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# Standard Specification for Systems and Equipment in Small Aircraft[1]

This standard is issued under the fixed designation F3061/F3061M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers international standards for the systems and equipment aspects of airworthiness and design for "small" aircraft.

1.2 The applicant for a design approval must seek the individual guidance of their respective CAA body concerning the use of this standard as part of a certification plan. For information on which CAA regulatory bodies have accepted this standard (in whole or in part) as a means of compliance to their Small Aircraft Airworthiness regulations (hereinafter referred to as "the Rules"), refer to ASTM F44 webpage (www.ASTM.org/COMMITTEE/F44.htm) which includes CAA website links.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 Following is a list of external standards referenced throughout this specification; the earliest revision acceptable for use is indicated. In all cases later document revisions are acceptable if shown to be equivalent to the listed revision, or if otherwise formally accepted by the governing civil aviation authority; earlier revisions are not acceptable.

2.2 *ASTM Standards:*[2]

F3060 Terminology for Aircraft

F3082/F3082M Specification for Flight for General Aviation Aeroplanes

F3083/F3083M Specification for Emergency Conditions, Occupant Safety and Accommodations

F3116/F3116M Specification for Design Loads and Conditions

F3117 Specification for Crew Interface in Aircraft

F3227/F3227M Specification for Environmental Systems in Small Aircraft

F3228 Specification for Flight Data and Voice Recording in Small Aircraft

F3230 Practice for Safety Assessments of Systems and Equipment in Small Aircraft

F3231/F3231M Specification for Electrical Systems in Small Aircraft

F3232/F3232M Specification for Flight Controls in Small Aircraft

F3233/F3233M Specification for Instrumentation in Small Aircraft

F3234/F3234M Specification for Exterior Lighting in Small Aircraft

F3236 Specification for High Intensity Radiated Field (HIRF) Protection in Small Aircraft

2.3 *Other Standards:*

FAA-S-8081-14B, Change 5 Private Pilot Practical Test Standards for Airplane

RTCA/DO-178, Rev B Software Considerations in Airborne Systems and Equipment Certification

RTCA/DO-254 Design Assurance Guidance for Airborne Electronic Hardware

2.4 *SAE Standards:*[3]

SAE ARP4754, Rev A Guidelines for Development of Civil Aircraft Systems

## 3. Terminology

3.1 Terminology specific to this standard is provided below. For general terminology, refer to Terminology F3060.

3.2 *Definitions of Terms Specific to This Standard:*

[1] This specification is under the jurisdiction of ASTM Committee F44 on General Aviation Aircraft and is the direct responsibility of Subcommittee F44.50 on Systems and Equipment.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, http://www.sae.org.

3.2.1 *aircraft type code, n*—an Aircraft Type Code (ATC) is defined by considering both the technical considerations regarding the design of the aircraft and the airworthiness level established based upon risk-based criteria. An ATC is expressed as an alphanumeric character string as illustrated in Fig. 1. An explanation of each character in the string is provided below.

3.2.1.1 *Discussion*—The first character in the Aircraft Type Code indicates the risk-based airworthiness level of the aircraft.

*(1)* A "1" indicates an airworthiness level corresponding to Level 1; this corresponds to seating for one or fewer passengers (excluding crew).

*(2)* A "2" indicates an airworthiness level corresponding to Level 2; this corresponds to seating for two or more passengers but no more than six (excluding crew).

*(3)* A "3" indicates an airworthiness level corresponding to Level 3; this corresponds to seating for seven or more passengers but no more than nine (excluding crew).

*(4)* A "4" indicates an airworthiness level corresponding to Level 4; this corresponds to seating for ten or more passengers but no more than nineteen (excluding crew).

3.2.1.2 *Discussion*—The second character in the Aircraft Type Code indicates the number of engines employed on the aircraft.

*(1)* An "S" indicates a single-engine aircraft.

*(2)* An "M" indicates a multiengine aircraft.

3.2.1.3 *Discussion*—The third character in the Aircraft Type Code indicates the type of engine(s) employed on the aircraft.

*(1)* An "R" indicates use of a reciprocating engine.

*(2)* A "T" indicates use of a turbine engine.

3.2.1.4 *Discussion*—The fourth character in the Aircraft Type Code indicates the stall speed of the aircraft.

*(1)* An "L" indicates a stall speed less than or equal to 83 km/h [45 knots].

*(2)* An "M" indicates a stall speed greater than 83 km/h [45 knots] but less than or equal to 113 km/h [61 knots].

*(3)* An "H" indicates a stall speed greater than 113 km/h [61 knots].

3.2.1.5 *Discussion*—The fifth character in the Aircraft Type Code indicates the cruise speed of the aircraft.

*(1)* An "L" indicates a cruise speed less than or equal to 463 km/h [250 knots] (or Mach ≤ 0.6).

*(2)* An "H" indicates a cruise speed greater than 463 km/h [250 knots] (or Mach > 0.6).

3.2.1.6 *Discussion*—The sixth character in the Aircraft Type Code indicates the allowed meteorological conditions of the aircraft.

*(1)* A "D" indicates an aircraft limited to Day VFR conditions only.

*(2)* An "N" indicates an aircraft limited to Day or Night VFR conditions only.

*(3)* A "I" indicates an aircraft certified for IFR operations.

3.2.1.7 *Discussion*—The seventh character in the Aircraft Type Code indicates the maximum operational altitude of the aircraft.

*(1)* An "L" indicates an aircraft with a maximum operational altitude equal to or less than 7620 m [25 000 ft].

*(2)* An "H" indicates an aircraft with a maximum operational altitude greater than 7620 m [25 000 ft].

3.2.1.8 *Discussion*—The eighth character in the Aircraft Type Code indicates the allowed flight maneuvers for the aircraft.

*(1)* An "N" indicates an aircraft that is limited to non-aerobatic maneuvers.

*(2)* An "A" indicates an aircraft that is certified for aerobatic maneuvers.

3.2.2 *continued safe flight and landing, n*—continued safe flight and landing is defined as the capability for continued controlled flight and landing, possibly using emergency procedures, but without requiring pilot skill beyond that needed to pass the Private Pilot Practical Test Standard for Airplane (refer to FAA-S-8081-14B), or requiring pilot forces beyond those defined in Specification F3082/F3082M. Landing may occur either at an airport or at an emergency landing location consistent with established emergency procedures. Some aircraft damage may be realized, either during flight or upon landing.

3.2.3 *development assurance level, n*—a development assurance level is an indication of the level of those planned and systematic actions used to substantiate, to an adequate level of

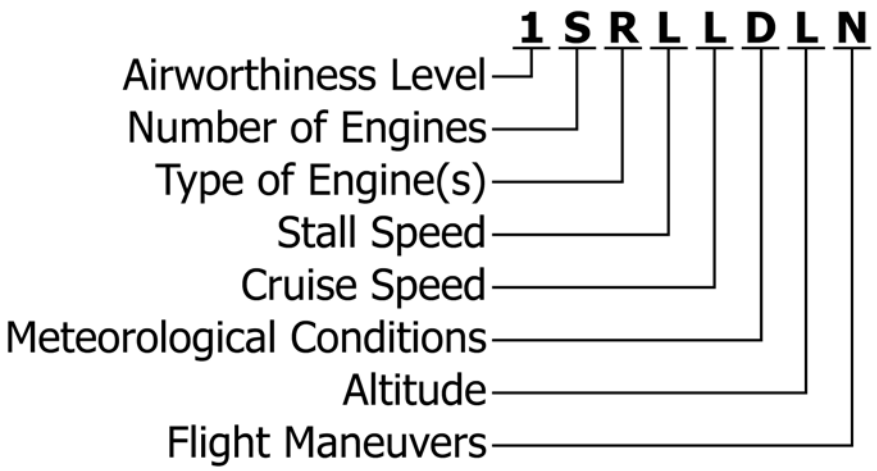


**FIG. 1 Illustration of Aircraft Type Code**

confidence, that errors in requirements, design, and implementation have been identified and corrected such that the system satisfies the applicable certification basis.

3.2.4 *primary function, n*—a primary function is a function that is installed to comply with applicable requirements for a required function and that provides the most pertinent controls or information instantly and directly to the pilot.

3.2.5 *primary system, n*—a primary system is a system that provides a primary function.

3.2.6 *secondary system, n*—a secondary system is a redundancy system that provides the same function as the primary system.

3.2.7 *unsafe system operating condition, n*—an unsafe system operating condition is any system operating condition which, if not detected and properly accommodated by crew action, would significantly contribute to or cause one or more serious injuries.

## 4. Basic Information

NOTE 1—Table 1 provides correlation between various Aircraft Type Codes and the individual requirements contained within this section; refer to 3.2.1. For each subsection, an indicator can be found under each ATC character field; three indicators are used:

An empty cell ( ) in all applicable ATC character field columns indicates that an aircraft must meet the requirements of that subsection.

A white circle (○) in multiple columns indicates that the requirements of that subsection are not applicable to an aircraft *only* if all such ATC character fields are applicable.

A mark-out (×) in any of the applicable ATC character field columns indicates that the requirements of that subsection are not applicable to an aircraft if that ATC character field is applicable.

