



ASTM INTERNATIONAL  
Helping our world work better

# A Technical Foundation for Unmanned Aircraft

Unmanned aircraft systems (UAS), commonly called drones, are dramatically changing how our world works. Some drones can sit in the palm of your hand while others are the size of jets. The uses for these unmanned devices are also proliferating: inspecting infrastructure, responding to emergencies, collecting weather data, delivering packages, and more. Standards must keep pace to ensure that drones and drone operations continue to support innovation, performance, and safety.

[www.astm.org](http://www.astm.org)

# UAS Standards Needs and the Work of ASTM International

In recent years, UAS have succeeded in the marketplace due to cost-effectiveness, logistical efficiency, recreational/consumer interest, lifesaving capabilities, and many other factors. Both the number of UAS companies and types of drones are growing quickly, with the sales of millions of drones in recent years totaling billions of U.S. dollars.

**UAS are being used for both personal and business purposes, and they now can:**

- Evaluate incidents before public safety personnel respond,
- Inspect infrastructure and buildings in hard-to-reach places,
- Monitor security of properties,
- Deliver critical packages and medicine,
- Collect weather data for meteorologists,
- Survey crops or animals,
- Map disaster areas, and much more.

With this growth also comes challenges. For example, due to airspace safety and security concerns, regulators in the United States, Europe, and elsewhere have created restrictions on when, how far, and at what altitude some drones can be flown. Also, drone manufacturers have expressed interest in creating common definitions of drone capabilities.

Overall, a growing number of global stakeholders are experiencing a need to standardize technical and operational aspects of the industry, for safety and quality reasons, and also to help incorporate drones into the airspace. That's why many of the world's leading experts in UAS came together in 2003 to start developing standards through ASTM International's committee on unmanned aircraft systems (F38).

**THE COMMITTEE ON UNMANNED AIRCRAFT SYSTEMS (F38)**

**The committee now includes a broad cross-section of the UAS community:**

- Manufacturers,
- Component makers,
- Government agencies,
- Design and maintenance professionals,
- Industry associations,
- Financial organizations, and
- Academia.

Already, the committee has created more than a dozen standards that support airworthiness, flight operations, personnel training and certification, and more. These standards range from visual line-of-sight operations to control systems for small UAS, and everything in between.

**Committee members are hard at work on creating additional standards in a wide array of areas:**

- Autonomy,
- Beyond line-of-sight deliveries,
- Business operations manuals,
- Design and construction,
- Detect-and-avoid technologies,
- Fixed-wing systems,
- Fuel cell design,
- Maintenance technician qualification/certification,
- Operations,
- Performance,
- Safety,
- Training... and more.

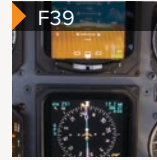
Notably, committee members are looking at the relationship between unmanned and manned aircraft. In some areas, existing manned aircraft standards – including those from ASTM International – might be leveraged to support UAS standardization needs.



A number of ASTM International committees are beginning to cross-pollinate ideas with the UAS committee, helping create a robust ecosystem for innovation and growth in the industry, including:



**F42**  
Additive Manufacturing Technologies



**F39**  
Aircraft Systems



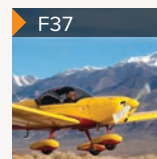
**F30**  
Emergency Medical Services



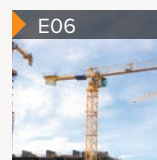
**F48**  
Exoskeletons/  
Exosuits



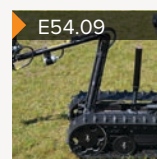
**F44**  
General Aviation Aircraft



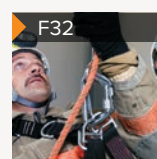
**F37**  
Light Sport Aircraft



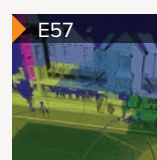
**E06**  
Performance of Buildings



**E54.09**  
Response Robots



**F32**  
Search and Rescue



**E57**  
3D Imaging Systems



# Related ASTM International Technical Committees



While the work of the committee on unmanned aircraft systems lies at the core of ASTM International's work in this industry, several others are impacting specific areas of interest:



