



ADVANCING STANDARDS
TRANSFORMING MARKETS

EMERGING AIRSPACE

HEALTH AND SAFETY

ADVANCED MANUFACTURING

BUILT ENVIRONMENT AND INFRASTRUCTURE SYSTEMS

CLEAN ENERGY AND DECARBONIZATION TECHNOLOGY

Standardization Impact Report

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Emerging Airspace



RELEVANT ASTM COMMITTEES

Committee F37 on Light Sport Aircraft
Committee F38 on Unmanned Aircraft Systems
Committee F39 on Aircraft Systems
Committee F44 on General Aviation Aircraft
Committee F46 on Aerospace Personnel
Committee F47 on Commercial Spaceflight

Airspace has been a pillar of global industry since the 20th century. Nevertheless, this area is still undergoing significant industrial growth and technological change. Commercial space missions are now available, and aircraft are being designed and manufactured with autonomous and advanced mobility technology. Aircraft manufacturers are also changing common practices and standards to make aircraft more sustainable.

Despite promising advancements, these technologies are not yet mature. Commercial spaceflight comes with increased health risks for passengers, and unmanned aircraft systems have outpaced existing regulations. New standards can help consumers feel more comfortable taking flights that utilize these technologies, and manufacturers can facilitate their production and usage with confidence.



Emerging Airspace

Commercial Spaceflight

Commercial spaceflight has two major emerging application areas: high-speed, point-to-point flights via space and space tourism. Both areas present major new market opportunities, with point-to-point spaceflight in particular offering the potential to dramatically increase the ease and speed with which people and goods move around the globe. However, these possible benefits are balanced by increased health and safety risks and a need for new standards and regulations to safeguard passengers.

FUTURE OF COMMERCIAL SPACEFLIGHT



ASTM NEWS STORIES

- [Classification of Commercial Spaceflight Safety Events](#)
- [New Standard Will Aid in Classification of Commercial Spaceflight Safety Events](#)
- [Design of Orbital and Suborbital Space Vehicles](#)
- [Passenger Medical Qualifications](#)
- [Return to Space](#)
- [Safety of Suborbital Vehicles](#)
- [New Commercial Spaceflight Standard Supports Safety of Suborbital Vehicles](#)
- [The Launch of a New Era for Space](#)
- [Standards in Zero Gravity](#)
- [How Commercial Spaceflight is Propelled by Safety Standards](#)
- [Spaceflight Standards for a New Era](#)
- [Case Study on Standards: Aircraft Braking Measurement](#)
- [Spacecraft Vehicle Types](#)

MARKET SIZE

High speed travel via outer space, which will compete with long-distance airline flights, has an estimated annual market value of at least \$20B.¹ The space tourism industry is expected to be a \$3B² market by 2030.

MARKET GROWTH

Innovations in space tourism are expected to drive growth in the broader space industry to a value of \$805B by 2030—or more than double the value over an 11-year period.³ Another projection suggests the space tourism industry may grow to more than \$1T by 2040.⁴

EXTREME REDUCTION IN TRAVEL TIME

By traveling at higher altitudes with reduced atmospheric friction, commercial spacecraft could travel a distance comparable to a 10-hour airline flight in less than an hour.⁵

INCREASED HEALTH HAZARDS

Space travel exposes passengers to extreme environmental conditions such as radiation, acceleration, and microgravity; consequently, it presents greater risks to physiological and psychological health compared to traditional airline flights, as well as increased safety risks.⁶

LACK OF REGULATION

Regulations for passenger safety in commercial spaceflight are largely absent due to a regulatory moratorium preventing the Federal Aviation Administration (FAA) from regulating “spaceflight passenger safety or [certifying] the safety of commercial spacecrafts” until late 2023, which was intentionally designed to give the industry time to mature.⁷

NEED FOR PREVENTIVE ACTION ON SAFETY

As the moratorium nears its end and industry begins to take the first commercial passengers into space, establishing safety regulations preemptively—ahead of a major passenger safety incident—may be key to increasing public confidence in the commercial spaceflight industry.⁸

OPPORTUNITY FOR STANDARDS

Congress may consider whether the federal government should adopt voluntary standards to regulate the safety of commercial spacecraft with humans onboard.⁹

U.N. Sustainable Development Goals Supported



Emerging Airspace

Commercial Spaceflight

ASTM IMPACT ACTIVITY

Commercial Spaceflight Federation (CSF)

Through partnership with the CSF, ASTM consistently receives updates on industry advancements, member concerns/challenges, policy goals, and more. This information helps ASTM set strategic objectives and share information with those responsible for evaluating new activities, prioritizing standards-development efforts, and identifying gaps.