*Example*—An aircraft with an ATC of 1SRLLDLN is being considered. Since all applicable columns are empty for 4.1.1, that subsection is applicable to the aircraft. Since the "1" airworthiness level column, the "L" stall speed column, and the "D" meteorological column for 4.1.6 all contain white circles, then that subsection is not applicable; however, for an aircraft with an ATC of 1SRMLDLN, 4.1.6 would be applicable since the "M" stall speed column does not contain a white circle. Subsection 4.2.1.1 would also not be applicable to the second aircraft, since it contains an × in the "M" stall speed column.

NOTE 2—The requirements of this chapter are applicable to all systems and equipment installed in the aircraft. These requirements are in addition to and do not supersede any additional system specific requirements identified elsewhere in these design standards or contained in the rules of the governing civil aviation authority.

4.1 *Function and Installation:*

4.1.1 Each item of installed equipment must be of a kind and design appropriate to its intended function.

4.1.2 Each item of installed equipment must be marked in a way that makes it clear to an installer the equipment's identification, function, or operating limitations, or any applicable combination of these factors. It is acceptable to reference equipment installation manuals for function or limitation information.

4.1.3 Each item of installed equipment must be installed according to limitations specified for that equipment.

4.1.4 Each item of installed equipment must function properly when installed.

4.1.5 The aircraft systems and equipment required for type certification or by operating rules must be designed and installed so that they perform as intended under the aircraft operating and environmental conditions.

NOTE 3—The intent of this requirement is to provide assurance that the required systems and equipment will function as intended in the expected operating and environmental conditions. It is recognized that random failures will occur throughout the aircraft life and that the failed device may no longer "perform as intended". The acceptability of such failures or combination of failures and their associated risks are addressed under the requirements of 4.2.

4.1.6 All aircraft systems and equipment must be designed and installed so that they do not adversely affect the safety of the aircraft or its occupants.

**TABLE 1 ATC Compliance Matrix, Section 4**

| Section | Airworthiness Level | | | | Number of Engines | | Type of Engine(s) | | Stall Speed | | | Cruise Speed | | Meteorological Conditions | | | Altitude | | Maneuvers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | S | M | R | T | L | M | H | L | H | D | N | I | L | H | N | A |
| 4 | | | | | | | | | | | | | | | | | | | | |
| 4.1 | | | | | | | | | | | | | | | | | | | | |
| 4.1.1 | | | | | | | | | | | | | | | | | | | | |
| 4.1.2 | | | | | | | | | | | | | | | | | | | | |
| 4.1.3 | | | | | | | | | | | | | | | | | | | | |
| 4.1.4 | | | | | | | | | | | | | | | | | | | | |
| 4.1.5 | | | | | | | | | | | | | | | | | | | | |
| 4.1.6 | ○ | | | | | | | | ○ | | | | | ○ | | | | | | |
| 4.1.7 | | | | | | | | | | | | | | | | | | | | |
| 4.1.8 | | | | | | | | | | | | | | | | | | | | |
| 4.1.8.1 | | | | | | | | | | | | | | | | | | | | |
| 4.1.8.2 | | | | | | | | | | | | | | | | | | | | |
| 4.2 | | | | | | | | | | | | | | | | | | | | |
| 4.2.1 | | | | | | | | | | | | | | | | | | | | |
| 4.2.1.1 | | × | × | × | | | | | | × | × | | | | × | × | | | | |
| 4.2.1.2 | ○ | | | | | | | | ○ | | | | | ○ | | | | | | |
| 4.2.1.3 | ○ | | | | | | | | ○ | | | | | ○ | | | | | | |
| 4.2.1.4 | ○ | | | | | | | | ○ | | | | | ○ | | | | | | |
| 4.2.2 | ○ | | | | | | | | ○ | | | | | ○ | | | | | | |
| 4.2.3 | ○ | | | | | | | | ○ | | | | | ○ | | | | | | |
| 4.2.3.1 | ○ | | | | | | | | ○ | | | | | ○ | | | | | | |
| 4.2.4 | | | | | | | | | ○ | | | | | ○ | | | | | | |
| 4.2.4.1 | | | | | | | | | ○ | | | | | ○ | | | | | | |
| 4.2.4.2 | | | | | | | | | ○ | | | | | ○ | | | | | | |

4.1.7 All aircraft systems and equipment must be designed and installed so that they do not adversely affect the proper functioning of those systems or equipment, or both, covered by 4.1.5.

4.1.8 Those systems and equipment not required for type certification or by operating rules are not required to perform their intended function under all aircraft operating and environmental conditions, provided that the resultant failure conditions are classified as "Negligible Failure Condition" in the assessment conducted per 4.2.1; refer to Practice F3230.

4.1.8.1 Non-required systems and equipment with failure conditions classified more severe than "Negligible Failure Condition" are not required to perform their intended function under all aircraft operating and environmental conditions, provided the failure is appropriately annunciated to the crew.

4.1.8.2 When addressing the requirements of 4.2, if any credit is taken for the installation, or any aspect, of these non-required systems, the portion of the system for which credit is taken must comply with 4.1.4.

4.2 *System Safety Requirements:*

4.2.1 An assessment of the aircraft and system functions must be performed to identify and classify the various Failure Conditions associated with each function; refer to Practice F3230.

4.2.1.1 The equipment, systems, and installations must be designed to minimize hazards to the aircraft in the event of a probable malfunction or failure; refer to Practice F3230.

4.2.1.2 The aircraft systems and associated components, considered separately and in relation to other systems, must be designed and installed so that each Catastrophic Failure Condition is "extremely improbable"; refer to Practice F3230.

4.2.1.3 The aircraft systems and associated components, considered separately and in relation to other systems, must be designed and installed so that each Hazardous Failure Condition is "extremely remote"; refer to Practice F3230.

4.2.1.4 The aircraft systems and associated components, considered separately and in relation to other systems, must be designed and installed so that each Major Failure Condition is "remote"; refer to Practice F3230.

4.2.2 Based on the results of the assessment per 4.2.1, the depth of analysis required to show compliance may be determined in accordance with Practice F3230.

4.2.3 Software and Airborne Electronic Hardware must be designed with the appropriate development assurance level as specified in Table 2 or in accordance with the Development Assurance Level (DAL) assignment methodology outlined in SAE ARP4754; refer to 3.2.3.

4.2.3.1 In showing compliance with the provisions of 4.2.3, once a DAL is assigned, acceptable means of compliance may be found in RTCA DO-178 or RTCA-DO254 or both; refer to Section 2.

4.2.4 Information concerning an unsafe system operating condition must be provided in a timely manner to the crew to enable them to take appropriate corrective action.

4.2.4.1 In showing compliance with the provisions of 4.2.4, if immediate pilot awareness and immediate or subsequent corrective action is required, the information required by 4.2.4 must be presented in accordance with Specification F3117.

4.2.4.2 In showing compliance with the provisions of 4.2.4, the assessment discussed in 4.2.1 should be used to determine what Failure Conditions would become "Unsafe System Operating Conditions" if the crew failed to take any action or observe appropriate precautions; refer to Practice F3230 and 3.2.7.

## 5. Electrical Systems

5.1 *Electrical System Requirements*—In addition to the applicable requirements of this specification, electrical systems shall comply with the provisions of Specification F3231/F3231M.

## 6. Environmental Requirements

6.1 *Ventilation Requirements*—In addition to the applicable requirements of this specification, ventilation systems shall comply with the corresponding provisions of Specification F3227/F3227M.

**TABLE 2 Development Assurance Level Requirements**

| Assessment Level[A] | Classification of Failure Conditions[A] | | | | |
|---|---|---|---|---|---|
| | Negligible | Minor | Major | Hazardous | Catastrophic |
| | Software (SW) and Airborne Electronic Hardware (AEH) Development Assurance Levels (DALs)[B] | | | | |
| I | No SW and/or HW DAL Requirement | P=D | P=C, S=D (See[C]) | P=C, S=D (See[C]) | P=C, S=C (See[C]) |
| II | | P=D | P=C, S=D (See[C]) | P=C, S=C (See[C]) | P=C, S=C (See[C]) |
| III | | P=D | P=C, S=D (See[C]) | P=C, S=C (See[C]) | P=B, S=C (See[C]) |
| IV | | P=D | P=C, S=D (See[C]) | P=B, S=C (See[C]) | P=A, S=B (See[C]) |

[A] Refer to Practice F3230.

[B] The letters of the alphabet used above denote the typical SW and AEH DALs. "P" indicates the primary system; "S" indicates the secondary system; "A", "B", "C", and "D" indicate the DAL in accordance with RTCA/DO-178B or RTCA/DO-254 as applicable. For example, an indication of "P=A" would translate to a SW or AEH DAL of "A" on the primary system.

[C] A secondary system is not necessarily required; however, if a secondary system is needed to meet the probability goals of Practice F3230, then that secondary system must meet the stated DAL goal.

6.2 *Pressurization Requirements*—In addition to the applicable requirements of this specification, pressurization systems shall comply with the corresponding provisions of Specification F3227/F3227M.

