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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 are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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 Weights and Centers of Gravity of Aircraft
F3083/F3083M Specification for Emergency Conditions, Occupant Safety and Accommodations
F3116/F3116M Specification for Design Loads and Conditions
F3117/F3117M Specification for Crew Interface in Aircraft
F3179/F3179M Specification for Performance of 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 Assessment of Systems and Equipment in Small Aircraft
F3231/F3231M Specification for Electrical Systems for Aircraft with Combustion Engine Electrical Power Generation
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
F3309/F3309M Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft

[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.

F3316/F3316M Specification for Electrical Systems for Aircraft with Electric or Hybrid-Electric Propulsion
F3367 Practice for Simplified Methods for Addressing High-Intensity Radiated Fields (HIRF) and Indirect Effects of Lightning on Aircraft

2.3 *SAE Standard:*[3]
SAE ARP4754, Rev A Guidelines for Development of Civil Aircraft Systems

2.4 *Other Standards:*
AC 20-136 Protection of Aircraft Electrical/Electronic Systems against the Indirect Effects of Lightning[4]
FAA-S-8081-14B, Change 5 Private Pilot Practical Test Standards for Airplane[4]
RTCA DO-178, Rev B Software Considerations in Airborne Systems and Equipment Certification[5]
RTCA DO-254 Design Assurance Guidance for Airborne Electronic Hardware[5]

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:*

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 aeroplane certification 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 aeroplane certification level of the aircraft.

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

(2) A "2" indicates an aeroplane certification 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 aeroplane certification 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 aeroplane certification 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*—

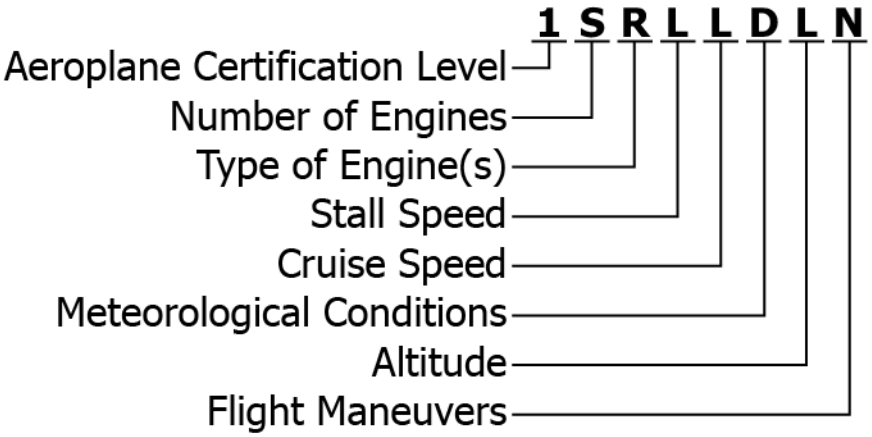

FIG. 1 Illustration of Aircraft Type Code

[3] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, http://www.sae.org.
[4] Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, http://www.faa.gov.
[5] Available from RTCA, 1150 18th NW, Suite 910, Washington, DC 20036, https://www.rtca.org.

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 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 *pneumatic system elements, n*—components associated with systems that use bleed air or other sources of compressed gas for their function (ice protection, vapor cycle cooling, rudder bias, door seal inflation, brake heating, emergency gear extension, emergency braking, etc.) Within the context of pressurization systems, pneumatic system elements include the valve(s) that regulates cabin inflow as well as all upstream equipment items that utilize bleed air; refer to 3.2.5.

3.2.5 *pressurization system elements, n*—components downstream of the valve(s) that regulates cabin inflow; refer to 3.2.4.

3.2.6 *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.