ASTM IMPACT ACTIVITY

FAA Office of Commercial Space Transportation (AST)

ASTM International's committee on commercial spaceflight (F47) actively engages with the FAA's Office of Commercial Space Transportation (AST) to develop industry safety standards and evaluate how ASTM standards can be used as a way to ensure compliance.

ASTM IMPACT ACTIVITY

Commercial Space Transportation Advisory Committee (COMSTAC)

F47's proactive engagement with COMSTAC positions ASTM as the world's leading SDO for the development of human spaceflight standards. Members of COMSTAC depend on regular updates from F47 to assist with the creation of safety frameworks for Congress to prepare for future regulatory action.

RELEVANT ASTM STANDARD

Standard Classification for Space Launch and Reentry Vehicles

[F3388](#)

F47's proactive engagement with COMSTAC positions ASTM as the world's leading SDO for the development of human spaceflight standards. Members of COMSTAC depend on regular updates from F47 to assist with the creation of safety frameworks for Congress to prepare for future regulatory action.

RELEVANT ASTM STANDARD

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

[F3514](#)

This guidance focuses on data exchange between space operators and the FAA for air traffic management (ATM) operations during FAA-licensed launches and reentries.

RELEVANT ASTM STANDARD

Standard Classification for Descriptions of Spaceport Capabilities

[F3610](#)

This classification provides voluntary guidance for spaceports to provide information about their capabilities, systems, restrictions, and other information for use by customers and potential customers.

RELEVANT ASTM STANDARD

Standard Guide for Medical Qualifications for Suborbital Vehicle Passengers

[F3568](#)

This standard will help the commercial spaceflight industry agree on common medical considerations that should be reviewed prior to flights. This will be used by operators and passengers to understand the basic medical questions to consider prior to flying.

RELEVANT ASTM STANDARD

Guide for Occupant Survivability in Orbital Vehicles

[F3668](#)

This guide is focused upon the design and operational capabilities necessary to support flight crew survivability when failure tolerance has been exhausted.

STANDARD IN PROGRESS

Standard Practice for Safe Operating Practices In-Space for Space Fission Reactors Used for Nuclear Power and Propulsion

[WK86387](#)

The scope of this standard is to develop a codified, consensus state-of-practice that can be used as a benchmark by the developers, analyzers, and evaluators of space reactors when assessing and assuring safety during in-space reactor operations.

Emerging Airspace

Advanced Air Mobility

Electric vertical take-off and landing (eVTOL) vehicles have the capability to take off and land in urban environments and are envisioned to allow rapid, zero-emission transport of passengers and goods. Potential applications of this technology include commercial air taxis, cargo delivery, inner-city travel, and agriculture, as well as emergency services, military use, and recreation. eVTOL technology is still under development and faces regulatory and logistical hurdles. However, several eVTOL manufacturers have stated that they expect to launch commercial operations of eVTOLs for passenger and cargo transportation as early as 2024.^{10,11}

FUTURE OF ADVANCED AIR MOBILITY VEHICLES



ASTM NEWS STORIES

- Building the Standards Launch-Pad for Emerging Airspace Industries
- Hybrid-Electric Powerplant Design
- New ASTM International Standard Supports Vertiport Design and Development for Advanced Air Mobility
- Making Autonomous Flight a Reality
- Standards Shape the New Age in Air Travel
- Parachute Standard Supports a Safe Landing
- Vertiport Standards Take Off
- White Paper on Autonomy in Aviation

ADDITIONAL RESOURCES

- [TR1-EB Autonomy Design and Operations in Aviation: Terminology and Requirements Framework](#)
- [TR2-EB Developmental Pillars for Increased Autonomy for Aircraft Systems](#)
- [TR3-EB Regulatory Barriers to Autonomy in Aviation](#)
- [Roles and Responsibilities for Operational Control in the Age of Increasingly Autonomous Flight White Paper](#)

MARKET GROWTH

A study from Fortune Business Insights sees the global commercial drone market value reaching \$47.38 billion by 2029 at a CAGR of 28.58% over a 2022-2029 forecast period. Other studies see the market reaching up to \$217 billion by 2028 at a CAGR of 56.4% over a 2022-2028 forecast period.^{12,13}

PILOTLESS EVTOL TRAVEL

Certification Will Be Challenging. The vast majority of eVTOL startups will begin with human pilots before transitioning to fully autonomous flights.¹⁴ While some companies have initiated the certification process with the FAA for piloted eVTOLs, significant challenges are expected for the certification of autonomous AAM vehicles.¹⁵