## 7. Manual Flight Controls

7.1 *Manual Flight Control Requirements*—In addition to the applicable requirements of this specification, manual flight controls shall comply with the corresponding provisions of Specification F3232/F3232M.

## 8. Automatic Flight Controls

8.1 *Automatic Flight Control Requirements*—In addition to the applicable requirements of this specification, automatic flight controls shall comply with the corresponding provisions of Specification F3232/F3232M.

## 9. Flight Data and Voice Recording

9.1 *Flight Recorder Requirements*—In addition to the applicable requirements of this specification, flight data and voice recording installations shall comply with the provisions of Specification F3228.

## 10. Hazard Mitigation

NOTE 4—Table 3 provides correlation between various Aircraft Type Codes and the individual requirements contained within this section; refer to 3.2.1. For each subsection, an indicator can be found under each ATC character field; three indicators are used:

An empty cell ( ) in all applicable ATC character field columns indicates that an aircraft must meet the requirements of that subsection.

A white circle (○) in multiple columns indicates that the requirements of that subsection are not applicable to an aircraft *only* if all such ATC character fields are applicable.

A mark-out (×) in any of the applicable ATC character field columns indicates that the requirements of that subsection are not applicable to an

**TABLE 3 ATC Compliance Matrix, Section 10**

| Section | Airworthiness Level | | | | Number of Engines | | Type of Engine(s) | | Stall Speed | | | Cruise Speed | | Meteorological Conditions | | | Altitude | | Maneuvers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | S | M | R | T | L | M | H | L | H | D | N | I | L | H | N | A |
| 10 | | | | | | | | | | | | | | | | | | | | |
| 10.1 | × | | | | | | | | | | | | | | | | | | | |
| 10.1.1 | × | | | | | | | | | | | | | | | | | | | |
| 10.1.2 | × | | | | | | | | | | | | | | | | | | | |
| 10.1.3 | × | | | | | | | | | | | | | | | | | | | |
| 10.1.4 | × | | | | | | | | | | | | | | | | | | | |
| 10.2 | | | | | | | | | | | | | | | | | | | | |
| 10.2.1 | | | | | | | | | | | | | | | | | | | | |
| 10.3 | | | | | | | | | | | | | | | | | | | | |
| 10.3.1 | | | | | | | | | | | | | | | | | | | | |
| 10.3.2 | | | | | | | | | | | | | | | | | | | | |
| 10.3.3 | × | | | | | | | | | | | | | | | | | | | |
| 10.3.4 | × | | | | | | | | | | | | | | | | | | | |
| 10.3.5 | × | | | | | | | | | | | | | | | | | | | |
| 10.3.6 | × | | | | | | | | | | | | | | | | | | | |
| 10.3.7 | × | | | | | | | | | | | | | | | | | | | |
| 10.3.8 | × | | | | | | | | | | | | | | | | | | | |
| 10.3.9 | × | | | | | | | | | | | | | | | | | | | |
| 10.4 | | | | | | | | | | | | | | | | | | | | |
| 10.4.1 | | | | | | | | | | | | | | | | | | | | |
| 10.4.2 | × | × | × | | | | | | | | | | | | | | | | | |
| 10.4.3 | × | × | × | | | | | | | | | | | | | | | | | |
| 10.4.4 | × | × | × | | | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | | | | | | |
| 10.6 | | | | | | | | | | | | | | | | | | | | |
| 10.6.1 | | | | | | | | | | | | | | | | | | | | |
| 10.6.2 | | | | | | | | | | | | | | | | | | | | |
| 10.6.3 | | | | | | | | | | | | | | | | | | | | |
| 10.6.4 | | | | | | | | | | | | | | | | | | | | |
| 10.7 | | | | | | | | | | | | | | | | | | | | |
| 10.7.1 | | | | | × | | | | | | | | | | | | | | | |
| 10.7.2 | | | | | × | | | | | | | | | | | | | | | |
| 10.7.3 | | | | | × | | | | | | | | | | | | | | | |
| 10.7.4 | | | | | × | | | | | | | | | | | | | | | |
| 10.7.5 | | | | | × | | | | | | | | | | | | | | | |
| 10.7.6 | | | | | × | | | | | | | | | | | | | | | |
| 10.7.7 | | | | | | | × | | | | | | | | | | | | | |
| 10.7.7.1 | | | | | | | × | | | | | | | | | | | | | |
| 10.7.7.2 | | | | | | | × | | | | | | | | | | | | | |
| 10.7.8 | | | | | | | | | | | | | | | | | | | | |
| 10.8 | | | | | × | | | | | | | | | | | | | | | |
| 10.9 | | | | | | | | | | | | | | | | | | | | |
| 10.9.1 | | | | | | | | | | | | | | | | | | | | |
| 10.9.2 | | | | | | | | | | | | | | | | | | | | |
| 10.9.3 | | | | | | | | | | | | | | | | | | | | |
| 10.9.4 | | | | | | | | | | | | | | | | | | | | |
| 10.9.5 | | | | | | | | | | | | | | | | | | | | |

aircraft if that ATC character field is applicable.

*Example*—An aircraft with an ATC of 1SRLLDLN is being considered. Since all applicable columns are empty for 10.2.1, that subsection is applicable to the aircraft. However, since the "1" airworthiness level column for 10.1.1 contains an ×, then that subsection is not applicable.

10.1 *Takeoff Warning System*—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 requirements of 10.1.1 through 10.1.4.

10.1.1 In showing compliance with 10.1, the system must provide to the pilots an aural warning that is automatically activated during the initial portion of the takeoff roll if the aircraft is in a configuration that would not allow a safe takeoff.

10.1.2 The warning provided in accordance with 10.1.1 must continue until the configuration is changed to allow safe takeoff, or action is taken by the pilot to abandon the takeoff roll.

10.1.3 In showing compliance with 10.1, 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.

10.1.4 For the purpose of showing compliance with 10.1, an unsafe takeoff configuration is the inability to rotate or the inability to prevent an immediate stall after rotation. This section is not intended to apply to control locks; refer to Specification F3232/F3232M.

10.2 *Pilot Compartment*—For each pilot compartment, the pilot and the aerodynamic controls listed in Specification F3117, excluding cables and control rods, must be suitably protected from items of mass departing a propeller.

10.2.1 The provisions of 10.2 may be met by ensuring 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.

10.3 *Flammable Fluid Fire Protection:*

10.3.1 Lines, tanks, or equipment containing fuel, oil, or other flammable fluids may not be installed in compartments to be used by the crew or passengers unless adequately shielded, isolated, or otherwise protected so that any breakage or failure of such an item would not create a hazard; compliance must be shown by analysis or test.

10.3.2 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.

10.3.3 Possible sources and paths of fluid leakage, and means of detecting leakage, must be considered when showing compliance with 10.3.1.

10.3.4 Flammability characteristics of fluids, including effects of any combustible or absorbing materials, must be considered when showing compliance with 10.3.1.

10.3.5 Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices, must be considered when showing compliance with 10.3.1.

10.3.6 Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents, must be considered when showing compliance with 10.3.1.

10.3.7 Ability of aircraft components that are critical to safety of flight to withstand fire and heat must be considered when showing compliance with 10.3.1.

10.3.8 If action by the flight crew is required to prevent or counteract a fluid fire (for example, equipment shutdown or actuation of a fire extinguisher), quick acting means must be provided to alert the crew.

10.3.9 Each area where flammable fluids or vapors might escape by leakage of a fluid system must be identified and defined.

10.4 *Fire Protection of Cargo and Baggage Compartments:*

10.4.1 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.

10.4.2 If the requirements of either 10.4.3 or 10.4.4 are not met, each cargo and baggage compartment must 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.

10.4.3 If the requirements of either 10.4.2 or 10.4.4 are not met, each cargo and baggage compartment must be equipped with a smoke or fire detector system to give a warning at the pilots' station. In addition, each compartment must meet the requirements of Specification F3083/F3083M.

10.4.4 If the requirements of either 10.4.2 or 10.4.3 are not met, each cargo and baggage compartment must be constructed and sealed to contain any fire within the compartment.

10.5 *Fire Protection of Flight Controls*—Flight controls 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.

10.6 *Lines, Fittings, and Components:*

10.6.1 Except as provided in 10.6.3 and 10.6.4, components, lines, and fittings must be shielded or located so as to safeguard against the ignition of leaking flammable fluid.

10.6.2 Except as provided in 10.6.3 and 10.6.4, flexible hose assemblies (hose and end fittings) must be shown to be suitable for the particular application.

10.6.3 Subsections 10.6.1 and 10.6.2 do not apply to lines, fittings, and components which are already approved as part of the type certificated engine.

10.6.4 Subsections 10.6.1 and 10.6.2 do not apply to vent and drain lines, and their fittings, whose failure will not result in, or add to, a fire hazard.

10.7 *Shutoff Means:*

10.7.1 Each engine installation must have means to shut off or otherwise prevent hazardous quantities of flammable liquids from flowing into, within, or through any engine compartment, except in lines, fittings, and components forming an integral part of an engine.

10.7.2 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.

10.7.3 Operation of any shutoff means may not interfere with the later emergency operation of other equipment such as propeller feathering devices.

