Designation: F2911 – 14ε1

Standard Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)[1]

This standard is issued under the fixed designation F2911; 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.

ε[1] NOTE—Corrected title editorially in March 2014.

1. Scope

1.1 This standard defines the production acceptance requirements for a small unmanned aircraft system (sUAS).

1.2 This standard is applicable to sUAS that comply with design, construction, and test requirements identified in Specification F2910. No sUAS may enter production until such compliance is demonstrated.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F2585 Specification for Design and Performance of Pneumatic-Hydraulic Unmanned Aircraft System (UAS) Launch System

F2908 Specification for Aircraft Flight Manual (AFM) for a Small Unmanned Aircraft System (sUAS)

F2909 Practice for Maintenance and Continued Airworthiness of Small Unmanned Aircraft Systems (sUAS)

F2910 Specification for Design, Construction, and Test of a Small Unmanned Aircraft System (sUAS)

F3003 Specification for Quality Assurance of a Small Unmanned Aircraft System (sUAS)

F3005 Specification for Batteries for Use in Small Unmanned Aircraft Systems (sUAS)

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *manufacturer, n*—entity responsible for assembly and integration of components and subsystems to create a safe operating sUAS. The builder of kit built systems provided by a manufacturer must conform to the manufacturer's assembly and test instructions without deviation in order for that kit-built system to meet this standard.

3.1.2 *propulsion system, n*—consists of one or more power plants (for example, a combustion engine or an electric motor and, if used, a propeller or rotor) together with the associated installation of fuel system, control and electrical power supply (for example, batteries, electronic speed controls, fuel cells, or other energy supply).

3.1.3 *small unmanned aircraft system, sUAS, n*—composed of the small unmanned aircraft (sUA) and all required on-board subsystems, payload, control station, other required off-board subsystems, any required launch and recovery equipment, and command and control (C2) links between the UA and the control station. For purposes of this standard sUAS is synonymous with a small Remotely Piloted Aircraft System (sRPAS) and sUA is synonymous with a small Remotely Piloted Aircraft (sRPA).

3.1.4 *supplier, n*—any entity engaged in the design and production of components (other than a payload which is not required for safe operation of the sUAS) used on a sUAS.

3.1.4.1 *Discussion*—Where the supplier is not the manufacturer, the supplier can only ensure that the components comply with accepted consensus standards.

3.2 *Shall versus Should versus May*—Use of the word "shall" implies that a procedure or statement is mandatory and must be followed to comply with this standard, "should" implies recommended, and "may" implies optional at the discretion of the supplier, manufacturer, or operator. Since "shall" statements are requirements, they include sufficient detail needed to define compliance (for example, threshold values, test methods, oversight, reference to other standards). "Should" statements are provided as guidance towards the overall goal of improving safety, and could include only subjective statements. "Should" statements also represent parameters that could be used in safety evaluations, and could lead to development of future requirements. "May" statements

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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.

are provided to clarify acceptability of a specific item or practice, and offer options for satisfying requirements.

4. Applicability

4.1 This standard is written for all sUAS that are permitted to operate over a defined area and in airspace defined by a nation's governing aviation authority (GAA). It is assumed that a visual observer(s) will provide for the sense-and-avoid requirement to prevent collisions with other aircraft and that the maximum range and altitude at which a sUAS can be flown will be specified by the nation's GAA. Unless otherwise specified by a nation's GAA this standard applies only to UA that have a maximum take off gross weight of 55 lb/25 kg or less.

5. Requirements

5.1 *Production:*

5.1.1 *General:*

5.1.1.1 The manufacturer is responsible for a product that complies with accepted consensus standards at the time of delivery and is demonstrated as fit and safe for flight. For sUAS assembled from components provided by a supplier, the supplier shall provide detailed instructions to the manufacturer concerning the assembly and test of those components. The components supplied by a supplier shall include a declaration that the components have been designed and manufactured in accordance with an accepted consensus standard and that the components, when assembled, tested, and maintained in accordance with the supplier's instructions, meet the safety standards implied by the applicable consensus standards. If required by a nation's GAA, the manufacturer/supplier shall also comply with any requirements for compliance with any applicable technical standard orders for specific components or systems, or both.