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

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

3.2.9 *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" aeroplane certification 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 4.2.2 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

TABLE 1 ATC Compliance Matrix, Section 4

Section	Aeroplane Certification 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																				
4.2.2																				
4.2.2.1	○								○					○						
4.2.2.2	○								○					○						
4.2.2.3	○								○					○						
4.2.2.4	○								○					○						
4.2.3																				
4.2.3.1																				
4.2.3.2																				
4.2.3.3																				
4.2.4	○								○					○						
4.2.5	○								○					○						
4.2.5.1	○								○					○						
4.2.6									○					○						
4.2.6.1									○					○						
4.2.6.2									○					○						

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.

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.

4.2.1.1 Practice F3230 provides one method of satisfying 4.2 for all normal category aircraft.

4.2.1.2 Practice F3309/F3309M provides one method of satisfying 4.2 for a limited set of aircraft as defined in that practice.

4.2.2 The equipment, systems, and installations must be designed to minimize hazards to the aircraft in the event of a probable malfunction or failure.

4.2.2.1 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."

4.2.2.2 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."

4.2.2.3 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."

4.2.2.4 For definitions of the failure condition severities and the qualitative probability terms used in 4.2.2, refer to Practice F3230.

4.2.3 As used in 4.2, the term "systems" refers to all pneumatic systems, fluid systems, electrical systems, mechanical systems, and powerplant systems included in the aircraft design except as provided in 4.2.3.1 through 4.2.3.3.

4.2.3.1 Powerplant systems provided as part of the type-certified engine are not subject to the provisions of 4.2.

4.2.3.2 The flight structure (such as wing, fuselage, empennage, engine-mounting, control surfaces and their associated simple systems, and landing gear and their primary attachments) are not subject to the provisions of 4.2.

4.2.3.3 Single failures within brake systems, including associated systems and components, are not subject to the provisions of 4.2 provided it is shown that the aircraft can be brought to rest, with a braked-roll stopping distance of not more than two times that obtained in determining the landing distance per Specification F3179/F3179M, following:

(1) Failure of any electrical, pneumatic, hydraulic, or mechanical connecting or transmitting element; or

(2) Loss of any single source of hydraulic or other brake-operating energy.

NOTE 4—The allowances of 4.2.3.3 have traditionally been applied only to jet aircraft with high takeoff and landing speeds.

4.2.4 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 or Practice F3309/F3309M.

4.2.5 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.

4.2.5.1 In showing compliance with the provisions of 4.2.5, once a DAL is assigned, acceptable means of compliance may be found in RTCA DO-178 or RTCA DO-254, or both; refer to Section 2.

4.2.6 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.

4.2.6.1 In showing compliance with the provisions of 4.2.6, if immediate pilot awareness and immediate or subsequent corrective action is required, the information required by 4.2.6 must be presented in accordance with Specification F3117/F3117M.

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.

4.2.6.2 In showing compliance with the provisions of 4.2.6, 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 or Practice F3309/F3309M and ~~3.2.7~~3.2.9.

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 5.1.1 and 5.1.2.

5.1.1 Electrical systems for aircraft equipped with combustion-engine propulsion shall comply with the provisions of Specification F3231/F3231M.

5.1.2 Electrical systems for aircraft equipped with electric propulsion shall comply with the provisions of Specification F3316/F3316M.

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.

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 5—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.

TABLE 3 ATC Compliance Matrix, Section 10

Section	Aeroplane Certification 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																				

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 10.2.1, that subsection is applicable to the aircraft. However, since the "1" aeroplane certification 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/F3117M, 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.

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; compliance must be shown by analysis or test.

10.3.3 Possible sources and paths of fluid leakage, and means of detecting leakage, must be considered when showing compliance with 10.3.2.

10.3.4 Flammability characteristics of fluids, including effects of any combustible or absorbing materials, must be considered when showing compliance with 10.3.2.

10.3.5 Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices, must be considered when showing compliance with 10.3.2.

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 10.3.2.

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 10.3.2.

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 6—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	Aeroplane Certification 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 7—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" aeroplane certification 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 aeroplane.

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 aeroplane, 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.

TABLE 5 ATC Compliance Matrix, Section 13

Section	Aeroplane Certification 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																				
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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																				
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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																				
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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																				