



Designation: F3231/F3231M – 23

Standard Specification for Electrical Systems for Aircraft with Combustion Engine Electrical Power Generation¹

This standard is issued under the fixed designation F3231/F3231M; 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 electrical systems, electrical equipment, and electrical power distribution aspects of airworthiness and design for aeroplanes with combustion engine generation of electrical power. The material was developed through open consensus of international experts in general aviation. This information was created by focusing on Normal Category Aeroplanes. The content may be more broadly applicable; it is the responsibility of the applicant to substantiate broader applicability as a specific means of compliance.

1.2 An applicant intending to propose this information as Means of Compliance for a design approval shall seek guidance from their respective oversight authority (for example, published guidance from applicable civil aviation authorities (CAAs)) concerning the acceptable use and application thereof. For information on which oversight authorities have accepted this specification (in whole or in part) as an acceptable Means of Compliance to their regulatory requirements (hereinafter “the Rules”), refer to ASTM Committee F44 web page (www.astm.org/COMMITTEE/F44.htm). **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 *Units*—This standard may present information in either SI units, English Engineering units, or both; 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 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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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 CAA; earlier revisions are not acceptable.

2.2 ASTM Standards:²

F2490 Guide for Aircraft Electrical Load and Power Source Capacity Analysis

F2639 Practice for Design, Alteration, and Certification of Aircraft Electrical Wiring Systems

F3060 Terminology for Aircraft

F3061/F3061M Specification for Systems and Equipment in Aircraft

F3066/F3066M Specification for Aircraft Powerplant Installation Hazard Mitigation

F3117/F3117M Specification for Crew Interface in Aircraft

F3235 Specification for Aircraft Storage Batteries

F3316/F3316M Specification for Electrical Systems for Aircraft with Electric or Hybrid-Electric Propulsion

2.3 FAA Standards:³

14 CFR Part 23 Airworthiness Standards: Normal Category Airplanes

DOT/FAA/AR-00/12 Aircraft Materials Fire Test Handbook

2.4 EASA Standard:⁴

CS-23 Normal, Utility, Aerobatic and Commuter Aeroplanes

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

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 specification is defined in Specification **F3061/F3061M**.

3.2.3 *distribution system, n*—as used in this specification, includes the distribution buses, their associated feeders, each control, and each protective device.

4. Electrical Systems

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 shall 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. **4.2.1.2** would not be applicable to either aircraft, since it contains an × in the “1” airworthiness level column.

NOTE 2—This standard provides specifications for the electrical generation and distribution systems used to power various aircraft systems and equipment. It intentionally does not address any electrical power systems that may be employed in electrically-powered aircraft propulsion systems; such power systems are addressed in Specification **F3316/F3316M**.

4.1 Power Source Capacity and Distribution:

4.1.1 Each installation whose functioning is required for type certification or under operating rules and that requires a power supply is an “essential load” on the power supply. The power sources and the system shall be able to supply the power loads specified in **4.1.1.1 – 4.1.1.7** in probable operating combinations and for probable durations. The power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operation authorized. Loads not required in controlled flight need not be considered for the two-engine-inoperative condition on aircraft with three or more engines.

4.1.1.1 When required by **4.1.1**, the power sources and the electrical distribution system, when functioning normally shall be able to support all connected loads.

4.1.1.2 When required by **4.1.1**, the power sources and the electrical distribution system shall be able to support all essential loads after the failure of any one generator/alternator.

4.1.1.3 When required by **4.1.1**, the power sources and the electrical distribution system shall be able to support all essential loads after the failure of any one power converter.

4.1.1.4 When required by **4.1.1**, the power sources and the electrical distribution system shall be able to support all essential loads after the failure of any one energy storage device.

4.1.1.5 When required by **4.1.1**, the power sources and the electrical distribution system shall be able to support all essential loads after the failure of any one engine on an aeroplane with two engines.

4.1.1.6 When required by **4.1.1**, the power sources and the electrical distribution system shall be able to support all essential loads after the failure of any two engines on an aeroplane with three or more engines.

4.1.1.7 When required by **4.1.1**, the power sources and the electrical distribution system shall be able to support all essential loads for which an alternate source of power is required, after any failure or malfunction in any one power supply system, any one distribution system, or any other utilization system.

4.2 Electrical Systems and Equipment:

NOTE 3—Guide **F2490** provides information and methodology for an electrical load analysis.

4.2.1 Electric power sources, their transmission cables, and their associated control and protective devices shall be able to furnish the required power at the proper voltage to each load circuit essential for safe operation.

4.2.1.1 Compliance with **4.2.1** shall be shown by an electrical load analysis or by electrical measurements that account for the electrical loads applied to the electrical system in probable combinations and for probable durations.

4.2.1.2 Compliance with **4.2.1** shall be shown by an electrical load analysis that accounts for the electrical loads applied to the electrical system in probable combinations and for probable durations.

4.2.2 Each electrical system, when installed, shall be free from hazards in itself, in its method of operation, and in its effects on other parts of the aircraft.

4.2.3 Each electrical system, when installed, shall be protected from fuel, oil, water, other detrimental substances, and mechanical damage.

4.2.4 Each electrical system, when installed, shall be designed so that the risk of electrical shock to crew, passengers, and ground personnel is reduced to a minimum.

4.2.5 Electric power sources shall function properly when connected in combination or independently.

4.2.6 No failure or malfunction of any electric power source in the distribution system shall impair the ability of any remaining source to supply load circuits essential for safe operation.

4.2.7 Each distribution system shall be designed so that essential load circuits can be supplied in the event of reasonably probable faults or open circuits including faults in heavy current carrying cables.