Emerging Airspace

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. The space tourism industry is expected to be a $3B 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. Another projection suggests the space tourism industry may grow to more than $1T by 2040.

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.

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.

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.

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.

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

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

**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.

**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.

**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 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.\(^{19}\)
### 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. 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. FAA convened an Aviation Rulemaking Committee (ARC) on BVLOS drones to develop rules for these operations and currently requires a waiver for BVLOS flights.

FUTURE OF UNMANNED AIRCRAFT SYSTEMS

MARKET GROWTH
The global commercial drone market had an estimated value of $14.82B in 2021 and is projected to reach $217B by 2028. A different projection claims this market will grow from $8.15B in 2022 to $47.38B by 2028.

PRIVACY AND SAFETY CONCERNS
The ability of UAS to operate in lower altitude airspace raises concerns about safety, privacy, data protection security, data sharing, and surveillance.

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.

STRATEGIES FOR SAFER AND MORE SECURE UAS BVLOS OPERATIONS.
The development of Detect and Avoid (DAA) and Command, Control, and Communications (C3) 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.
# 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.
Emerging Airspace
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

WK84631  This proposed standard will help identify communications security principles and relevant frameworks for securing ad hoc uncrewed aircraft system communications.

STANDARD IN PROGRESS

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

COMMERCIAL SPACEFLIGHT

ADVANCED AIR MOBILITY
Emerging Airspace
End Notes/References

UNMANNED AIRCRAFT SYSTEMS (UAS)

21 https://www.eff.org/deeplinks/2022/08/over-horizon-drones-lineup-privacy-not-sight
24 https://www.fortunebusinessinsights.com/commercial-drone-market-102171
25 Including the safety of individuals on the ground and other aircraft.
26 https://commons.erau.edu/cgi/viewcontent.cgi?article=1669&context=ijaaa
29 https://www.nasa.gov/aeroresearch/programs/iasp/uas/command-and-control/
30 https://www.faa.gov/uas/research_development/traffic_management