area for which the flight attendant is responsible.
- (3) Positioned so that the seat will not interfere with the use of a passageway or exit when the seat is not in use.
- (4) Located to minimize the probability that occupants would suffer injury by being struck by items dislodged from service areas, stowage compartments, or service equipment.
- (5) Either forward or rearward facing with an energy absorbing rest that is designed to support the arms, shoulders, head, and spine.
- (6) Equipped with a restraint system consisting of a combined safety belt and shoulder harness unit with a single point release. There must be means to secure each restraint system when not in use to prevent interference with rapid egress in an emergency.
- (i) Each safety belt must be equipped with a metal to metal latching device.
- (j) If the seat backs do not provide a firm handhold, there must be a handgrip or rail along each aisle to enable persons to steady themselves while using the aisles in moderately rough air.
- (k) Each projecting object that would injure persons seated or moving about the airplane in normal flight must be padded.
- (l) Each forward observer's seat required by the operating rules must be shown to be suitable for use in conducting the necessary enroute inspection.

Amdt. 25-88, Eff. 12/9/96

FAR 25.787 : Stowage compartments.

- (a) Each compartment for the stowage of cargo, baggage, carry-on articles, and equipment (such as life rafts), and any other stowage compartment must be designed for its placarded maximum weight of contents and for the critical load distribution at the appropriate maximum load factors corresponding to the specified flight and ground load conditions, and to the emergency landing conditions of Sec. 25.561(b), except that the forces specified in the emergency landing conditions need not be applied to compartments located below, or forward, of all occupants in the airplane. If the airplane has a passenger seating configuration, excluding pilots seats, of 10

- (b) The primary controls listed in Sec. 25.779(a), excluding cables and control rods, must be located with respect to the propellers so that no member of the minimum flight crew (established under Sec. 25.1523), or part of the controls, lies in the region between the plane of rotation of any inboard propeller and the surface generated by a line passing through the center of the propeller hub making an angle of five degrees forward or aft of the plane of rotation of the propeller.

- (c) If provision is made for a second pilot, the airplane must be controllable with equal safety from either pilot seat.

- (d) The pilot compartment must be constructed so that, when flying in rain or snow, it will not leak in a manner that will distract the crew or harm the structure.

- (e) [Vibration and noise characteristics of cockpit equipment may not interfere with safe operation of the airplane.]

Amdt. 25-4, Eff. 4/30/65

FAR 25.772 : Pilot compartment doors.

For an airplane that has a lockable door installed between the pilot compartment and the passenger compartment :

- (a) For airplanes with a maximum passenger seating configuration of more than 20 seats, the emergency exit configuration must be designed so that neither crewmembers nor passengers require use of the flightdeck door in order to reach the emergency exits provided for them ;]
- (b) Means must be provided to enable flight crewmembers to directly enter the passenger compartment from the pilot compartment if the cockpit door becomes jammed.
- (c) [There must be an emergency means to enable a flight attendant to enter the pilot compartment in the event that the flightcrew becomes incapacitated.]

Amdt. 25-106, Eff. 1/15/2002

FAR 25.773 : Pilot compartment view.

- (a) *Nonprecipitation conditions.* For non-precipitation conditions, the following apply :

- (1) Each pilot compartment must be arranged to give the pilots a sufficiently extensive, clear, and undistorted view, to enable them to safely perform any maneuvers within the operating limitations of the airplane, including taxiing, takeoff, approach, and landing.
- (2) Each pilot compartment must be free of glare and reflection that could interfere with the normal duties of the minimum flight crew (established under Sec. 25.1523). This must be shown in day and night flight tests under nonprecipitation conditions.

- (b) *Precipitation conditions.* For precipitation conditions, the following apply :

- (1) The airplane must have a means to maintain a clear portion of the windshield, during precipitation conditions, sufficient for both pilots to have a sufficiently extensive view along the flight path in normal flight attitudes of the airplane. This means must be designed to function, without continuous attention on the part of the crew, in—
 - (i) [Heavy rain at speeds up to 1.5 V_{SR1} with lift and drag devices retracted ; and]

(ii) The icing conditions specified in Sec. 25.1419 if certification with ice protection provisions is requested.