10.7.4 Each shutoff must be outside of the engine compartment unless an equal degree of safety is provided with the shutoff inside the compartment.

10.7.5 Not more than 0.95 L [0.25 US gal] 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 0.95 L [0.25 US gal], it must be demonstrated that this greater amount can be safely contained or drained overboard.

10.7.6 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.

10.7.7 Engine installations need not have an engine oil system shutoff if the conditions of 10.7.7.1 and 10.7.7.2 are met.

10.7.7.1 To comply with 10.7.7, the oil tank must be integral with, or mounted on, the engine.

10.7.7.2 To comply with 10.7.7, all oil system components external to the engine must be fireproof or located in areas not subject to engine fire conditions.

10.7.8 Power operated shut off 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.

10.8 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.

10.9 *Equipment Containing High Energy Rotors:*

10.9.1 High energy rotors contained in equipment such as Auxiliary Power Units (APUs) and constant speed drive units must be able to withstand damage caused by malfunctions, vibration, abnormal speeds, and abnormal temperatures.

10.9.2 Auxiliary rotor cases in equipment such as Auxiliary Power Units (APUs) and constant speed drive units must be able to contain damage caused by the failure of high energy rotor blades.

10.9.3 Equipment control devices, systems, and instrumentation must reasonably ensure that no operating limitations affecting the integrity of high energy rotors in equipment such as Auxiliary Power Units (APUs) and constant speed drive units will be exceeded in service.

10.9.4 As an alternative to 10.9.1 through 10.9.3, it may 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.

10.9.5 As an alternative to 10.9.1 through 10.9.4, equipment containing high energy rotors may be located where rotor failure will neither endanger the occupants nor adversely affect continued safe flight.

## 11. Hydraulic Systems

NOTE 5—Table 4 provides correlation between various Aircraft Type Codes and the individual requirements contained within this section; refer to 3.2.1. For each subsection, an indicator can be found under each ATC character field; three indicators are used:

An empty cell ( ) in all applicable ATC character field columns indicates that an aircraft must meet the requirements of that subsection.

A white circle (○) in multiple columns indicates that the requirements of that subsection are not applicable to an aircraft *only* if all such ATC character fields are applicable.

A mark-out (×) in any of the applicable ATC character field columns indicates that the requirements of that subsection are not applicable to an aircraft if that ATC character field is applicable.

*Example*—An aircraft with an ATC of 1SRLLDLN is being considered. Since all applicable columns are empty for 11.1.2, that subsection is applicable to the aircraft.

11.1 *Hydraulic Systems:*

11.1.1 Each hydraulic system and its elements must withstand, without yielding, the structural loads expected in addition to hydraulic loads.

11.1.2 A means to verify the quantity of hydraulic fluid in the system must be provided.

**TABLE 4 ATC Compliance Matrix, Section 11**

| Section | Airworthiness Level | | | | Number of Engines | | Type of Engine(s) | | Stall Speed | | | Cruise Speed | | Meteorological Conditions | | | Altitude | | Maneuvers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | S | M | R | T | L | M | H | L | H | D | N | I | L | H | N | A |
| 11 | | | | | | | | | | | | | | | | | | | | |
| 11.1 | | | | | | | | | | | | | | | | | | | | |
| 11.1.1 | | | | | | | | | | | | | | | | | | | | |
| 11.1.2 | | | | | | | | | | | | | | | | | | | | |
| 11.1.3 | | | | | | | | | | | | | | | | | | | | |
| 11.1.4 | | | | | | | | | | | | | | | | | | | | |
| 11.1.5 | | | | | | | | | | | | | | | | | | | | |
| 11.1.6 | | | | | | | | | | | | | | | | | | | | |
| 11.1.7 | | | | | | | | | | | | | | | | | | | | |
| 11.1.7.1 | | | | | | | | | | | | | | | | | | | | |
| 11.1.7.2 | | | | | | | | | | | | | | | | | | | | |
| 11.1.8 | | | | | | | | | | | | | | | | | | | | |

11.1.3 A means to indicate the pressure in each hydraulic system which supplies two or more primary functions must be provided to the flight crew.

11.1.4 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.

11.1.5 There must be means 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.

11.1.6 The minimum design burst pressure must be 2.5 times the operating pressure.

11.1.7 Each system must be substantiated by proof pressure tests.

11.1.7.1 When proof tested, no part of any system may fail, malfunction, or experience a permanent set.

11.1.7.2 The proof load of each system must be at least 1.5 times the maximum operating pressure of that system.

11.1.8 A hydraulic accumulator or reservoir may be installed on the engine side of any firewall if: it is an integral part of an engine or propeller system; or, the reservoir is nonpressurized and the total capacity of all such nonpressurized reservoirs is 0.95 L [0.25 US gal] or less.

## 12. Instrumentation

12.1 *Instrumentation Requirements*—In addition to the applicable requirements of this specification, instrumentation shall comply with the provisions of Specification F3233/F3233M.

## 13. Mechanical Systems & Equipment

NOTE 6—Table 5 provides correlation between various Aircraft Type Codes and the individual requirements contained within this section; refer to 3.2.1. For each subsection, an indicator can be found under each ATC character field; three indicators are used:

An empty cell ( ) in all applicable ATC character field columns indicates that an aircraft must meet the requirements of that subsection.

A white circle (○) in multiple columns indicates that the requirements of that subsection are not applicable to an aircraft *only* if all such ATC character fields are applicable.

A mark-out (×) in any of the applicable ATC character field columns indicates that the requirements of that subsection are not applicable to an aircraft if that ATC character field is applicable.

*Example*—An aircraft with an ATC of 1SRLLDLN is being considered. Since all applicable columns are empty for 13.2.1, that subsection is applicable to the aircraft. However, since the "1" airworthiness level column for 13.1.1 contains an ×, then that subsection is not applicable.

13.1 *Landing Gear:*

13.1.1 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.

13.1.2 Compliance with the provisions of 13.1.1 may be shown by analysis or tests, or both.

13.2 *Shock Absorption Tests:*

13.2.1 Except as provided in 13.2.1.1 through 13.2.1.3, it must be shown by energy absorption tests that the limit load factors selected for design in accordance with Specification F3116/F3116M for takeoff and landing weights will not be exceeded.

13.2.1.1 For increases in previously approved takeoff or landing weights, or both, the requirements of 13.2.1 may be shown by analysis based on tests conducted on a landing gear system with identical energy absorption characteristics.

13.2.1.2 The requirements of 13.2.1 may be shown by analysis based on previously approved wheel-type landing gear on aircraft with similar weights and performance.

13.2.1.3 The requirements of 13.2.1 may be shown by analysis based on landing gear for which adequate experience and substantiating data are available.

13.2.2 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.

13.3 *Limit Drop Tests:*

13.3.1 If compliance with 13.2.1 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 in conjunction with Table 6:

$$h = C \cdot \left(\frac{W}{S}\right)^{1/2} \tag{1}$$

13.3.1.1 In complying with the requirements of 13.3.1, the free drop height may not be less than 0.234 m [9.2 in.] and need not be more than 0.475 m [18.7 in.].

13.3.2 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 that derived from the following formula in conjunction with Table 7:

$$W_e = W \cdot \left(\frac{h + [d \cdot (1 - L)]}{h + d}\right) \tag{2}$$

13.3.3 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.

13.3.4 The value of $d$ used in the computation of $W_e$ in 13.3.2 may not exceed the value actually obtained in the drop test.

13.3.5 The limit inertia load factor must be determined from the drop test in 13.3.2 according to the following formula in conjunction with Table 8:

$$n = \frac{n_j \cdot W_e}{W} + L \tag{3}$$

13.3.6 The value of $n$ determined in accordance with 13.3.5 may not be more than the limit inertia load factor used in the landing conditions in Specification F3116/F3116M.

13.4 *Ground Load Dynamic Tests:*

13.4.1 If compliance with the ground load requirements of Specification F3116/F3116M is shown dynamically by drop test, one drop test must be conducted that meets the requirements of 13.3 except that the drop height must be either: 2.25 times the drop height prescribed in 13.3.1; or, sufficient to develop 1.5 times the limit load factor.

13.4.2 The critical landing condition for each of the design conditions specified in Specification F3116/F3116M must be used for proof strength.