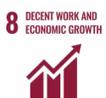
Critical for Cost Competitiveness. Achieving full autonomy is a critical requirement for reducing the average cost per mile of eVTOLs to economically compete with automotive ride-share services.¹⁶

ZERO-EMISSION AIR TRAVEL

Promising Option for Sustainability. One of the major goals driving the advancement of electric aviation across the globe is to reduce emissions.¹⁷ eVTOLs could be a first-mover technology in the push toward zero-emission air travel.¹⁸

Lowering Emissions Across Multiple Sectors. eVTOLs have the potential to lower the carbon cost of varied application areas such as public safety operations, humanitarian aid, inspections of infrastructure, and remote sensing.¹⁹

U.N. Sustainable Development Goals Supported



Emerging Airspace

Advanced Air Mobility

ASTM IMPACT ACTIVITY

ASTM International's Strategic
Administrative Committee AC377

AC377 works to ensure that aviation regulations are compatible with autonomous systems and comprise members from ASTM's committees on light sport aircraft (F37), unmanned aircraft systems (F38), aircraft systems (F39), general aviation aircraft (F44), and aerospace personnel (F46).

The committee examines autonomy in all aspects of aviation including the design and operations of these vehicles including airplanes, air taxis, or eVTOLs, and drones.

RELEVANT ASTM STANDARD

Standard Specification for
Vertiport Design

F3423

This specification establishes minimum standards for vertiports and vertistops on which aircraft capable of vertical takeoff and landing may safely operate.

STANDARD IN PROGRESS

Standard Specification for Vertiport
Automation Supplemental
Data Service Provider (SDSP)
Performance

WK85153

This specification defines performance-based standards for vertiport automation supplemental data service provider (SDSP) data and services to UAS service suppliers/providers (USS/USP), operators in a UAS traffic management (UTM) and provider of services for UAM (PSU) ecosystem.

Emerging Airspace

Unmanned Aircraft Systems (UAS)

Unmanned aircraft systems (UAS) are controlled remotely or autonomously. They have a broad range of applications, including filming, package delivery, meteorological research, aerial surveillance, mapping, monitoring, and inspection, and search and rescue. UAS can also be used to perform tasks in environments that would be hazardous to human pilots, such as areas that are unstable, difficult to access, or contaminated with toxins or radiation.²⁰ In recent years, UAS have seen significant advancements in beyond visual line of sight (BVLOS) capabilities, which allow drones to fly beyond the visual distance of operators.²¹ FAA convened an Aviation Rulemaking Committee (ARC) on BVLOS drones to develop rules for these operations and currently requires a waiver for BVLOS flights.²²

FUTURE OF UNMANNED AIRCRAFT SYSTEMS



ASTM NEWS STORIES

- Charting the Future of Drone Delivery
- Training and Certification Help Improve Aircraft Safety
- Security Framework for Uncrewed Aircraft Systems
- The Sky Is the Limit: The Future of Unmanned Aircraft Systems
- A New Era for UAS Standards
- Standards Enable the Future of Drone Operations
- Traffic Management Requirements for Drones
- Safer Skies
- Standards Up in the Air
- Subcommittee on UAS Infrastructure

MARKET GROWTH

The global commercial drone market had an estimated value of \$14.82B in 2021 and is projected to reach \$217B by 2028.²³ A different projection claims this market will grow from \$8.15B in 2022 to \$47.38B by 2028.²⁴

PRIVACY AND SAFETY CONCERNS

The ability of UAS to operate in lower altitude airspace raises concerns about safety,²⁵ privacy, data protection security, data sharing, and surveillance.²⁶

REGULATIONS LAGGING BEHIND TECHNOLOGY

UAS technology development has outpaced the regulatory landscape for jurisdictions worldwide. The FAA's BVLOS ARC recently concluded that the current aviation regulatory framework is unable to accommodate existing UAS operations.²⁷

STRATEGIES FOR SAFER AND MORE SECURE UAS BVLOS OPERATIONS.

The development of Detect and Avoid (DAA)²⁸ and Command, Control, and Communications (C3)²⁹ technologies will help to accelerate FAA efforts to certify BVLOS operations for drones. DAA uses sensors to help UAS avoid collisions, while C3 enables secure communications between UAS and ground-based pilots and air traffic control.

UAS TRAFFIC MANAGEMENT (UTM) INFRASTRUCTURE.

UTM—a UAS analog of Air Traffic Control (ATC)—is under development to enable the safe and secure management of low-altitude uncontrolled drone operations.³⁰

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8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



Emerging Airspace

Unmanned Aircraft Systems (UAS)

ASTM IMPACT ACTIVITY

National Center for Aircraft Technician Training (NCATT) Certification

ASTM's National Center for Aircraft Technician Training (NCATT) Certification provides training and certifications to foster safety and professionalism in the aerospace workforce.

