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Standard Specification for High Intensity Radiated Field (HIRF) Protection in Small Aircraft[1]

This standard is issued under the fixed designation F3236; 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 high intensity radiated field (HIRF) protection aspects of airworthiness and design for "small" aircraft.

1.2 The applicant for a design approval must seek the individual guidance for their respective civil aviation authority (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/committeee/F44.htm), which includes CAA website links. Annex A1 maps the Means of Compliance described in this specification to EASA CS-23, amendment 5, or later, and FAA 14 CFR Part 23, amendment 64, or later.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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, 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 through this document; 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 Small Aircraft

2.3 *EASA Standard:*[3]

CS-23 Normal, Utility, Aerobatic and Commuter Aeroplanes

[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 European Union Aviation Safety Agency (EASA), Konrad-Adenauer-Ufer 3, D-50668 Cologne, Germany, https://www.easa.europa.eu.

2.4 *EUROCAE Standard:*[4]
EUROCAE ED-107, Rev A Guide to Certification of Aircraft in a High-Intensity Radiated Field (HIRF) Environment
2.5 *FAA Standards:*[5]
14 CFR Part 23 Airworthiness Standards: Normal Category Airplanes
FAA-S-8081-14B, Change 5 Private Pilot Practical Test Standards for Airplane
2.6 *SAE Standard:*[6]
SAE ARP 5583, Rev A Guide to Certification of Aircraft in a High-Intensity Radiated Field (HIRF) Environment

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 airworthiness 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 standard is defined in Specification F3061/F3061M.

4. High-Intensity Radiated Field (HIRF) Protection

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 4.2.1, that subsection is applicable to the aircraft. Since both the "L" stall speed column and the "D" meteorological column for 4.1.1 contain white circles, then that subsection is not applicable; however, for an aircraft with an ATC of 1SRMLDLN, 4.1.1 would be applicable since the "M" stall speed column does not contain a white circle.

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									○					○						
4.1.1.1									○					○						
4.1.1.2									○					○						
4.1.1.3									○					○						
4.1.2									○					○						
4.1.3									○					○						
4.2																				
4.2.1																				
4.2.2																				
4.2.3																				
4.2.3.1																				
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4.2.3.3																				
4.2.3.4																				
4.2.3.5																				
4.2.4																				
4.2.5																				
4.2.5.1																				
4.2.5.2																				
4.2.5.3																				
4.2.5.4																				

[4] Available from EUROCAE, 9-23 rue Paul Lafargue, "Le Triangle" building, 93200 Saint-Denis, France, https://www.eurocae.net.
[5] Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, http://www.faa.gov.
[6] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, http://www.sae.org.

NOTE 2—Guidance in addition to the following sections may be found in either SAE ARP 5583 or EUROCAE ED-107.

4.1 *Electrical and Electronic Systems HIRF Protection:*

4.1.1 Each electrical and electronic system that performs a function whose failure would prevent the continued safe flight and landing of the aircraft must be designed and installed so that it meets the requirements of 4.1.1.1 – 4.1.1.3.

4.1.1.1 In showing compliance with 4.1.1, the function must not be adversely affected during and after the time the aircraft is exposed to HIRF Environment "I" as described in 4.2.1.

4.1.1.2 In showing compliance with 4.1.1, each electrical or electronic system must automatically recover normal operation of its function, in a timely manner, after the aircraft is exposed to HIRF Environment "I" as described in 4.2.1, unless the system's recovery conflicts with other operational or functional requirements of the system.

4.1.1.3 In showing compliance with 4.1.1, each electrical or electronic system must not be adversely affected during and after the time the aircraft is exposed to HIRF Environment "II" as described in 4.2.2.

4.1.2 Each electrical and electronic system that performs a function whose failure would significantly 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 the system is not adversely affected when the equipment providing the function is exposed to Equipment HIRF Test Level 1 as described in 4.2.3 or Equipment HIRF Test Level 2 as described in 4.2.4.

4.1.3 ~~Each~~ When required by regulation, each electrical and electronic system that performs a function whose 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 the system is not adversely affected when the equipment providing the function is exposed to Equipment HIRF Test Level 3 as described in 4.2.5.

4.2 *HIRF Environments and Test Levels*—4.2.1 – 4.2.5 specify the HIRF environments and equipment HIRF test levels for electrical and electronic systems. The field strength values for the HIRF environments and equipment HIRF test levels are expressed in root-mean-square units measured during the peak of the modulation cycle.