**TABLE 5 ATC Compliance Matrix, Section 13**

| Section | Airworthiness Level | | | | Number of Engines | | Type of Engine(s) | | Stall Speed | | | Cruise Speed | | Meteorological Conditions | | | Altitude | | Maneuvers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | S | M | R | T | L | M | H | L | H | D | N | I | L | H | N | A |
| 13 | | | | | | | | | | | | | | | | | | | | |
| 13.1 | | | | | | | | | | | | | | | | | | | | |
| 13.1.1 | × | × | × | | | | | | | | | | | | | | | | | |
| 13.1.2 | × | × | × | | | | | | | | | | | | | | | | | |
| 13.2 | | | | | | | | | | | | | | | | | | | | |
| 13.2.1 | | | | | | | | | | | | | | | | | | | | |
| 13.2.1.1 | | | | | | | | | | | | | | | | | | | | |
| 13.2.1.2 | | × | × | × | | | | | | × | × | | | | | | | | | |
| 13.2.1.3 | | × | × | × | | | | | | × | × | | | | | | | | | |
| 13.2.2 | | | | | | | | | | | | | | | | | | | | |
| 13.3 | | | | | | | | | | | | | | | | | | | | |
| 13.3.1 | | | | | | | | | | | | | | | | | | | | |
| 13.3.1.1 | | | | | | | | | | | | | | | | | | | | |
| 13.3.2 | | | | | | | | | | | | | | | | | | | | |
| 13.3.3 | | | | | | | | | | | | | | | | | | | | |
| 13.3.4 | | | | | | | | | | | | | | | | | | | | |
| 13.3.5 | | | | | | | | | | | | | | | | | | | | |
| 13.3.6 | | | | | | | | | | | | | | | | | | | | |
| 13.4 | | | | | | | | | | | | | | | | | | | | |
| 13.4.1 | | | | | | | | | | | | | | | | | | | | |
| 13.4.2 | | | | | | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | | | | | | |
| 13.5.1 | | | | | | | | | | | | | | | | | | | | |
| 13.5.2 | | | | | | | | | | | | | | | | | | | | |
| 13.6 | | | | | | | | | | | | | | | | | | | | |
| 13.6.1 | | | | | | | | | | | | | | | | | | | | |
| 13.6.2 | | | | | | | | | | | | | | | | | | | | |
| 13.6.3 | | | | | | | | | | | | | | | | | | | | |
| 13.6.4 | | | | | | | | | | | | | | | | | | | | |
| 13.6.5 | | | | | | | | | | | | | | | | | | | | |
| 13.6.6 | | | | | | | | | | | | | | | | | | | | |
| 13.6.7 | | | | | | | | | | | | | | | | | | | | |
| 13.6.8 | | | | | | | | | | | | | | | | | | | | |
| 13.6.8.1 | | | | | | | | | | | | | | | | | | | | |
| 13.6.9 | | | | | | | | | | | | | | | | | | | | |
| 13.6.9.1 | | | | | | | | | | | | | | | | | | | | |
| 13.6.9.2 | | | | | | | | | | | | | | | | | | | | |
| 13.6.9.3 | | | | | | | | | | | | | | | | | | | | |
| 13.6.9.4 | | | | | | | | | | | | | | | | | | | | |
| 13.6.9.5 | | | | | | | | | | | | | | | | | | | | |
| 13.6.9.6 | | | | | | | | | | | | | | | | | | | | |
| 13.6.9.7 | | | | | | | | | | | | | | | | | | | | |
| 13.6.10 | | | | | | | | | | | | | | | | | | | | |
| 13.6.11 | | | | | | | | | | | | | | | | | | | | |
| 13.7 | | | | | | | | | | | | | | | | | | | | |
| 13.7.1 | | | | | | | | | | | | | | | | | | | | |
| 13.7.2 | | | | | | | | | | | | | | | | | | | | |
| 13.8 | | | | | | | | | | | | | | | | | | | | |
| 13.8.1 | | | | | | | | | | | | | | | | | | | | |
| 13.8.2 | | | | | | | | | | | | | | | | | | | | |
| 13.8.3 | | | | | | | | | | | | | | | | | | | | |
| 13.8.4 | | | | | | | | | | | | | | | | | | | | |
| 13.9 | | | | | | | | | | | | | | | | | | | | |
| 13.9.1 | | | | | | | | | | | | | | | | | | | | |
| 13.9.1.1 | | | | | | | | | | | | | | | | | | | | |
| 13.9.1.2 | | | | | | | | | | | | | | | | | | | | |
| 13.9.2 | | | | | | | | | | | | | | | | | | | | |
| 13.9.3 | | | | | | | | | | | | | | | | | | | | |
| 13.9.4 | | | | | | | | | | | | | | | | | | | | |
| 13.9.5 | | | | | | | | | | | | | | | | | | | | |
| 13.9.5.1 | | | | | | | | | | | | | | | | | | | | |
| 13.9.5.2 | | | | | | | | | | | | | | | | | | | | |
| 13.10 | | | | | | | | | | | | | | | | | | | | |
| 13.11 | | | | | | | | | | | | | | | | | | | | |
| 13.11.1 | | | | | | | | | | | | | | | | | | | | |
| 13.11.2 | | | | | | | | | | | | | | | | | | | | |
| 13.11.3 | × | × | × | | | | | | | | | | | | | | | | | |
| 13.11.4 | | | | | | | | | | | | | | | | | | | | |
| 13.11.5 | | | | | | | | | | | | | | × | | | | | | |
| 13.11.6 | × | × | × | | | | | | | | | | | | | | | | | |
| 13.11.7 | | | | | | | | | | | | | | | | | | | | |
| 13.11.8 | | | | | | | | | | | | | | | | | | | | |
| 13.11.9 | | | | | | | | | | | | | | | | | | | | |

**TABLE 5** *Continued*

| Section | Airworthiness Level | | | | Number of Engines | | Type of Engine(s) | | Stall Speed | | | Cruise Speed | | Meteorological Conditions | | | Altitude | | Maneuvers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | S | M | R | T | L | M | H | L | H | D | N | I | L | H | N | A |
| 13.11.9.1 | | | | | | | | | | | | | | | | | | | | |
| 13.11.10 | | | | | | | | | | | | | | | | | | | | |
| 13.11.10.1 | | | | | | | | | | | | | | | | | | | | |
| 13.11.10.2 | | | | | | | | | | | | | | | | | | | | |
| 13.11.10.3 | | | | | | | | | | | | | | | | | | | | |
| 13.11.11 | × | × | × | | | | | | | | | | | | | | | | | |

**TABLE 6 Legend for Drop Test Height Formula**

| Variable | Value | SI Units | English Units |
|---|---|---|---|
| $h$ | Height of Free Drop Test | m | in. |
| $C$ | Unit Correction Factor | 0.0414 | 3.6 |
| $W$ | Design Maximum Takeoff Weight | kg | $lb_m$ |
| $S$ | Wing Area (including fuselage projection) | $m^2$ | $ft^2$ |

**TABLE 7 Legend for Effective Weight Formula**

| Variable | Value | SI Units | English Units |
|---|---|---|---|
| $W_e$ | Effective Weight to be used in Drop Test | kg | $lb_m$ |
| $h$ | Specified Drop Height | m | in. |
| $d$ | Deflection Under Impact of the Tire at the Approved Inflation Pressure<br>PLUS<br>Vertical Component of Axle Travel relative to the Drop Mass | m | in. |
| $W$ | For Main Gear Units, $W_M$<br>(Static Weight on that Unit with the Aircraft in Level Attitude, with the Nose Wheel clear for nose-wheel type aircraft)<br>For Tail Gear Units, $W_T$<br>(Static Weight on the Tail Unit with the Aircraft in the Tail-Down Attitude)<br>For Nose Wheel Units, $W_N$<br>(Vertical Component of the Static Reaction at the Nose Wheel, assuming that the Mass of the Aircraft acts at the Center of Gravity and exerts a force of 1.0 g Downward and 0.33 g Forward) | kg | $lb_m$ |
| $L^A$ | Ratio of Assumed Wing Lift to Aircraft Weight | — | — |

[A] $L$ need not be more than 0.667.

**TABLE 8 Legend for Limit Inertia Load Factor Formula**

| Variable | Value | SI Units | English Units |
|---|---|---|---|
| $n$ | Limit Inertia Load Factor | — | — |
| $n_j$ | Acceleration (dv/dt, in g's) as recorded in the Drop Test<br>PLUS<br>1.0 | — | — |
| $W_e$ | Effective Weight to be used in Drop Test | kg | $lb_m$ |
| $W$ | For Main Gear Units, $W_M$<br>(Static Weight on that Unit with the Aircraft in Level Attitude, with the Nose Wheel clear for nose-wheel type aircraft)<br>For Tail Gear Units, $W_T$<br>(Static Weight on the Tail Unit with the Aircraft in the Tail-Down Attitude)<br>For Nose Wheel Units, $W_N$<br>(Vertical Component of the Static Reaction at the Nose Wheel, assuming that the Mass of the Aircraft acts at the Center of Gravity and exerts a force of 1.0 g Downward and 0.33 g Forward) | kg | $lb_m$ |
| $L^A$ | Ratio of Assumed Wing Lift to Aircraft Weight | — | — |

[A] $L$ need not be more than 0.667.

13.5 *Reserve Energy Absorption Drop Tests:*

13.5.1 If compliance with the reserve energy absorption requirements in 13.2.2 is shown by free drop tests, the drop height may not be less than 1.44 times that specified in 13.3.

