Designation: F2910 – 22

# Standard Specification for Design and Construction of a Small Unmanned Aircraft System (sUAS)[1]

This standard is issued under the fixed designation F2910; 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 defines the design, construction, and test requirements for a small unmanned aircraft system (sUAS).

1.2 *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.*

1.3 *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]

F2908 Specification for Unmanned Aircraft Flight Manual (UFM) for an Unmanned Aircraft System (UAS)

F2909 Specification for Continued Airworthiness of Lightweight Unmanned Aircraft Systems

F2911 Practice for Production Acceptance of Small Unmanned Aircraft System (sUAS)

F3002 Specification for Design of the Command and Control System for Small Unmanned Aircraft Systems (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)

F3060 Terminology for Aircraft

F3341/F3341M Terminology for Unmanned Aircraft Systems

## 3. Terminology

3.1 *Unique and Common Terminology*—Terminology used in multiple standards is defined in F3341/F3341M, UAS Terminology Standard and F3060, Aircraft Terminology Standard. Terminology that is unique to this specification is defined in this section.

3.1.1 *continued safe flight, n*—a condition whereby a UA is capable of continued safe flight, possibly using emergency procedures, without requiring exceptional pilot skill. Upon landing some UA damage may occur as a result of a failure condition.

3.1.2 *launch and recovery load, n*—those loads experienced during normal launch and recovery of the UA.

3.1.3 *limit load, n*—those loads experienced in the normal operation and maintenance of the UA.

3.1.4 *manufacturer, n*—entity responsible for assembly and integration of components and subsystems to create a safe operating sUAS.

3.1.5 *permanent deformation, n*—a condition whereby a UA structure is altered such that it does not return to the shape required for normal flight.

3.1.6 *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).

3.1.7 *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 sUA 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).

3.1.8 *structural failure, n*—a condition whereby the structure is not able to carry normal operating loads.

[1] This specification is under the jurisdiction of ASTM Committee F38 on Unmanned Aircraft Systems and is the direct responsibility of Subcommittee F38.01 on Airworthiness.

Current edition approved Oct. 1, 2022. Published December 2022. Originally approved in 2014. Last previous edition approved in 2014 as F2910–14. DOI: 10.1520/F2910-22.

[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.

3.1.9 *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.

3.1.9.1 *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 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 authorized 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 the sUAS can be flown at 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 takeoff gross weight of 55 lb/25 kg or less.

## 5. Requirements

5.1 *General:*

5.1.1 The sUAS shall be designed and constructed to meet sUAS limitations and performance capabilities required by the nation's GAA.

5.1.2 The sUA shall be designed and constructed so that the maximum level flight speed cannot exceed the maximum airspeed authorized by the nation's GAA. In addition, the maximum level flight airspeed should not exceed an airspeed that would prevent the sUA from remaining within the confines of the defined operational area without excessive maneuvering or exceptional pilot skill.

5.1.3 The sUAS shall be designed using appropriate and reasonable engineering design and verification techniques. Test shall be conducted in accordance with section 5.11 to verify that the design requirements have been satisfied and the results of the tests recorded and available for future reference.

5.1.4 The sUAS shall be designed and constructed to initialize in a known, safe state when power is applied.

5.1.5 The sUA should be designed and constructed to minimize the likelihood of fire, explosion, or the release of hazardous chemicals, materials, and flammable liquids or gasses, or a combination thereof, in flight or in the event of a crash, hard landing, or ground handling mishap. This includes, but is not limited to: containing the fire if the sUA crashes; protecting first responders from hazards at the crash site; use of flame resistant materials; suppression of in-flight fires; and protection against battery-induced fires.

5.1.6 During the design process, the manufacturer shall determine the permissible range of weight and positions of the center of gravity of the sUA. The sUA shall then be designed and constructed to ensure that the center of gravity remains within this permissible weight and range for all intended payloads, fuel, batteries, and other onboard items. If removing/adding ballast is permitted, the sUAS aircraft flight manual shall include instructions with respect to loading, marking, and securing of removable ballast and ensuring the center of gravity remains within limits that can be controlled by the control system and ensures adequate aerodynamic stability. The aircraft flight manual shall have a method to verify or calculate CG location.

5.1.7 During the design process, the manufacturer shall determine the maximum takeoff gross weight and minimum operational empty weight for the sUA.

5.1.8 The sUAS should be designed and constructed to minimize injury to persons or damage to property during operation.

5.1.8.1 Designs that use exposed, rigid sharp structural objects should be minimized. For those systems that might have components capable of causing injury due to misuse or mishandling, a warning/caution statement should be added to the aircraft flight manual alerting the crew to the risk.

5.1.8.2 The sUA shall be designed so that the sUA will remain controllable and predictable or capable of performing a safe recovery maneuver in the event of asymmetric deployment of any single, normal control surface as well as high-lift/drag devices (trailing edge flaps, leading edge flaps or slats, spoilers, flaperons, and the like).

5.1.9 The sUA shall be designed and constructed so that all fasteners will remain secure over the operational and environmental range of flight conditions.

5.1.10 The sUA should be designed and constructed so that it is possible to determine quickly that all doors, panels, and hatches that can be opened are secured before takeoff.

5.1.11 *Construction*—In addition to construction requirements specified above:

5.1.11.1 The sUAS should incorporate materials that have the strength, corrosion resistance, and durability characteristics appropriate to the application in the design.

5.1.11.2 Energy absorbing structure should be used wherever possible.

5.1.11.3 Material strength design properties should be based on analysis or testing, or both, determined by the manufacturer/supplier that confirms these material strength design properties have been achieved. Documentation of this analysis or testing, or both, should be recorded and available at either the manufacturer's or supplier's location (as appropriate) for future reference.

5.2 *Structure:*

5.2.1 The sUA structure shall be designed and constructed so that: