

means must be provided to indicate the proper functioning of that system to the flight crew.

[Amdt. 25-23, 35 FR 5678, Apr. 8, 1970, as amended by Amdt. 25-35, 39 FR 1831, Jan. 15, 1974; Amdt. 25-36, 39 FR 35461, Oct. 1, 1974; Amdt. 25-38, 41 FR 55467, Dec. 20, 1976; Amdt. 25-54, 45 FR 60173, Sept. 11, 1980; Amdt. 25-72, 55 FR 29785, July 20, 1990; Amdt. 25-115, 69 FR 40527, July 2, 2004]

§ 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.
- (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. 25-23, 35 FR 5678, Apr. 8, 1970, as amended by Amdt. 25-46, 43 FR 50598, Oct. 30, 1978; Amdt. 25-54, 45 FR 60173, Sept. 11, 1980; Amdt. 25-72, 55 FR 29785, July 20, 1990]

§ 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 conditions 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.

(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

§ 25.1316

14 CFR Ch. I (1-1-07 Edition)

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. 25-23, 35 FR 5679, Apr. 8, 1970, as amended by Amdt. 25-38, 41 FR 55467, Dec. 20, 1976; Amdt. 25-41, 42 FR 36970, July 18, 1977]

§ 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.

[Doc. No. 25912, 59 FR 22116, Apr. 28, 1994]

INSTRUMENTS: INSTALLATION

§ 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 § 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; and

(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