Designation: F3232/F3232M – 23

Standard Specification for Flight Controls in Small Aircraft[1]

This standard is issued under the fixed designation F3232/F3232M; 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 flight control 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 specification as part of a certification plan. For information on which CAA regulatory bodies have accepted this specification (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

F3061/F3061M Specification for Systems and Equipment in Aircraft

F3116/F3116M Specification for Design Loads and Conditions

F3117/F3117M Specification for Crew Interface in Aircraft

F3173/F3173M Specification for Aircraft Handling Characteristics

F3180/F3180M Specification for Low-Speed Flight Characteristics of Aircraft

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

2.3 *Other Standards:*

FAA-S-ACS Private Pilot - Airplane Airman Certification Standards[3]

RTCA/DO-335 Guidance for Installation of Automatic Flight Guidance and Control Systems (AFGCS) for Part 23 Airplanes[4]

3. Terminology

3.1 Terminology specific to this specification 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; the method of defining an ATC applicable to this specification is defined in Specification F3061/F3061M.

3.2.2 *continued safe flight and landing, n*—continued safe flight and landing as applicable to this specification is defined in Specification F3061/F3061M.

[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 Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, http://www.faa.gov.

[4] Available from RTCA, Inc., 1150 18th St., NW, Suite 910, Washington, DC 20036, http://www.rtca.org.

3.2.3 *single failure, n*—a single failure as applicable to this specification is defined in Practice F3230.

4. Manual Flight Controls

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.

Examples—An aircraft with an ATC of 1SRLLDLN is being considered. Since all applicable columns are empty for 4.1.2, that subsection is applicable to the aircraft. However, since the "S" number-of-engines column for 4.4.8 contains an ×, then that subsection is not applicable.

4.1 *Control Surface Installation:*

4.1.1 Movable surfaces must be installed so that there is no interference between any surfaces, their bracing, or adjacent fixed structure, when one surface is held in its most critical clearance positions and the others are operated through their full movement.

4.1.2 If an adjustable stabilizer is used, it must have stops that will limit its range of travel to that allowing safe flight and landing.

4.1.3 Control surface hinges, except ball and roller bearing hinges, must have a factor of safety of not less than 6.67 with respect to the ultimate bearings strength of the softest material used as a bearing.

4.1.3.1 For ball or roller bearing hinges, the approved rating of the bearing may not be exceeded.

4.1.4 Control system joints (in push-pull systems) that are subject to angular motion, except those in ball and roller bearing systems, must have a special factor of safety of not less than 3.33 with respect to ultimate bearing strength of the softest material used as a bearing.

4.1.4.1 The factor specified in 4.1.4 may be reduced to 2.0 for joints in cable control systems.

4.1.4.2 For ball or roller bearings, the approved rating of the bearing may not be exceeded.

4.2 *Operation and Arrangement:*

4.2.1 Each control must operate easily, smoothly, and positively enough to allow proper performance of its functions.

4.2.2 Controls must be arranged and identified to provide for convenience in operation and so as to not cause confusion and subsequent inadvertent operation; refer to Specification F3117/F3117M.

4.3 *Control System Stops:*

4.3.1 Each control system must have stops that positively limit the range of motion of each movable aerodynamic surface controlled by the system.

4.3.2 Each stop must be located so that wear, slackness, or takeup adjustments will not adversely affect the control characteristics of the aircraft because of a change in the range of surface travel.

4.3.3 Each stop must be able to withstand any loads corresponding to the design conditions for the control system.

4.4 *Trim Systems:*

4.4.1 Proper precautions must be taken to prevent inadvertent, improper, or abrupt trim tab operation.

4.4.2 There must be means near the trim control to indicate to the pilot the direction of trim control movement relative to aircraft motion.

4.4.3 There must be means to indicate to the pilot the position of the trim device with respect to both the range of adjustment and, in the case of lateral and directional trim, the neutral position.

4.4.4 The means provided to satisfy the requirements of 4.4.2 and 4.4.3 must be visible to the pilot and must be located and designed so as to not cause confusion.

4.4.5 The pitch trim indicator must be clearly marked with a position or range within which it has been demonstrated that take-off is safe for all center of gravity positions and each flap position approved for takeoff.

4.4.6 The design of the primary flight controls must be such as to minimize the likelihood of failure of any connecting or transmitting element in the control system that could result in loss of control of any axis.

4.4.7 Trimming devices must be designed so that, when any one connecting or transmitting element in the primary flight control system fails, adequate control for safe flight and landing is available with the longitudinal trimming devices.

4.4.8 Trimming devices must be designed so that, when any one connecting or transmitting element in the primary flight control system fails, adequate control for safe flight and landing is available with the longitudinal and directional trimming devices.

4.4.9 Tab controls must be irreversible unless the tab is properly balanced and has no unsafe flutter characteristics. Irreversible tab systems must have adequate rigidity and reliability in the portion of the system from the tab to the attachment of the irreversible unit to the aircraft structure.

4.4.10 If a powered trim system is installed, it must be demonstrated that the aeroplane is safely controllable, and that the pilot can perform all the maneuvers and operations necessary for continued safe flight and landing following any powered trim system runaway that is not extremely improbable, allowing for appropriate time delay after pilot recognition of the trim system runaway. The demonstration must be conducted at the critical aeroplane weights and center of gravity positions.

4.5 *Control System Locks:*

4.5.1 If there is a device to lock the control system on the ground or water, there must be a means to give unmistakable warning to the pilot when lock is engaged, or to automatically disengage the device when the pilot operates the primary flight controls in a normal manner.

4.5.2 If there is a device to lock the control system on the ground or water, the device must be installed to limit the operation of the aircraft so that, when the device is engaged, the pilot receives unmistakable warning at the start of the takeoff.

4.5.3 If there is a device to lock the control system on the ground or water, the device must have a means to preclude the possibility of it becoming inadvertently engaged in flight.

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
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4.4.6		×	×	×		×				×	×									
4.4.7	○					×			○											
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4.13.3				×									×					×		
4.13.4																				
4.13.5					×															
4.13.6	○								○					○						