Designation: F3239 – 18

Standard Specification for Aircraft Electric Propulsion Systems[1]

This standard is issued under the fixed designation F3239; 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 addresses airworthiness requirements for the design and installation of electric propulsion systems for aeroplanes. Hybrid-electric propulsion systems are addressed implicitly unless explicitly stated otherwise. This specification was written with the focus on electric propulsion systems with conventional system layout, propulsion characteristics, and operation. 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 must seek guidance from their respective oversight authority (for example, published guidance from applicable CAAs) concerning the acceptable use and application thereof. For information on which oversight authorities have accepted this standard (in whole or in part) as an acceptable Means of Compliance to their regulatory requirements (hereinafter "the Rules"), refer to the ASTM Committee F44 web page (www.astm.org/COMMITTEE/F44.htm).

1.3 *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.*

1.4 *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 *ASTM Standards:*[2]

F3060 Terminology for Aircraft

F3061/F3061M Specification for Systems and Equipment in Small Aircraft

F3062/F3062M Specification for Aircraft Powerplant Installation

F3063/F3063M Specification for Aircraft Fuel and Energy Storage and Delivery

F3064/F3064M Specification for Aircraft Powerplant Control, Operation, and Indication

F3065/F3065M Specification for Aircraft Propeller System Installation

F3066/F3066M Specification for Aircraft Powerplant Installation Hazard Mitigation

F3114/F3114M Specification for Structures

F3116/F3116M Specification for Design Loads and Conditions

F3120/F3120M Specification for Ice Protection for General Aviation Aircraft

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

2.2 *FAA Standards:*[3]

AC23-16 Systems and Equipment Guide for Certification of Part 23 Airplanes and Airships

3. Terminology

3.1 The following is a selection of relevant terms. See Terminology F3060 for more definitions and abbreviations.

3.2 *Definitions:*

3.2.1 *capacity*—total amount between minimum and maximum condition (for example, empty and full).

[1] This specification is under the jurisdiction of ASTM Committee F44 on General Aviation Aircraft and is the direct responsibility of Subcommittee F44.40 on Powerplant.

Current edition approved Sept. 1, 2018. Published September 2018. DOI: 10.1520/F3239-18.

[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.

3.2.2 *electric propulsion unit (EPU)*—the EPU shall as a minimum consist of the electric motor, associated electronic controllers, disconnects, wiring, and monitoring gauges and meters.

3.2.2.1 *Discussion*—The EPU is an aircraft engine.

3.2.3 *energy distribution system*—a system that provides energy for propulsion from the energy storage systems to the propulsive units.

3.2.3.1 *Discussion*—The energy distribution system is considered equivalent to the fuel system on liquid hydrocarbon based powerplants.

3.2.4 *energy storage system (ESS)*—a source (component or system) that stores and provides energy that can be drawn upon for propulsion.

3.2.4.1 *Discussion*—Typical energy storage systems include but are not limited to batteries, fuel cell systems or capacitors and their integrated management systems, if installed. The energy storage system is considered equivalent to a fuel tank on liquid hydrocarbon based powerplants.

3.2.5 *quantity*—amount available at the time of measurement.

3.2.6 *usable energy capacity*—minimum capacity of an energy storage system between the defined fully charged and the minimum charge state which can be drawn upon at any rate up to maximum rated power of this energy storage system under any likely operating condition.

4. Powerplant Installation

4.1 *General:*

4.1.1 Each powerplant installation shall meet the applicable requirements of Specification F3062/F3062M.

4.1.2 Each propeller system shall meet the applicable requirements of Specification F3065/F3065M.

4.1.3 Each EPU shall meet the technical requirements of an accepted specification appropriate to the application.

5. Energy Distribution Systems

5.1 *General:*

5.1.1 Each energy distribution system shall meet the applicable requirements of Specification F3063/F3063M and F3316/F3316M.

5.1.2 Each energy distribution system shall safely provide sufficient power to each EPU under the most critical operating conditions.

5.1.3 The combined usable energy capacity of all energy storage systems shall be enough to maintain maximum continuous power of the EPU for a minimum of 30 minutes. For hybrid systems this may be accomplished with any combination of generation and energy storage.

NOTE 1—Operational rules for which the aeroplane is intended to be used may require greater endurance.

5.2 *Independence:*

5.2.1 For aeroplanes with multiple EPUs, the energy distribution system shall be designed so that, in at least one system configuration, the failure of any one component will not result in the loss of power of more than one EPU or require immediate action by the pilot to prevent the loss of power of more than one EPU.

NOTE 2—Refer to AC23-16 for guidance on the independence of energy distribution systems.

5.3 *Energy Storage System:*

5.3.1 *General:*

5.3.1.1 Each energy storage system shall meet the requirements of an accepted specification appropriate to the application.

5.3.1.2 Each energy storage system shall be installed in accordance with the applicable installation instructions.

5.3.1.3 Each energy storage system shall be designed to safely deliver the required power under the conditions specified in 5.1.2 when drawn upon.

5.3.2 *Installation:*

5.3.2.1 Each energy storage system shall be supported to withstand the vibration and inertia loads to which it may be subjected in operation.

5.3.2.2 Each energy storage system shall have access provisions for maintenance.

5.3.2.3 Design precautions shall be taken to minimize the hazards to the aircraft in the event of a fire or sudden discharge which could result in damage to components, structure, or flight controls near the storage area.

5.3.2.4 The energy storage system installation shall protect the occupants and the critical airframe and systems from a single cell thermal runaway.

5.3.3 *Compartments:*

5.3.3.1 Each energy storage system shall be ventilated and drained as necessary to prevent accumulation of hazardous, flammable, or corrosive fluids or vapors.

5.3.3.2 Each energy storage system shall be isolated from personnel compartments by an enclosure that is vented and drained to the exterior of the aeroplane.

5.3.3.3 Any enclosure required by 5.3.3.2 shall sustain any personnel compartment pressurization loads without permanent deformation or failure under the conditions defined in Specifications F3116/F3116M and F3114/F3114M.

5.3.3.4 For energy storage systems in compartments adjacent to fire zones there shall be sufficient clearance or insulation between the compartment and the firewall to prevent ignition or malfunction of the energy storage system as a result of fire in the fire zone.

5.3.4 *Energy Capacity:*

5.3.4.1 The usable energy capacity for each energy storage system shall be established.

5.3.4.2 The available remaining energy quantity information shall be provided.

5.3.5 *Charging System:*

5.3.5.1 The charging connection and system shall be designed to minimize hazards to personnel.

5.3.5.2 The charging connection shall be designed to ensure correct connection of the charging connector.

5.3.5.3 The charging system shall be designed to protect the aeroplane from a charging source with incorrect voltage including high voltage, low voltage, incorrect polarity, effects of shorting, and type of current (AC/DC).