## Additive Manufacturing Technologies (F42)

Startups, established businesses, trade associations, academia, and government are all represented in the committee on additive manufacturing technologies (F42). The group has been meeting since 2009 when the vast potential for AM was coming to light. More than 20 standards have been developed that support the application and adoption of AM for diverse materials and processes, including a group that, through a partner agreement, are joint standards with the International Organization for Standardization, and are also European standards. These standards are providing a common language, broadly accepted specifications for AM materials, guides for these new technologies, and more.

## Aircraft Systems (F39)

The committee on aircraft systems (F39) focuses on electrical systems for general aviation aircraft through five technical subcommittees. Standards currently include practices for the design, alteration, and certification; inspection; and maintenance of aircraft electrical wiring systems, as well as a guide for electrical load and power source capacity analysis. In addition, the committee is responsible for specifications for system performance and avionics systems. Electric propulsion, IR filters, altitude, airspeed, and fuel quantity indicators are covered in additional draft standards.

## Emergency Medical Services (F30)

The committee on emergency medical services (EMS) focuses on areas such as EMS equipment (including immobilization devices and air ambulances); emergency medical technicians and first responder training; EMS system structure; and medical dispatch management and communications. Notable among the committee's more than 30 standards is F2020 for the design, construction and procurement of EMS systems ambulances.

## ASTM INTERNATIONAL Helping our world work better

A family of services to strengthen organizations – in addition to standards – are available from ASTM International. Specific available offerings that apply or may be customized for unmanned aircraft systems are highlighted here.

1

### Proficiency Testing Programs (PTP)

Statistical quality assurance programs available through ASTM International help laboratories assess their performance in conducting test methods in their own laboratories by comparing data against that of other participants. About 4,600 labs, more than half of which are outside the U.S., use these programs. Individual programs cover plastics, metals, and petroleum products, among other options. The programs are accredited in accordance with the recognized international standard ISO/IEC 17043: 2010, Conformity Assessment - General Requirements for Proficiency Testing, by the American Association for Laboratory Accreditation.

2

### Training and E-Learning

ASTM International's practical, hands-on training programs – accredited by the International Association for Continuing Education and Training – bring together industry-respected standards and instructors who helped develop those standards. These include self-paced e-learning courses, webinars, and in-person courses in industries such as construction, coal, petroleum, and plastics. One e-seminar, for example, covers Statistics in ASTM Standard Test Method Development, Application, and Quality Assurance.



F48

### Exoskeletons/Exosuits (F48)

Donned devices help people to do tasks more efficiently or for a greater period of time. A worker could use a heavy construction tool more efficiently for a longer time with less muscle strain. A soldier could carry heavy gear more easily. A patient recovering from surgery or health problem could retrain muscles to walk or lift. For these and other industrial, medical, and military applications, standards will help demonstrate benefits, and limitations. The committee on exoskeletons and exosuits (F48) is developing standards for performance and safety, among other topics, of these wearable systems.



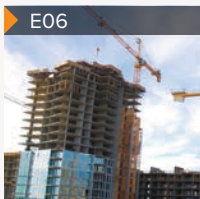
F44

### General Aviation Aircraft (F44)

The committee on general aviation aircraft (F44) addresses standards for planes for fewer than 12 passengers and weigh less than 19,000 lbs. (8,600 kg). Some 300 members from more than 20 countries work on standards for design and construction, systems and performance, quality acceptance, and safety monitoring. The committee oversees 30 standards on topics such as aircraft weights and centers of gravity; control, operational characteristics of instruments and sensors of propulsion systems; design loads; crew aspects of airworthiness and design; and ice protection. Many standards are also underway for compliance; airframe and aircraft structures; propeller systems; and more.



