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Standard Guidance for Space Data Exchange to Support Integration of Space Operations into Air Traffic Management¹

This standard is issued under the fixed designation F3514; 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 guidance focuses on data exchange between space operators and the U.S. Federal Aviation Administration (FAA) for Air Traffic Management (ATM) operations during FAA-licensed launches and reentries.

1.2 This guidance does not apply to licensing or regulatory purposes, nor to the tracking of payloads, such as satellites.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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.*

1.5 *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 *ASTM Standard:*²

F3377 Terminology Relating to Commercial Spaceflight

2.2 *Code of Federal Regulations:*³

14 CFR §401.107 Definitions

2.3 *FAA Documents:*

**CSINAS Commercial Space Integration into the National
Airspace System: Concept of Operations**⁴

JO 7210.3BB Facility Operation and Administration⁵

3. Terminology

3.1 *Definitions*—See Terminology **F3377**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *hazard volume, n*—an airspace volume to protect nonparticipating aircraft from a launch vehicle, reentry vehicle, amateur rocket, jettisoned stages, hardware, or falling debris generated by failures associated with launches or reentries.

3.2.2 *National Airspace System (NAS), n*—the airspace, navigation facilities, and airports of the United States, along with their associated information, services, rules, regulations, policies, procedures, personnel, and equipment. It includes components shared jointly with the military.

3.2.3 *reentry, n*—the return of a spacecraft or missile into the earth's atmosphere.

3.2.4 *space operator, n*—the operator of the launch or reentry vehicle.

3.2.5 *traffic management initiative (TMI), n*—air traffic management techniques used to manage demand with capacity in the NAS.

4. Applicability

4.1 This guidance applies to all vehicle traffic launching into suborbital and orbital altitudes and reentries.

4.2 This guidance can be adapted to provide similar guidance for other air navigation service providers (ANSPs) looking to exchange data with space operators.

¹ This guidance is under the jurisdiction of ASTM Committee **F47** on Commercial Spaceflight and is the direct responsibility of Subcommittee **F47.05** on Cross-Cutting.

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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.

³ Available from U.S. Government Publishing Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401, <https://www.ecfr.gov/>.

⁴ Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, https://www.faa.gov/space/airspace_integration/media/Final_CSINAS_ConOps.pdf.

⁵ Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1036232.

4.3 The workgroup reached out to the FAA to inquire about what data it needs from industry for ATM operations and also used operational experience working with the FAA and other available documents to identify data that could help the FAA better integrate launches and reentries into ATM.

4.4 It is expected that this guidance will be updated as industry and FAA gain additional experience and lessons learned about data exchange for launch and reentry missions.

5. Guidance for Data Exchange

5.1 General:

5.1.1 Data exchange between space operators and the FAA is necessary to maintain safety and improve launch and reentry operations in the NAS. This includes the sharing of data from the FAA to space operators and vice versa.

5.1.2 As described in the FAA’s vision for commercial space integration (see CSINAS), the FAA is envisioning more real-time data exchange to support the integration of commercial space operations including data that may not be currently required for obtaining a license, such as real-time state vectors.

5.1.3 The vision in CSINAS also describes data exchange for pre-operational planning and post-operations including capabilities/concepts, such as “file and fly” and a planning portal. At the time of this writing, the FAA is still developing these concepts and investigating data exchange needs for pre-operational planning and post-operations. Since that work is still very early compared to the FAA’s work on real-time data exchange, this guidance document currently focuses on real-time data exchange.

5.1.4 Space operators shall follow available and applicable FAA data exchange requirements for launches and reentries. It is encouraged that the FAA collaborate and engage with space operators to define these requirements.

5.1.5 Data exchange should be based on electronic communications, when possible. The use of automation to send, receive, and process the data is encouraged.

5.1.6 Spaceports or other third-party service providers can play a supporting role in this data exchange. For example, they can become an intermediary between space operators and the FAA, or aggregate data from multiple space operators.

5.1.7 Where possible, sending and receiving data between the FAA and space operators should be in an Extensible Markup Language (XML)-based format.

5.1.8 Time in data messages should be represented in Coordinated Universal Time (UTC), when possible, unless otherwise specified below.

5.2 *Data Types*—The following provides a high-level description about the types of data exchange that can help maintain safety and improve operations in the NAS during launches and reentries.

5.2.1 *State Vector Data*—State vector data describes the position and speed of the tracked vehicle and major vehicle components that need to be monitored by the FAA during the mission as they transit through the NAS (not while in orbit). Generally, these are rocket stages, capsules, or other objects if they are transmitting a unique state vector, such as fairing halves, capsule trunk, etc. Update rate on trajectory data should be provided at an average of 1 Hz or other agreed upon rate

between the space operator and the FAA. Useful state vector data are described in 5.2.1.1 – 5.2.1.3.

5.2.1.1 *Time*—Time when the tracked object reports its trajectory information. Data source: space operator; Format: UNIX Epoch.

5.2.1.2 *Position*—Object’s position given in geodetic Earth-Centered, Earth-Fixed or North-East-Down x , y , and z coordinates. Data source: space operator; Format: see FAA “SDI_Common_LRO_ICD_2.2.”⁶

5.2.1.3 *Velocity*—Object’s velocity given in geodetic Earth-Centered, Earth-Fixed, or North-East-Down x , y , and z coordinates. Data source: space operator; Format: see FAA “SDI_Common_LRO_ICD_2.2.”⁶

5.2.2 *Mission Event Triggers*—Key mission events are those that help the FAA gain more certainty about a launch/reentry time or signify a need to implement/modify certain airspace management methods. Examples of mission event triggers include initiation of flight, reusable stage separation and return, and specific launch preparation activities (such as liquid oxygen loading) that narrows launch windows. These are sometimes listed in the ready-for-release 15-day document (R-15) for orbital flights, but are always identified through discussions between the FAA and the space operator for that mission type.

5.2.3 *Communication Health Status*—Status about the communication link between the space operator and the FAA, and between the space operator and their launch or reentry vehicle (for example, loss of signal between the space operator and their vehicle).

5.2.4 *Anomaly and Emergency Information*—According to JO 7210.3BB, letters of agreement (LOAs) exist between air traffic control (ATC) facilities and commercial space launch/reentry sites, and space operators. Appendix 6 of JO 7210.3BB provides guidance for the development of these commercial space LOAs and sample text. Section 5 of Appendix 6 in JO 7210.3BB states that the LOA “Specify procedure(s) for handling anomalies and emergencies. Information conveyed should include the location of event (latitude and longitude, represented as degree–minute–second), vehicle state, projected time the hazard will no longer be present, and any other pertinent details.” The sample LOA text describes the type of information (for example, last known vehicle state and event location, and predicted location and duration of impacted airspace (when known)) that must be communicated to the FAA during an emergency or anomaly including “Other information that will provide estimated positions of hazards.” The data descriptions in 5.2.4.1 – 5.2.4.4 can help provide more structure when communicating this information to the FAA.

⁶ “SDI_Common_LRO_ICD_2.2,” FAA, Washington, D.C., 2020. This interim interface control document (ICD) is based on an FAA operational prototype capability called Space Data Integrator Minimum Viable Product (SDI MVP), which the FAA is using to collect data for decision support while further refining operational data needs as the industry evolves. The ICD is stable and not anticipated to change in the next year. Any changes are expected to be coordinated in advance. It can be obtained by contacting the Manager of Space Integration in the FAA’s Program Management Office, Space Integration Team (AJM-225) through your FAA representative.