(2) The first pilot must have—

- (i) A window that is openable under the conditions prescribed in paragraph (b)(1) of this section when the cabin is not pressurized, provides the view specified in that paragraph, and gives sufficient protection from the elements against impairment of the pilot's vision; or
- (ii) An alternate means to maintain a clear view under the conditions specified in paragraph (b)(1) of this section, considering the probable damage due to a severe hail encounter.

(c) *Internal windshield and window fogging.* The airplane must have a means to prevent fogging of the internal portions of the windshield and window panels over an area which would provide the visibility specified in paragraph (a) of this section under all internal and external ambient conditions, including precipitation conditions, in which the airplane is intended to be operated.

(d) Fixed markers or other guides must be installed at each pilot station to enable the pilots to position themselves in their seats for an optimum combination of outside visibility and instrument scan. If lighted markers or guides are used they must comply with the requirements specified in Sec. 25.1381.

Amdt. 25-108, EFF. 12/26/2002

FAR 25.775 : Windshields and windows.

(a) Internal panes must be made of nonsplintering material.

(b) Windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the impact of a four-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to the value of V_C at sea level, selected under Sec. 25.335(a).

(c) Unless it can be shown by analysis or tests that the probability of occurrence of a critical windshield fragmentation condition is of a low order, the airplane must have a means to minimize the danger to the pilots from flying windshield fragments due to bird impact. This must be shown for each transparent pane in the cockpit that—

- (1) Appears in the front views of the airplane;
- (2) Is inclined 15 degrees or more to the longitudinal axis of the airplane; and
- (3) Has any part of the pane located where its fragmentation will constitute a hazard to the pilots.

(d) The design of windshields and windows in pressurized airplanes must be based on factors peculiar to high altitude operation, including the effects of continuous and cyclic pressurization loadings, the inherent characteristics of the material used, and the effects of temperatures and temperature differentials. The windshield and window panels must be capable of withstanding the maximum cabin pressure differential loads combined with critical aerodynamic pressure and temperature effects after any single failure in the installation or associated systems. It may be assumed that, after a single failure that is obvious to the flight crew (established under Sec. 25.1523), the cabin pressure differential is reduced from the maximum, in accordance with appropriate operating limitations, to allow continued safe flight of the airplane with a cabin pressure altitude of not more than 15,000 feet.

FAR 25.785 : Seats, berths, safety belts, and harnesses.

(a) A seat (or berth for a nonambulant person) must be provided for each occupant who has reached his or her second birthday.

(b) Each seat, berth, safety belt, harness, and adjacent part of the airplane at each station designated as occupiable during takeoff and landing must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in Secs. 25.561 and 25.562.

(c) Each seat or berth must be approved.

(d) Each occupant of a seat that makes more than an 18° angle with the vertical plane containing the airplane centerline must be protected from head injury by a safety belt and an energy absorbing rest that will support the arms, shoulders, head, and spine, or by a safety belt and shoulder harness that will prevent the head from contacting any injurious object. Each occupant of any other seat must be protected from the head injury by a safety belt and, as appropriate to the type, location, and angle of facing of each seat, by one or more of the following :

- (1) A shoulder harness that will prevent the head from contacting any injurious object.
- (2) The elimination of any injurious object within striking radius of the head.
- (3) An energy absorbing rest that will support the arms, shoulders, head, and spine.

(e) Each berth must be designed so that the forward part has a padded end board, canvas diaphragm, or equivalent means, that can withstand the static load reaction of the occupant when subjected to the forward inertia force specified in Sec. 25.561. Berths must be free from corners and protuberances likely to cause injury to a person occupying the berth during emergency conditions.

(f) Each seat or berth, and its supporting structure, and each safety belt or harness and its anchorage must be designed for an occupant weight of 170 pounds, considering the maximum load factors, inertia forces, and reactions among the occupant seat, safety belt, and harness for each relevant flight and ground load condition (including the emergency landing conditions prescribed in Sec. 25.561). In addition—

- (1) The structural analysis and testing of the seats, berths, and their supporting structures may be determined by assuming that the critical load in the forward, sideward, downward, upward, and rearward directions (as determined from the prescribed flight, ground, and emergency landing conditions) acts separately or using selected combinations of loads if the required strength in each specified direction is substantiated. The forward load factor need not be applied to safety belts for berths.
- (2) Each pilot seat must be designed for the reactions resulting from the application of the pilot forces prescribed in Sec. 25.395.
- (3) The inertia forces specified in Sec. 25.561 must be multiplied by a factor of 1.33 (instead of the fitting factor prescribed in Sec. 25.625) in determining the strength of the attachment of each seat to the structure and each belt or harness to the seat or structure.