F37



E06

### Light Sport Aircraft (F37)

The growth of the ultralight and light aviation aircraft industry led to standards for design, development, and maintenance of the aircrafts. Powered parachute, weight-shift control, airplane, glider, gyroplane, and lighter-than-air aircraft are part of this category of light sport aircraft. The 35 standards from the committee on light sport aircraft (F37) help manufacturers design and evaluate their models, and regulators — such as the U.S. Federal Aviation Administration — and users can point to the standards as well for quality and acceptance.

### Performance of Buildings (E06)

The committee on performance of buildings (E06) supports their construction and management through diverse standards. The 275+ standards from the committee cover building components and assembly, and their overall performance. Many more are underway, including a standard that will guide unmanned aircraft systems use for façade inspection — how to scan the façade, preserve the data, and use the information for reporting. Additional building-related UAS standards may be developed as well, for example, about using UAS for testing façade materials.

3

### ASTM's National Center for Aerospace and Transportation Technologies (NCATT)

NCATT certifications demonstrate the knowledge base of the advanced aerospace technician and promote integrity, safety, and professionalism in the aerospace workforce. NCATT certificates identify professionals who demonstrate their knowledge through testing and commit themselves to the aerospace industry. Associations and professionals across every industry use these certifications to recognize qualified and competent individuals. Potential added certifications could address unmanned aircraft pilot skills.

4

### The Safety Equipment Institute (SEI)

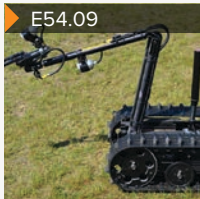
As the unmanned aircraft industry continues to grow, certification could also play a growing role. The Safety Equipment Institute tests and certifies a broad range of safety and protective products used in work and recreational settings. An ASTM International affiliate, SEI leads in certifying products such as sports and athletic equipment, safety and protective products used by first responders, and eye and face protection for industrial workers.

5

### Interlaboratory Study Program (ILS)

ASTM International's Interlaboratory Study Program helps committees create precision statements for test methods. The ILS program also helps with interlaboratory study design, volunteer labs, samples and suppliers, collecting and analyzing data, and compiling research report information.

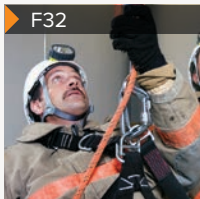
# Related ASTM International Technical Committees



E54.09

## Response Robots (E54.09)

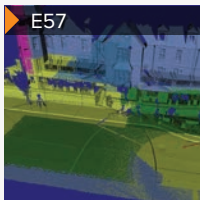
Response robots perform diverse tasks: climb stairs, move over rough surfaces, pick up and put down objects, dismantle bombs, map unsafe areas, search for survivors, and more. These machines have common characteristics: sensors, radio communications, and mobility. Through a subcommittee on response robots (E54.09) in the committee on homeland security applications (E54), standards have been developed that help measure robot capabilities. Standards address mobility in confined areas and on the stairs, radio communication, and more, with additional ones underway to help evaluate robot sensing, dexterity, endurance, and inspection, among others. The group is now developing standards for response UAS. A suite of more than 50 standards is anticipated to result.



F32

## Search and Rescue (F32)

To enhance the skills of emergency responders and their tools, the committee on search and rescue (F32) develops standards that specify equipment such as ropes and carabiners; guide operations management and describe how to do certain operations such as cold water rescue, demonstrate search and rescue dog obedience and agility, and use whistles during rope rescues; and guide rescues on land and in the water. The committee, which is responsible for about 65 standards, also currently includes proposed standards for using unmanned aircraft systems in SAR. One completed standard in this area defines small UAS in terms of their capabilities, intended to help local and state emergency managers in ordering devices that will be useful for incidents.