13.5.2 If the effect of wing lift is provided for, the units must be dropped with an effective weight equal to that derived from the following formula in conjunction with Table 9:

**TABLE 9 Legend for Reserve Energy Effective Weight Formula**

| Variable | Value | SI Units | English Units |
|---|---|---|---|
| $W_e$ | Effective Weight to be used in Drop Test | kg | $lb_m$ |
| $h$ | Specified Drop Height | m | in |
| $d$ | Deflection Under Impact of the Tire at the Approved Inflation Pressure PLUS Vertical Component of Axle Travel relative to the Drop Mass | m | in |
| $W$ | For Main Gear Units, $W_M$ (Static Weight on that Unit with the Aircraft in Level Attitude, with the Nose Wheel clear for nose-wheel type aircraft) | kg | $lb_m$ |
| | For Tail Gear Units, $W_T$ (Static Weight on the Tail Unit with the Aircraft in the Tail-Down Attitude) | | |
| | For Nose Wheel Units, $W_N$ (Vertical Component of the Static Reaction at the Nose Wheel, assuming that the Mass of the Aircraft acts at the Center of Gravity and exerts a force of 1.0 g Downward and 0.33 g Forward) | | |

$$W_e = W \cdot \left( \frac{h}{h+d} \right) \quad (4)$$

13.6 *Landing Gear Extension / Retraction Systems:*

13.6.1 For aircraft with retractable landing gear, each landing gear retracting mechanism and its supporting structure must be designed for maximum flight load factors with the gear retracted.

13.6.2 For aircraft with retractable landing gear, each landing gear retracting mechanism and its supporting structure must be designed for the combination of friction, inertia, brake torque, and air loads, occurring during retraction at any airspeed up to 1.6 times $V_{S1}$ with flaps retracted.

13.6.3 For aircraft with retractable landing gear, each landing gear retracting mechanism and its supporting structure must be designed for any load factor up to those specified in Specification F3116/F3116M for the flaps-extended condition.

13.6.4 For aircraft with retractable landing gear, the landing gear and retracting mechanism, including the wheel well doors, must withstand flight loads, including loads resulting from all yawing conditions specified in Specification F3116/F3116M, with the landing gear extended at any speed up to at least 1.6 times $V_{S1}$ with the flaps retracted.

13.6.5 For aircraft with retractable landing gear, there must be positive means (other than the use of hydraulic pressure) to keep the landing gear extended.

13.6.6 For landplanes with retractable landing gear that cannot be extended manually, there must be means to extend the landing gear in the event of either: any reasonably probable failure in the normal landing gear operation system; or, any reasonably probable failure in a power source that would prevent the operation of the normal landing gear operation system.

13.6.7 For aircraft with retractable landing gear, the proper functioning of the retracting mechanism must be shown by operation tests.

13.6.8 For aircraft with retractable landing gear, 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.

13.6.8.1 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.

13.6.9 For landplanes with retractable landing gear, aural or equally effective landing gear warning devices must be provided in accordance with 13.6.9.1 through 13.6.9.7.

13.6.9.1 Except as provided in 13.6.9.3, at least one warning device must function 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.

13.6.9.2 A throttle stop may not be used to satisfy 13.6.9.1 in place of an aural warning device.

13.6.9.3 If there is a manual shutoff for the warning device used to satisfy 13.6.9.1, 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.

13.6.9.4 At least one warning device must function 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.

13.6.9.5 There may not be a manual shutoff for the warning device used to satisfy 13.6.9.4.

13.6.9.6 The flap position sensing unit for the warning device used to satisfy 13.6.9.4 may be installed at any suitable location.

13.6.9.7 The system for the warning device used to satisfy 13.6.9.4 may use any part of the system (including the aural warning device) for the warning device used to satisfy 13.6.9.1.

13.6.10 For aircraft with retractable landing gear, 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.

13.6.11 If nose/tail wheel steering is installed, movement of the pilot’s steering control must not result in a condition that would interfere with the retraction or extension of the landing gear.

13.7 *Wheels:*

13.7.1 The maximum static load rating of each wheel may not be less than the corresponding static ground reaction at the design maximum weight and critical center of gravity.

13.7.2 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 Specification F3116/F3116M.

13.8 *Tires:*

13.8.1 Each main wheel tire must have a static tire rating that is not exceeded by a load on each main wheel tire equal to the corresponding static ground reaction under the design maximum weight and critical center of gravity.

13.8.2 Each nose wheel tire must have a dynamic tire rating that is not exceeded by a load on nose wheel tires equal to the reaction obtained at the nose wheel, assuming the mass of the aircraft to be concentrated at the most critical center of gravity and exerting a downward force of 1.0*W* and a forward force as described in Table 10 (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.

13.8.3 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.

13.8.4 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.

13.9 *Brakes:*

13.9.1 If brakes are 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 methods presented in 13.9.1.1 and 13.9.1.2.

13.9.1.1 The brake kinetic energy absorption requirements must be based on a conservative analysis of the sequence of events expected during landing at the design landing weight.

13.9.1.2 Instead of an analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula in conjunction with Table 11:

$$KE = \frac{C \cdot W \cdot V^2}{N} \tag{5}$$

13.9.2 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 aircraft with wheels locked.

13.9.3 If a landing distance determination is required by Specification F3082/F3082M, the pressure on the wheel braking system must not exceed the maximum design pressure established for the system; higher pressures are not allowed for this determination.

**TABLE 10 Forward Nose Gear Forces**

| Aircraft Stall Speed | Forward Force |
|---|---|
| Less than or equal to 83 km/h [45 knots] | 0.21*W* |
| Greater than 83 km/h [45 knots] | 0.31*W* |

13.9.4 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 aircraft; refer to Practice F3230.

13.9.5 For aircraft required to meet Specification F3082/F3082M, the rejected takeoff brake kinetic energy capacity rating of each main wheel brake assembly may not be less than the kinetic energy absorption requirements determined under either of the methods presented in 13.9.5.1 and 13.9.5.2.

13.9.5.1 In showing compliance with 13.9.5, the brake kinetic energy absorption requirements must be based on a conservative analysis of the sequence of events expected during a rejected takeoff at the design takeoff weight.

13.9.5.2 In showing compliance with 13.9.5, instead of an analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula in conjunction with Table 12:

$$KE = \frac{C \cdot W \cdot V^2}{N} \tag{6}$$

13.10 *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 Specification F3116/F3116M.

13.11 *Door Systems:*

13.11.1 If external passenger or crew doors are employed, there must be a means to lock and safeguard each such door against inadvertent opening during flight by persons, by cargo, or as a result of mechanical failure.

13.11.2 If external passenger or crew doors are employed, each such door must be openable from the inside and the outside when the internal locking mechanism is in the locked position.

13.11.3 Each external passenger or crew door must be openable from both the inside and outside, even though persons may be crowded against the door on the inside of the aircraft.

13.11.4 If external passenger or crew doors are employed, there must be a means of opening each such door which is simple and obvious and is arranged and marked inside and outside so that the door can be readily located, unlocked, and opened.

13.11.5 The provisions of 13.11.4 must be met even in darkness.

13.11.6 If inward opening external passenger or crew 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.

13.11.7 If external passenger or crew doors are employed, each such door must meet the marking requirements of Specification F3083/F3083M.

13.11.8 If external passenger or crew doors are employed, each such door must be reasonably free from jamming as a result of fuselage deformation in an emergency landing.

13.11.9 Auxiliary locking devices may be used for external passenger or crew doors.

**TABLE 11 Legend for Landing Kinetic Energy Formula**

| Variable | Value | SI Units | English Units |
|---|---|---|---|
| *KE* | Kinetic Energy per Wheel | N·m | $lb_f$·ft |
| *C* | Unit Correction Factor | 0.0386 | 0.0443 |
| *W* | Design Landing Weight | kg | $lb_m$ |
| *V*[A] | Aircraft Speed | km/h | knots |
| *N* | Number of Main Wheels with Brakes | | |

[A] *V* must be not less than $V_{S0}$, the power-off stalling speed of the aircraft at sea level, at the design landing weight, and in the landing configuration.

**TABLE 12 Legend for Rejected Takeoff Kinetic Energy Formula**

| Variable | Value | SI Units | English Units |
|---|---|---|---|
| *KE* | Kinetic Energy per Wheel | N·m | $lb_f$·ft |
| *C* | Unit Correction Factor | 0.0386 | 0.0443 |
| *W* | Design Takeoff Weight | kg | $lb_m$ |
| *V*[A] | Ground Speed | km/h | knots |
| *N* | Number of Main Wheels with Brakes | | |

[A] *V* is the ground speed associated with the maximum value of $V_1$ selected in accordance with Specification F3082/F3082M.

13.11.9.1 Auxiliary locking devices that are actuated externally to the aircraft may be used, but such devices must be overridden by the normal internal opening means for each external passenger or crew door.

13.11.10 Each external door forward of any engine, engine inlet, or propeller and each door of the pressure vessel on a pressurized aircraft must comply with the requirements of 13.11.10.1 through 13.11.10.3.

13.11.10.1 In showing compliance with 13.11.10 or 13.11.11, or both, 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.

13.11.10.2 In showing compliance with 13.11.10 or 13.11.11, or both, 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 crew member using a flashlight or an equivalent lighting source.

13.11.10.3 In showing compliance with 13.11.10 or 13.11.11, or both, there must be a visual warning means to signal a flight crew member 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.

13.11.11 Each external door, regardless of location on the aircraft, must comply with the requirements of 13.11.10.1 through 13.11.10.3.

## 14. Exterior Lighting

14.1 *Exterior Lighting Requirements*—In addition to the applicable requirements of this specification, exterior lighting shall comply with the provisions of Specification F3234/F3234M.