5.1.1.2 The manufacturer is responsible for ensuring that the sUAS has been assembled in accordance with the component supplier's instructions and complies with Specification F2910.

5.1.1.3 *Compliance with Quality Assurance Standard*—Quality assurance shall be exercised across production in accordance with Specification F3003.

5.1.2 *Structure*—sUAS airframe structures shall meet the requirements specified in Specification F2910. sUAS structures using materials that have no applicable certified material characteristics shall be demonstrated to be suitable for the mission involved.

5.1.2.1 *Material procurement*—Components used shall be consistent and uncontrolled variation or substitution shall be avoided.

5.1.2.2 *Assembly practices*—Consistent, accepted practices and assembly using materials such as epoxy, CA cements, shall be applied in accordance with product supplier's data sheets for safety and acceptable results.

5.1.2.3 *Tooling*—Molds, tooling, and jigs shall be used that produce an airframe which conforms to the engineering design in terms of part fit, assembly tolerances, defect size, and other requirements documented in the design.

5.1.2.4 *Fastening and joining*—Mechanical components such as fittings, pushrods, rotor structures and fittings shall be properly secured using safety wire, thread locking adhesives, crimping, welding or other effective means of restraining mechanical components.

5.1.2.5 *Lubrication*—Where lubrication of fittings is used, the manufacturer shall ensure that the lubricant used is appropriate to the application, thermal range and predicted load.

5.1.3 *Propulsion:*

5.1.3.1 *Motor/engine mounting*—Consistent, accepted practices and assembly using materials such as epoxy, CA cements, and the like shall be applied in accordance with product supplier's data sheets for safety and acceptable results.

5.1.3.2 *Security*—Motor/engine/propeller mounting shall be verified to meet manufacturer/supplier specified torque levels and security.

5.1.3.3 *Dynamic balancing*—Prior to installation, propellers or rotors or rotor blades shall be statically and dynamically balanced per design specification.

5.1.3.4 *Propulsion batteries*—For electric propulsion systems, provisions in Specification F3005 shall apply.

5.1.4 *Systems*—Systems that can be shown not to be impacted by, or to impact on, other subsystems may be demonstrated independent of all-up functional verification of systems. For example, a launch sub system that has no interface with the flight control system may be demonstrated to meet functionality with an airframe or a dummy airframe.

5.1.5 *Payload:*

5.1.5.1 *Physical*—Payload(s) shall be mounted in the manner specified by the sUAS design or manufacturer's instructions (or both) with attention given to proper shock and vibration attenuations. Current draw from primary power systems (batteries, generators, and so forth) shall be verified during production and functionality of circuit protection and fusing shall also be verified. If the manufacturer allows payloads to be installed post-production, then specific requirements for the design installation, and test of these type payloads shall be specified in the aircraft flight manual developed in accordance with Specification F2908 or the maintenance and continued airworthiness documentation developed in accordance with Practice F2909. Maximum safe gross weight of the system shall be determined and payload weight shall not result in a gross weight that exceeds maximum determined safe gross weight.

5.1.5.2 *Effect on CG location*—Payloads shall be located as specified by the sUAS designer and center of gravity for each aircraft shall be verified with payload installed. This shall include center of gravity changes due to fuel consumption or in-flight offloaded payloads, or both.

5.1.5.3 *Accountability for system design changes*—No change in physical location of components may be made without engineering definition of the impact of such change on flight performance or electronic or electrical compatibility of command and control systems that are impacted by such change. Where a change in systems performance is predicted for such physical change, the change shall be validated to ascertain that system functionality will remain within specification limits. When such changes are made to accommodate issues such as unavailability of parts or material, those changes shall be documented in an engineering change order (ECO)