

JAR 25.1307 (continued)

(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.

#### **JAR 25.1309 Equipment, systems and installations**

(a) The equipment, systems, and installations whose functioning is required by the JAR and national operating regulations must be designed to ensure that they perform their intended functions under any foreseeable operating conditions. (See AMJ 25.1309 and ACJ No. 2 to JAR 25.1309.) However, systems used for non-essential services need only comply so far as is necessary to ensure that the installations are neither a source of danger in themselves nor liable to prejudice the proper functioning of any essential service.

(b) The aeroplane systems and associated components, considered separately and in relation to other systems, must be designed so that (see AMJ 25.1309 and ACJ No. 3 to JAR 25.1309 and AMJ 25.1309(b)) –

(1) The occurrence of any failure condition which would prevent the continued safe flight and landing of the aeroplane is extremely improbable; and

(2) The occurrence of any other failure condition which would reduce the capability of the aeroplane 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 minimise crew errors which could create additional hazards. (See AMJ 25.1309 and ACJ Nos. 4 and 8 to JAR 25.1309.)

JAR 25.1309 (continued)

(d) Compliance with the requirements of subparagraph (b) of this paragraph must be shown by analysis, and where necessary, by appropriate ground, flight, or simulator tests. The analysis must consider (see AMJ 25.1309) –

(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 aeroplane 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 for certification 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 (see ACJ No. 6 to JAR 25.1309):

(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-engined aeroplanes; and

(ii) Any two engines on three-or-more engined aeroplanes.

After the failure of any two engines on a three-engined aeroplane, those services essential to airworthiness must continue to function and perform adequately within the limits of operation implied by the emergency conditions. (See ACJ No. 7 to JAR 25.1309.)

(4) Essential loads for which an alternate source of power is required by any applicable JAR or national operating regulations, after any failure or malfunction in any one power supply system, distribution system, or other utilisation system.

(f) In determining compliance with subparagraphs (e)(2) and (3) of this paragraph, the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operation authorised. Loads not

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required in controlled flight need not be considered for the two-engine-inoperative condition on aeroplanes with three or more engines.

(g) In showing compliance with sub-paragraphs (a) and (b) of this paragraph with regard to system and equipment design and installation, critical environmental conditions including vibration and acceleration loads, handling by personnel and where appropriate fluid pressure effects, must be considered. For power generation, distribution and utilisation equipment required by or used for certification, 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 aeroplanes.

#### JAR 25X1315 Negative acceleration

No hazardous malfunction may occur as a result of the aeroplane being operated at the negative accelerations within the flight envelopes prescribed in JAR 25.333. This must be shown for the greatest duration expected for the acceleration. (See also ACJ 25X1315.)

#### [ JAR 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 aeroplane, 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 aeroplane is exposed to lightning.

(b) For functions whose failure would contribute to or cause a condition that would reduce the capability of the aeroplane 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 aeroplane is exposed to lightning.

(c) Compliance with the lightning protection criteria prescribed in sub-paragraphs (a) and (b) of this paragraph must be shown for exposure to a severe lightning environment. The applicant must design for and verify that aircraft electrical/

JAR 25.1316(c) (continued)

electronic systems are protected against the effects of lightning by:

- (1) Determining the lightning strike zones for the aeroplane;
- (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 paragraph, and their locations on or within the aeroplane;
- (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. ]

#### INSTRUMENTS: INSTALLATION

##### JAR 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. Where a third (stand-by) instrument is fitted, to comply with JAR 25.1303 (b) it must be installed so that both pilots can use it. (See ACJ 25.1321 (a).)

(b) The flight instruments required by JAR 25.1303 (b) must be grouped on the instrument panel and centred 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 centre position;
- (2) The instrument that most effectively indicates airspeed must be adjacent to and directly to the left of the instrument in the top centre position;
- (3) The instrument that most effectively indicates altitude must be adjacent to and directly to the right of the instrument in the top centre position; and