## 15. Oxygen Systems

15.1 *Oxygen System Requirements*—In addition to the applicable requirements of this specification, oxygen systems shall comply with the corresponding provisions of Specification F3227/F3227M.

## 16. Pneumatic Systems

NOTE 7—Table 13 provides correlation between various Aircraft Type Codes and the individual requirements contained within this section; refer to 3.2.1. For each subsection, an indicator can be found under each ATC character field; three indicators are used:

An empty cell ( ) in all applicable ATC character field columns indicates that an aircraft must meet the requirements of that subsection.

A white circle (○) in multiple columns indicates that the requirements of that subsection are not applicable to an aircraft *only* if all such ATC character fields are applicable.

A mark-out (×) in any of the applicable ATC character field columns indicates that the requirements of that subsection are not applicable to an aircraft if that ATC character field is applicable.

*Example*—An aircraft with an ATC of 1SRLLDLN is being considered. Since all applicable columns are indicated for 16.1.1, that subsection is applicable to the aircraft.

16.1 *Pressurization and Pneumatic Systems:*

16.1.1 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.

**TABLE 13 ATC Compliance Matrix, Section 16**

| Section | Airworthiness Level | | | | Number of Engines | | Type of Engine(s) | | Stall Speed | | | Cruise Speed | | Meteorological Conditions | | | Altitude | | Maneuvers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | S | M | R | T | L | M | H | L | H | D | N | I | L | H | N | A |
| 16 | | | | | | | | | | | | | | | | | | | | |
| 16.1 | | | | | | | | | | | | | | | | | | | | |
| 16.1.1 | | | | | | | | | | | | | | | | | | | | |
| 16.1.2 | | | | | | | | | | | | | | | | | | | | |
| 16.1.3 | | | | | | | | | | | | | | | | | | | | |

16.1.2 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.

16.1.3 An analysis, or a combination of analysis and test, may be substituted for any test required by 16.1.1 or 16.1.2 if the governing civil aviation authority finds it equivalent to the required test.

## 17. Lightning Protection

NOTE 8—Table 14 provides correlation between various Aircraft Type Codes and the individual requirements contained within this section; refer to 3.2.1. For each subsection, an indicator can be found under each ATC character field; three indicators are used:

An empty cell ( ) in all applicable ATC character field columns indicates that an aircraft must meet the requirements of that subsection.

A white circle (○) in multiple columns indicates that the requirements of that subsection are not applicable to an aircraft *only* if all such ATC character fields are applicable.

A mark-out (×) in any of the applicable ATC character field columns indicates that the requirements of that subsection are not applicable to an aircraft if that ATC character field is applicable.

*Example*—An aircraft with an ATC of 1SRLLDLN is being considered. Since the "D" meteorological column for 17.1.1 contains an ×, then that subsection is not applicable.

17.1 *Electrical Bonding and Protection Against Lightning and Static Electricity:*

17.1.1 The aircraft must be protected against catastrophic effects from lightning.

17.1.2 For metallic components, compliance with 17.1.1 may be shown by either: bonding the components properly to the airframe; or, designing the components so that a strike will not endanger the aircraft.

17.1.3 For non-metallic components, compliance with 17.1.1 may be shown by either: designing the components to minimize the effect of a strike; or, incorporating acceptable means of diverting the resulting electrical current so as not to endanger the aircraft.

17.2 *Fuel System Lightning Protection:*

17.2.1 The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by direct lightning strikes to areas having a high probability of stroke attachment.

17.2.2 The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by swept lightning strokes on areas where swept strokes are highly probable.

17.2.3 The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by corona or streamering at fuel vent outlets.

17.3 *Electrical and Electronic Systems Lightning Protection:*

17.3.1 Each electrical and electronic system that performs a function, for which there is no redundant or mitigating function and whose failure would prevent the continued safe flight and landing of the aircraft, must be designed and installed so that the function is not adversely affected during and after the time the aircraft is exposed to lightning.

17.3.2 Each electrical and electronic system that performs a function, for which there is no redundant or mitigating function and whose failure would prevent the continued safe flight and landing of the aircraft, must be designed and installed so that, for functions for which there is no redundant function or mitigation, the system automatically recovers normal operation of that function in a timely manner after the aircraft is exposed to lightning.

17.3.3 Each electrical and electronic system that performs a function, for which failure would reduce the capability of the aircraft or the ability of the flight crew to respond to an adverse operating condition, must be designed and installed so that the function recovers normal operation in a timely manner after the aircraft is exposed to lightning.

## 18. High-Intensity Radiated Field (HIRF) Protection

18.1 *HIRF Protection Requirements*—In addition to the applicable requirements of this specification, HIRF protection shall comply with the provisions of Specification F3236.

**TABLE 14 ATC Compliance Matrix, Section 17**

| Section | Airworthiness Level | | | | Number of Engines | | Type of Engine(s) | | Stall Speed | | | Cruise Speed | | Meteorological Conditions | | | Altitude | | Maneuvers | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | S | M | R | T | L | M | H | L | H | D | N | I | L | H | N | A |
| 17 | | | | | | | | | | | | | | | | | | | | |
| 17.1 | | | | | | | | | | | | | | | | | | | | |
| 17.1.1 | | | | | | | | | | | | | | × | | | | | | |
| 17.1.2 | | | | | | | | | | | | | | × | | | | | | |
| 17.1.3 | | | | | | | | | | | | | | × | | | | | | |
| 17.2 | | | | | | | | | | | | | | | | | | | | |
| 17.2.1 | | | | | | | | | | | | | | × | | | | | | |
| 17.2.2 | | | | | | | | | | | | | | × | | | | | | |
| 17.2.3 | | | | | | | | | | | | | | × | | | | | | |
| 17.3 | | | | | | | | | | | | | | | | | | | | |
| 17.3.1 | | | | | | | | | | | | | | × | | | | | | |
| 17.3.2 | | | | | | | | | | | | | | × | | | | | | |
| 17.3.3 | | | | | | | | | | | | | | × | × | | | | | |

# APPENDIX

**(Nonmandatory Information)**

## X1. SUPPORTING INFORMATION FOR REVISIONS

### X1.1 Revisions to Specification F3061/F3061M (throughout)

X1.1.1 *Revision 17:*

X1.1.1.1 *Discussion*—Now that we have reached initial stability in the content of the standard, there are advantages to parsing the document into its constituent components. The proposed revision to Specification F3061/F3061M is in support of, and only makes sense in context of, the creation of ten (10) new ASTM Standards, which are administratively coupled to this revision ballot.

X1.1.1.2 *Proposal*—As follows:

*(1)* **No technical content changes are being proposed.**

*(2)* Update Section 2 to reflect the new referenced document set.

*(3)* Update Section 3 to reflect the new terminology set.

*(4)* Relocate the "how to" language of Section 4 into a new standard practice, and reference the new standard as needed.

*(5)* Relocate the bulk of Section 5 into a new standard specification, and reference the new standard as needed.

*(6)* Relocate the battery technology-specific aspects of Section 5 into a new standard specification.

*(7)* Relocate Sections 6 and 15 into a new standard specification, and reference the new standard as needed.

*(8)* Relocate Sections 7 and 8 into a new standard specification, and reference the new standard as needed.

*(9)* Relocate Section 9 into a new standard specification, and reference the new standard as needed.

*(10)* Relocate Section 12 into a new standard specification, and reference the new standard as needed.

*(11)* Relocate Section 14 into a new standard specification, and reference the new standard as needed.

*(12)* Relocate Section 18 into a new standard specification, and reference the new standard as needed.

*(13)* Perform editorial clean-up and corrections as needed.

X1.1.1.3 *Rationale for Change(s)*—Parsing Specification F3061/F3061M will provide more freedom and flexibility for the disparate task groups to move forward with improvements, since having individual documents will reduce the need for coordinating ballot activities to the extent required by a single document.

### X1.2 Revisions to Section 3.2.1.5(*1*)

X1.2.1 *Revision 16:*

X1.2.1.1 *Discussion*—The proposed rules include both speed and Mach information regarding the division between low-speed and high-speed aircraft; the standard currently includes only the speed information.

X1.2.1.2 *Proposal*—Add the Mach information to the standard to better align with the proposed rules.

X1.2.1.3 *Rationale for Change(s)*—The proposal is for the addition of harmonizing information only; no technical content is added, deleted, or modified.

### X1.3 Revision to 3.2.1.5(*2*)

X1.3.1 *Revision 16:*

X1.3.1.1 *Discussion*—The proposed rules include both speed and Mach information regarding the division between low-speed and high-speed aircraft; the standard currently includes only the speed information.

X1.3.1.2 *Proposal*—Add the Mach information to the standard to better align with the proposed rules.

X1.3.1.3 *Rationale for Change(s)*—The proposal is for the addition of harmonizing information only; no technical content is added, deleted, or modified.

### X1.4 Revisions to 3.2.1.8(*1*)

X1.4.1 *Revision 16:*

X1.4.1.1 *Discussion*—The proposed rules use the word "aerobatic" rather than "acrobatic"; the standard currently uses the latter.