E57

## 3D Imaging Systems (E57)

Three-dimensional imaging systems capture data useful for construction and repairs, assist with health and medical care, and increase transportation safety, among other purposes. The standards of the committee on 3D imaging systems (E57) aim to further the use of these technologies in several industries. The committee has completed close to 10 standards: one on imaging data exchange and another on application best practices as well as tests for evaluating range and pose of systems, with more underway. E57 works with the Open Geospatial Consortium on projects of mutual interest such as UAS.

## Other Committees

UAS use holds potential for several other industries where ASTM International committees make a difference. The work of committees such as those on petroleum products, lubricants, and liquid fuels (D02); road and paving materials (D04); and nuclear technology and applications (E10), can make use of unmanned aircraft systems, for example, to inspect critical infrastructure such as pipelines, roads, or power plants, for routine maintenance or to investigate reported problems.



◀ **Katharine Morgan**, ASTM International president, watches drone and robot demonstrations according to standards from the committee on homeland security applications (E54). U.S. National Institute of Standards and Technology training officers conducted the demos at the Virginia Beach Fire Department testing facility.

See video at [www.astm.org/video/VBFD](http://www.astm.org/video/VBFD).

# Partnering to Advance UAS

## National Fire Protection Association (NFPA)

The globally recognized National Fire Protection Association and ASTM International have signed a memorandum of understanding and formed a joint working group to support the increasing number of public safety officials who want to use drones to support their mission. The group initially plans to develop benchmarks, use-case scenarios, and performance criteria. These tools could lead to both technical standards as well as training and certification for firefighters, law enforcement, emergency medical services personnel, search-and-rescue teams, and others.

## American National Standards Institute (ANSI) UAS Standardization Collaborative (UASSC)

The ANSI UAS Standardization Collaborative is working to coordinate and accelerate the development of standards and conformity assessment needed to integrate drones into the U.S. national airspace. This includes four working groups: credentialing, airworthiness, operations/procedures, and airspace/infrastructure. Staff and members from ASTM International's UAS and aviation sector committees are participating in this effort to map out standardization needs, including coordination with non-U.S.-based organizations.

## European UAS Standards Coordination Group (EUSCG)

The European UAS Standards Coordination Group, which is part of the European Organization for Civil Aviation Equipment (EUROCAE), seeks similar goals as the ANSI effort. This group is coordinating and monitoring activity related to standardization.

## U.S. National Institute of Justice (NIJ)

Through a memorandum of understanding, the U.S. National Institute of Justice and ASTM International — as well as its affiliate the Safety Equipment Institute — are supporting standardization and equipment certification for people in law enforcement, public safety, and related fields. The agreement is helping to support standards development in areas of greatest need; support NIJ participation in ASTM International committees; foster information sharing in research and testing; support NIJ's use of ASTM International standards; coordinate standards-related activities across U.S. federal agencies; and more.

## U.S. National Institute of Standards and Technology (NIST)

Many employees of the U.S. National Institute of Standards and Technology serve on ASTM International technical committees, including those related to drones, response robots, and many other areas. Their research, data, live demonstrations, and overall support for ASTM International's standards activities is longstanding.

## Open Geospatial Consortium (OGC)

A memorandum of understanding with the Open Geospatial Consortium is fostering collaboration on standards and other tools that support the growing geospatial industry. Areas emphasized include data acquisition and dissemination, location-based services, and unmanned (autonomous) navigation.

## Additional Partnerships

Coordination is taking place with the Radio Technical Commission for Aeronautics (RTCA), which develops technical guidance; SAE International, which sets standards for automotive and aerospace; the Aerospace Industries Association (AIA), which represents the U.S. aerospace and defense industry; and the unmanned working group of EUROCAE, which also develops industry standards for aviation.



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Committed to serving global societal needs, ASTM International positively impacts public health and safety, consumer confidence, and overall quality of life. We integrate consensus standards – developed with our international membership of volunteer technical experts – and innovative services to improve lives... Helping our world work better.

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