4.2.1 HIRF Environment "I" is specified in Table 2.

4.2.2 HIRF Environment "II" is specified in Table 3.

4.2.3 Equipment HIRF Test Level 1 is specified in 4.2.3.1 – 4.2.3.5

4.2.3.1 From 10 kilohertz (kHz) to 400 megahertz (MHz), use conducted susceptibility tests with continuous wave (CW) and 1 kHz square wave modulation with 90 % depth or greater. The conducted susceptibility current must start at a minimum of 0.6 milliamperes (mA) at 10 kHz, increasing 20 decibels (dB) per frequency decade to a minimum of 30 mA at 500 kHz.

4.2.3.2 From 500 kHz to 40 MHz, the conducted susceptibility current must be at least 30 mA.

TABLE 2 HIRF Environment "I"[A]

Frequency	Field Strength (volts/meter)	
	Peak	Average
10 kHz to 2 MHz	50	50
2 MHz to 30 MHz	100	100
30 MHz to 100 MHz	50	50
100 MHz to 400 MHz	100	100
~~400 MHz to 700 MHz~~	~~700~~	~~100~~
400 MHz to 700 MHz	700	50
700 MHz to 1 GHz	700	100
1 GHz to 2 GHz	2000	200
2 GHz to 6 GHz	3000	200
6 GHz to 8 GHz	1000	200
8 GHz to 12 GHz	3000	300
12 GHz to 18 GHz	2000	200
18 GHz to 40 GHz	600	200

[A] In this table, the higher field strength applies at the frequency band edges.

TABLE 3 HIRF Environment "II"[A]

Frequency	Field Strength (volts/meter)	
	Peak	Average
10 kHz to 500 kHz	20	20
500 kHz to 2 MHz	30	30
2 MHz to 30 MHz	100	100
30 MHz to 100 MHz	10	10
100 MHz to 200 MHz	30	10
200 MHz to 400 MHz	10	10
400 MHz to 1 GHz	700	40
1 GHz to 2 GHz	1300	160
2 GHz to 4 GHz	3000	120
4 GHz to 6 GHz	3000	160
6 GHz to 8 GHz	400	170
8 GHz to 12 GHz	1230	230
12 GHz to 18 GHz	730	190
18 GHz to 40 GHz	600	150

[A] In this table, the higher field strength applies at the frequency band edges.

4.2.3.3 From ~~40~~40 MHz to ~~500~~400 MHz, use conducted susceptibility tests, starting at a minimum of 30 mA at 40 MHz, decreasing 20 dB per frequency decade to a minimum of 3 mA at 400 MHz.

4.2.3.4 From ~~100~~100 MHz to 400 MHz, use radiated susceptibility tests at a minimum of 20 volts per meter (V/m) peak with CW and 1 kHz square wave modulation with 90 % depth or greater.

4.2.3.5 From 400 MHz to 8 gigahertz (Ghz), use radiated susceptibility tests at a minimum of 150 V/m peak with pulse modulation of 4 % duty cycle with a 1 kHz pulse repetition frequency. This signal must be switched on and off at a rate of 1 Hz with a duty cycle of 50 %.

4.2.4 Equipment HIRF Test Level 2 is HIRF Environment "II" as specified in 4.2.2, reduced by acceptable aircraft transfer function and attenuation curves. Testing must cover the frequency band of 10 kHz to 8 GHz.

4.2.5 Equipment HIRF Test Level 3 is specified in 4.2.5.1 – 4.2.5.4.

4.2.5.1 From 10 kHz to 400 MHz, use conducted susceptibility tests, starting at a minimum of 0.15 mA at 10 kHz, increasing 20 dB per frequency decade to a minimum of 7.5 mA at 500 kHz.

4.2.5.2 From 500 kHz to 40 MHz, use conducted susceptibility tests at a minimum of 7.5 mA.

4.2.5.3 From ~~40~~40 MHz to 400 MHz, use conducted susceptibility tests, starting at a minimum of 7.5 mA at 40 MHz, decreasing 20 dB per frequency decade to a minimum of 0.75 mA at 400 MHz.

4.2.5.4 From 100 MHz to 8 GHz, use radiated susceptibility tests at a minimum of 5 V/m.

5. Keywords

5.1 HIRF; HIRF protection; radiated fields