X1.4.1.2 *Proposal*—Harmonize with the proposed rules by using the word "aerobatic" in place of the existing language.

X1.4.1.3 *Rationale for Change(s)*—The proposal is for the addition of harmonizing information only; no technical content is added, deleted, or modified.

### X1.5 Revisions to 3.2.1.8(*2*)

X1.5.1 *Revision 16:*

X1.5.1.1 *Discussion*—The proposed rules use the word "aerobatic" rather than "acrobatic"; the standard currently uses the latter.

X1.5.1.2 *Proposal*—Harmonize with the proposed rules by using the word "aerobatic" in place of the existing language.

X1.5.1.3 *Rationale for Change(s)*—The proposal is for the addition of harmonizing information only; no technical content is added, deleted, or modified.

### X1.6 Revisions to Section 4.1.8.1

X1.6.1 *Revision 16a:*

X1.6.1.1 *Discussion*—Section 4.1.8.1 is currently subordinate to 4.1.8, which states that the focus is "systems and equipment not required for certification or operating rules." However, section 4.1.8.1 itself is complex enough that users may lose track of its subordinate position and miss the limited focus.

X1.6.1.2 *Proposal*—Add language to Section 4.1.8.1 to restate the limitation of focus.

X1.6.1.3 *Rationale for Change(s)*—The proposal is for the addition of "intentional redundancy" in order to improve the overall clarity for the user; no technical content is added, deleted, or modified.

### X1.7 Revisions to Section 10.7.1

X1.7.1 *Revision 16:*

X1.7.1.1 *Discussion*—The compatibility matrix for Section 10 (Table 3 indicates that the sections included in the Affected Content are not applicable to single-engine aircraft. Each of these sections, however, also contains language specifying "for multiengine installations" (or similar), which is redundant to Table 3.

X1.7.1.2 *Proposal*—Remove the redundant language from the sections included in the Affected Content.

X1.7.1.3 *Rationale for Change(s)*—The proposal is for the removal of redundant information only; no technical content is added, deleted, or modified.

### X1.8 Revisions to Section 10.7.2

X1.8.1 *Revision 16:*

X1.8.1.1 *Discussion*—The compatibility matrix for Section 10 (Table 3) indicates that the sections included in the Affected Content are not applicable to single-engine aircraft. Each of these sections, however, also contains language specifying "for multiengine installations" (or similar), which is redundant to Table 3.

X1.8.1.2 *Proposal*—Remove the redundant language from the sections included in the Affected Content.

X1.8.1.3 *Rationale for Change(s)*—The proposal is for the removal of redundant information only; no technical content is added, deleted, or modified.

### X1.9 Revisions to Section 10.7.3

X1.9.1 *Revision 16:*

X1.9.1.1 *Discussion*—The compatibility matrix for Section 10 (Table 3) indicates that the sections included in the Affected Content are not applicable to single-engine aircraft. Each of these sections, however, also contains language specifying "for multiengine installations" (or similar), which is redundant to Table 3.

X1.9.1.2 *Proposal*—Remove the redundant language from the sections included in the Affected Content.

X1.9.1.3 *Rationale for Change(s)*—The proposal is for the removal of redundant information only; no technical content is added, deleted, or modified.

### X1.10 Revisions to 10.7.4

X1.10.1 *Revision 16:*

X1.10.1.1 *Discussion*—The compatibility matrix for Section 10 (Table 3) indicates that the sections included in the Affected Content are not applicable to single-engine aircraft. Each of these sections, however, also contains language specifying "for multiengine installations" (or similar), which is redundant to Table 3.

X1.10.1.2 *Proposal*—Remove the redundant language from the sections included in the Affected Content.

X1.10.1.3 *Rationale for Change(s)*—The proposal is for the removal of redundant information only; no technical content is added, deleted, or modified.

### X1.11 Revisions to Section 10.7.5

X1.11.1 *Revision 16:*

X1.11.1.1 *Discussion*—The compatibility matrix for Section 10 (Table 3) indicates that the sections included in the Affected Content are not applicable to single-engine aircraft. Each of these sections, however, also contains language specifying "for multiengine installations" (or similar), which is redundant to Table 3.

X1.11.1.2 *Proposal*—Remove the redundant language from the sections included in the Affected Content.

X1.11.1.3 *Rationale for Change(s)*—The proposal is for the removal of redundant information only; no technical content is added, deleted, or modified.

### X1.12 Revisions to Section 10.7.6

X1.12.1 *Revision 16:*

X1.12.1.1 *Discussion*—The compatibility matrix for Section 10 (Table 3) indicates that the sections included in the Affected Content are not applicable to single-engine aircraft. Each of these sections, however, also contains language specifying "for multiengine installations" (or similar), which is redundant to Table 3.

X1.12.1.2 *Proposal*—Remove the redundant language from the sections included in the Affected Content.

X1.12.1.3 *Rationale for Change(s)*—The proposal is for the removal of redundant information only; no technical content is added, deleted, or modified.

### X1.13 Revisions to Section 10.7.7

X1.13.1 *Revision 16:*

X1.13.1.1 *Discussion*—The compatibility matrix for Section 10 (Table 3) indicates that the section included in the Affected Content is not applicable to reciprocating-engine aircraft. The section, however, also contains language specifying "for turbine installations" (or similar), which is redundant to Table 3.

X1.13.1.2 *Proposal*—Remove the redundant language from the sections included in the Affected Content.

X1.13.1.3 *Rationale for Change(s)*—The proposal is for the removal of redundant information only; no technical content is added, deleted, or modified.

### X1.14 Revisions to Section 10.8

X1.14.1 *Revision 16:*

X1.14.1.1 *Discussion*—The compatibility matrix for Section 10 (Table 3) indicates that the sections included in the Affected Content are not applicable to single-engine aircraft. Each of these sections, however, also contains language specifying "for multiengine installations" (or similar), which is redundant to Table 3.

X1.14.1.2 *Proposal*—Remove the redundant language from the sections included in the Affected Content.

X1.14.1.3 *Rationale for Change(s)*—The proposal is for the removal of redundant information only; no technical content is added, deleted, or modified.

### X1.15 Revisions to Table 5

X1.15.1 *Revision 16b:*

X1.15.1.1 *Discussion*—The current language (incorporated from Part 23 Amdt 62) does not allow for certain analysis-only

paths to landing gear certification that have been historically available to VLA aircraft. With appropriate limitations on the scope of application, these analysis-only paths should be allowed.

X1.15.1.2 *Proposal*—Add language consistent with the allowances provided VLA aircraft to provide analysis-only certification paths; limit the applicability of these paths to Level 1, slow-stall aircraft.

X1.15.1.3 *Rationale for Change(s)*—The proposal is for the addition of alternative means of compliance for a limited scope of application. This is consistent with the goal of simplifying the means of compliance as appropriate for the various levels of risk, complexity, performance, etc.

### X1.16 Revisions to Section 13.2.1

X1.16.1 *Revision 16b:*

X1.16.1.1 *Discussion*—The current language (incorporated from Part 23 Amdt 62) does not allow for certain analysis-only paths to landing gear certification that have been historically available to VLA aircraft. With appropriate limitations on the scope of application, these analysis-only paths should be allowed.

X1.16.1.2 *Proposal*—Add language consistent with the allowances provided VLA aircraft to provide analysis-only certification paths; limit the applicability of these paths to Level 1, slow-stall aircraft.

X1.16.1.3 *Rationale for Change(s)*—The proposal is for the addition of alternative means of compliance for a limited scope of application. This is consistent with the goal of simplifying the means of compliance as appropriate for the various levels of risk, complexity, performance, etc.

### X1.17 Revisions to Section 13.2.1.2

X1.17.1 *Revision 16b:*

X1.17.1.1 *Discussion*—The current language (incorporated from Part 23 Amdt 62) does not allow for certain analysis-only paths to landing gear certification that have been historically available to VLA aircraft. With appropriate limitations on the scope of application, these analysis-only paths should be allowed.

X1.17.1.2 *Proposal*—Add language consistent with the allowances provided VLA aircraft to provide analysis-only certification paths; limit the applicability of these paths to Level 1, slow-stall aircraft.

X1.17.1.3 *Rationale for Change(s)*—The proposal is for the addition of alternative means of compliance for a limited scope of application. This is consistent with the goal of simplifying the means of compliance as appropriate for the various levels of risk, complexity, performance, etc.

### X1.18 Revisions to Section 13.2.1.3

X1.18.1 *Revision 16b:*

X1.18.1.1 *Discussion*—The current language (incorporated from Part 23 Amdt 62) does not allow for certain analysis-only paths to landing gear certification that have been historically available to VLA aircraft. With appropriate limitations on the scope of application, these analysis-only paths should be allowed.

X1.18.1.2 *Proposal*—Add language consistent with the allowances provided VLA aircraft to provide analysis-only certification paths; limit the applicability of these paths to Level 1, slow-stall aircraft.

X1.18.1.3 *Rationale for Change(s)*—The proposal is for the addition of alternative means of compliance for a limited scope of application. This is consistent with the goal of simplifying the means of compliance as appropriate for the various levels of risk, complexity, performance, etc.