ASTM's committee on aerospace personnel (F46) currently supports the development of technical standards and updates and maintains the ASTM NCATT certification program. ASTM's NCATT program recently endorsed the Unmanned Aircraft Systems Certification for advanced aerospace technicians working in UAS maintenance.

ASTM IMPACT ACTIVITY

How to Use ASTM F3586 Remote ID Means of Compliance for FAA Regulation 14 CFR Part 89 – eLearning Course

F3586

This course is intended to introduce how to use F3586 to comply with FAA Regulation 14 CFR Part 89. Throughout the course, subsections of F3411, are highlighted.

ASTM IMPACT ACTIVITY

Subcommittee on Infrastructure

F38.04

The mission of the new subcommittee is to identify, evaluate, and establish best practices for the design, construction, and maintenance of UAS infrastructure. This included landing and takeoff zones, charging and refueling stations, and data communications systems.

ASTM IMPACT ACTIVITY

Subcommittee on Autonomous and Electric Aircraft Maintenance Personnel

F46.06

This subcommittee develops and maintains international standards and guidance for endorsement level requirements for the education, training and certification of aerospace personnel working in electric powered and electric propulsion aircraft.

RELEVANT ASTM STANDARD

Standard Guide for Unmanned Aircraft System Maintenance

F3600

This guide is used to assess competencies of qualified individuals who wish to become certified as a UAS technician through a certification program.

RELEVANT ASTM STANDARD

Standard Specification for Remote ID and Tracking

F3411

This specification covers the performance requirements for remote identification (Remote ID) of UAS. Remote ID allows governmental and civil identification of UAS for safety, security, and compliance purposes. The objective is to increase UAS remote pilot accountability by removing anonymity while preserving operational privacy for remote pilots, businesses, and their customers. Remote ID is an enabler of enhanced operations such as beyond visual line of sight (BVLOS) operations as well as operations over people.

RELEVANT ASTM STANDARD

Standard Practice for Remote ID Means of Compliance to Federal Aviation Administration Regulation 14 CFR Part 89

F3586

This practice provides a means of compliance (MOC) that gives sufficient clarity to the UAS or broadcast module manufacturers to produce a compliant remote ID systems (RIDS) such that submitting a Declaration of Compliance to this MOC will satisfy the requirements of FAA 14 CFR Part 89 rule. This practice also explains what to expect from aircraft operating in compliance to this MOC.

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Unmanned Aircraft Systems (UAS)

RELEVANT ASTM STANDARD

Standard Specification for UAS
Traffic Management (UTM)
UAS Service Supplier (USS)
Interoperability

F3548

This global specification provides components that may be used to satisfy requirements expected to be common to many UTM-related regulations. This specification is not intended to comprehensively address all aspects of any particular UTM-related regulation or concept of operations. Similarly, because varying terminology for the same concept is frequently used across different regulations, readers should not expect an exact terminology consistent with any particular UTM-related regulation.

RELEVANT ASTM STANDARD

Standard Test Method for
Assessing the Safety of Small
Unmanned Aircraft Impacts

F3389

This test method is used for assessing the safety of small UAS impacts on people on the ground during operations that involve flight over people.

It provides a framework for creating new designs and evaluating existing designs to determine blunt-force trauma injury potential to the head or neck, or both, during a collision with a person on the ground.

RELEVANT ASTM STANDARD

Standard Specification for Detect
and Avoid System Performance
Requirements

F3442

This specification outlines the system objectives, activities, and evidence required to demonstrate adequate design and safe use of a detect and avoid (DAA) system. Such systems, in concert with other systems and equipment, enable UAS to operate beyond the visual line of sight (BVLOS) of the pilot in command (PIC). As the name suggests, these systems comprise a function for sensing potential flight hazards and assessing hazard severity ("detect") and a function for maneuvering the aircraft out of the way of the hazard ("avoid"). Such systems may also support operations within the PIC's VLOS.

STANDARD IN PROGRESS

New Guide for Device-to-Device
Certificate-based Communications
Security Framework for UAS/UAM

WK84631

This proposed standard will help identify communications security principles and relevant frameworks for securing ad hoc uncrewed aircraft system communications.

STANDARD IN PROGRESS

New Specification for Standard
Guide for Advanced Air Mobility
(AAM) Maintenance Technician
Qualification

WK88720

This proposed standard will address the fundamental subject knowledge, task performance, and task knowledge activities and functions for AAM and other next generation aircraft maintenance professionals.

Emerging Airspace

End Notes/References

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