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Standard Specification for Verification of Lightweight Unmanned Aircraft Systems (UAS)¹

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1. Scope

1.1 This specification covers the airworthiness requirements for the design of light unmanned aircraft systems. This specification defines the baseline verification requirements for an unmanned aircraft system (UAS).

1.2 As a minimum, a UAS is defined as a system composed of the unmanned aircraft and all required on-board subsystems, payload, control station, other required off-board subsystems, any required launch and recovery equipment, all required crew members, and command and control (C2) links between UA and the control station.

1.3 The intent is for this standard of practice for CAA, self- or third-party determinations of airworthiness for UAS. This specification provides the core requirements for airworthiness certification of lightweight (UAS) for certain CAA operational approvals using risk-based categories. Additional requirements are envisioned to address the requirements for expanded operations and characteristics not addressed by this specification.

1.4 This specification is intended to support UAS operations. It is assumed that the risk of UAS will vary based on concept of operations, environment, and other variables. The fact that there are no human beings onboard the UAS may reduce or eliminate some hazards and risks. However, at the discretion of the CAA, this specification may be applied to other UAS operations.

1.5 *Units*—The values in Imperial units are to be regarded as the standard. The values in SI are for information only.

1.6 *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.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standard-*

ization 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

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

F3060 Terminology for Aircraft

F3120/F3120M Specification for Ice Protection for General Aviation Aircraft

F3201 Practice for Ensuring Dependability of Software Used in Unmanned Aircraft Systems (UAS)

F3298 Specification for Design, Construction, and Verification of Lightweight Unmanned Aircraft Systems (UAS)

F3341/F3341M Terminology for Unmanned Aircraft Systems

F3478 Practice for Development of a Durability and Reliability Flight Demonstration Program for Low-Risk Unmanned Aircraft Systems (UAS) under FAA Oversight

2.2 ANSI Standard:³

ANSI Z535.1-1998 American National Standard for Safety Colors

2.3 FAA Standard:⁴

Order 8130.34D Airworthiness Certification of Unmanned Aircraft Systems and Optionally Piloted Aircraft

2.4 Federal Standard:⁵

14 CFR Part 107 Small Unmanned Aircraft Systems

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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, <http://www.faa.gov>.

⁵ Available from U. S. Government Accountability Office (GAO), 441 G St., NW, Washington, DC 20548, <http://www.gao.gov>.

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.

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- 2.5 *Joint Authorities for Rulemaking of Unmanned Systems*:⁶
CS-LURS Certification Specification for Light Unmanned Rotorcraft Systems
CS-LUAS Recommendations for Certification Specification for Light Unmanned Aeroplane Systems
- 2.6 *Unmanned Systems Canada Best Practices*:⁷
Small Remotely Piloted Aircraft System (UAS) Best Practices for BVLOS Operations

3. Terminology

3.1 *Unique and Common Terminology*—Terminology used in multiple standards is defined in Terminology **F3341/F3341M** and Terminology **F3060**.

3.2 Terminology that is unique to this specification is defined in this section.

3.3 This specification uses terminology contained within Specification **F3298**. These terms are not duplicated within this document.

3.4 Abbreviations:

- 3.4.1 *ADS-B*—automatic dependent surveillance broadcast
 3.4.2 *AR*—aspect ratio
 3.4.3 *AFCS*—automated flight control system

4. Significance and Use/Applicability

4.1 This specification is intended for lightweight UAS permitted to operate over a defined area and in airspace authorized by a nation's civil aviation authority (CAA) with a fully interactive off-board person as "Remote Pilot in Command."

4.2 The baseline covered by this specification should not require an authorization by a civil aviation authority for the flight but stay within defined boundaries for the operation (for example, distance from airports, from people, maximum weight, altitude, airspeed and operational envelope). However, unless otherwise allowed by a nation's CAA or subject to voluntarily compliance by an applicant, this specification applies to UA that are remotely piloted (that is, flown without the possibility of direct human intervention from within or on the aircraft), and conduct expanded operations that typically require authorization from the CAA (for example, Operations Authorization for Specific Category UAS or Part 107 Certificate of Waiver/Authorization) with specific limitations adapted to the operation.

4.3 These requirements apply to unmanned aircraft systems that are:

- 4.3.1 *Fixed-Wing*—Heavier than air and supported in flight by the dynamic reaction of the air against its wings. The UA may be powered or unpowered; the UA may have rigid, semi-rigid, or flexible wings.
 4.3.2 *VTOL*—Heavier than air and capable of vertical or near-vertical takeoffs and landings. The rotor system may be

powered or unpowered; rotors may be either fixed collective pitch or collective pitch control that are not adjustable in flight. Reference 3.1.52 for characteristics by category of vertical flight aircraft.

4.3.3 Hybrid UAS (that is, incorporating gyrodyne or powered-lift flight modes) are recommended to follow the most restrictive aspects of this specification.

5. Flight

5.1 Proof of Compliance:

5.1.1 Each applicant who claims compliance to this specification shall be able to show compliance with the applicable requirements of this specification.

6. Operating Limitations and Information

6.1 During the verification process, the applicant shall determine and document in the aircraft flight manual appropriate operating limitations and other information necessary for safe operation of the system. This shall include any wind limitations as well as features of the control station and the C2 link functions of the system.

6.2 Weight and Center of Gravity:

6.2.1 During the verification process, the applicant shall determine and document weight and loading distribution, including the maximum certificated weights and the center of gravity (CG) range.

6.2.2 The applicant shall determine the location of the reference datum used in balance computations.

6.3 Propulsion System Limitations:

6.3.1 The propulsion limitations portion describes operating limitations on an aircraft's reciprocating or electric engine(s).

6.3.2 These include limitations for takeoff power, maximum continuous power, and maximum normal operating power, which is the maximum power the engine can produce without any restrictions, and any other limitations specified in the OEM engine/motor installation manual.

6.4 Electromagnetic Environmental Effects:

6.4.1 The UAS should be verified with an operational envelope that contains a specific external High Intensity Radio Frequency (HIRF) environment.

7. Documentation

7.1 Verification Control:

7.1.1 The documentation of an unmanned aircraft consists of at least the following:

7.1.1.1 The drawings and specifications, and a listing of those drawings and specifications necessary to define the configuration of the UA shown to comply with this specification.

7.1.1.2 Information on dimensions, materials, and processes necessary to define the structural strength of the UA.

7.1.1.3 Any other data necessary to allow, by comparison, the determination that later UA of the same or similar design meet the requirements of this specification.

7.1.2 The manufacturer shall retain documentation of appropriate verification results including data showing compliance with this specification.

⁶ Available from Joint Authorities for Rulemaking of Unmanned Systems (JARUS), <http://www.jarus-rpas.org>.

⁷ Available from Unmanned Systems Canada, PO Box 81055, Ottawa, Ontario, K1P 1B1, <https://www.unmannedsystems.ca>.