(g) Each seat at a flight deck station must have a restraint system consisting of a combined safety belt and shoulder harness with a single-point release that permits the

FAR 25.783 : Doors.

- (a) Each cabin must have at least one easily accessible external door.
- (b) There must be a means to lock and safeguard each external door against opening in flight (either inadvertently by persons or as a result of mechanical failure or failure of a single structural element either during or after closure). Each external door must be operable from both the inside and the outside, even though persons may be crowded against the door on the inside of the airplane. Inward opening doors may be used if there are means to prevent occupants from crowding against the door to an extent that would interfere with the opening of the door. The means of opening must be simple and obvious and must be arranged and marked so that it can be readily located and operated, even in darkness. Auxiliary locking devices may be used.
- (c) Each external door must be reasonably free from jamming as a result of fuselage deformation in a minor crash.
- (d) Each external door must be located where persons using them will not be endangered by the propellers when appropriate operating procedures are used.
- (e) There must be a provision for direct visual inspection of the locking mechanism to determine if external doors, for which the initial opening movement is not inward (including passenger, crew, service, and cargo doors), are fully closed and locked. The provision must be discernible under operational lighting conditions by appropriate crewmembers using a flashlight or equivalent lighting source. In addition, there must be a visual warning means to signal the appropriate flight crewmembers if any external door is not fully closed and locked. The means must be designed such that any failure or combination of failures that would result in an erroneous closed and locked indication is improbable for doors for which the initial opening movement is not inward.
- (f) External doors must have provisions to prevent the initiation of pressurization of the airplane to an unsafe level if the door is not fully closed and locked. In addition, it must be shown by safety analysis that inadvertent opening is extremely improbable.
- (g) Cargo and service doors not suitable for use as emergency exits only meet paragraphs (e) and (f) of this section and be safeguarded against opening in flight as a result of mechanical failure or failure of a single structural element.
- (h) [Each passenger entry door in the side of the fuselage must meet the applicable requirements of Secs. 25.807 through 25.813 for a Type II or larger passenger emergency exit.]
- (i) If an integral stair is installed in a passenger entry door that is qualified as a passenger emergency exit, the stair must be designed so that under the following conditions the effectiveness of passenger emergency egress will not be impaired :
- (1) The door, integral stair, and operating mechanism have been subjected to the inertia forces specified in Sec. 25.561(b)(3), acting separately relative to the surrounding structure.
- (2) The airplane is in the normal ground attitude and in each of the attitudes corresponding to collapse of one or more legs of the landing gear.
- (j) All lavatory doors must be designed to preclude anyone from becoming trapped inside the lavatory, and if a locking mechanism is installed, it be capable of being unlocked from the outside without the aid of special tools.

Amdt. 25-88, Eff. 12/9/96

- (e) [The windshield panels in front of the pilot must be arranged so that, assuming the loss of vision through any one panel, one or more panels remain available for use by a pilot seated at a pilot station to permit continued safe flight and landing.]

Amdt. 25-38, Eff. 2/1/77

FAR 25.777 : Cockpit controls.

- (a) Each cockpit control must be located to provide convenient operation and to prevent confusion and inadvertent operation.
- (b) The direction of movement of cockpit controls must meet the requirements of Sec. 25.779. Wherever practicable, the sense of motion involved in the operation of other controls must correspond to the sense of the effect of the operation upon the airplane or upon the part operated. Controls of a variable nature using a rotary motion must move clockwise from the off position, through an increasing range, to the full on position.
- (c) The controls must be located and arranged, with respect to the pilots' seats, so that there is full and unrestricted movement of each control without interference from the cockpit structure or the clothing of the minimum flight crew (established under Sec. 25.1523) when any member of this flight crew, from 5'2" to 6'3" in height, is seated with the seat [belt and shoulder harness (if provided)] fastened.
- (d) Identical powerplant controls for each engine must be located to prevent confusion as to the engines they control.
- (e) Wing flap controls and other auxiliary lift device controls must be located on top of the pedestal, aft of the throttles, centrally or to the right of the pedestal centerline, and not less than 10 inches aft of the landing gear control.
- (f) The landing gear control must be located forward of the throttles and must be operable by each pilot when seated with seat [belt and shoulder harness (if provided)] fastened.
- (g) Control knobs must be shaped in accordance with Sec. 25.781. In addition, the knobs must be of the same color, and this color must contrast with the color of the control knobs for other purposes and the surrounding cockpit.
- (h) If a flight engineer is required as part of the minimum flight crew (established under Sec. 25.1523), the airplane must have a flight engineer station located and arranged so that the flight crewmembers can perform their functions efficiently and without interfering with each other.

Amdt. 25-46, Eff. 12/1/78

FAR 25.779 : Motion and effect of cockpit controls.

Cockpit controls must be designed so that they operate in accordance with the following movement and actuation :

- (a) Aerodynamic controls :

(1) *Primary.*

<i>Controls</i>	<i>Motion and effect</i>
Aileron	Right (clockwise) for right wing down.
Elevator	Rearward for nose up.
Rudder	Right pedal forward for nose right.

Élodie Roux, Septembre 2003

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(2) Secondary.

Controls	Motion and effect
Flaps (or auxiliary lift devices).	Forward for flaps up; rearward for flaps down.
Trim tabs (or equivalent).	Rotate to produce similar rotation of the airplane about an axis parallel to the axis of the control.

(b) Powerplant and auxiliary controls :

(1) Powerplant.

Controls	Motion and effect
[Power or thrust]	Forward to increase forward thrust and rearward to increase rearward thrust.
Propellers	Forward to increase rpm.
Mixture	Forward or upward for rich.
Carburetor air heat	Forward or upward for cold.
Supercharger	Forward or upward for low blower. For turbo-superchargers, forward, upward, or clockwise, to increase pressure.

(2) Auxiliary.

Controls	Motion and effect
Landing gear	Down to extend.

Amdt. 25-72, Eff. 8/20/90

FAR 25.781 : Cockpit control knob shape.

Cockpit control knobs must conform to the general shapes (but not necessarily the exact sizes or specific proportions) in the following figure (Figure 47.1, p. 591) :

Amdt. 25-72, Eff. 8/20/90

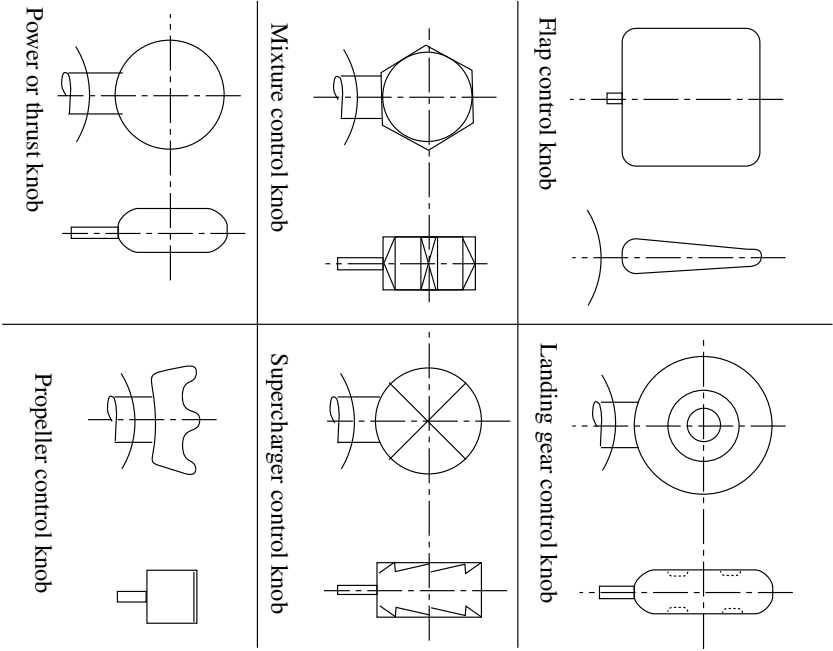


FIG. 47.1 – Cockpit control knobs