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The Key Role of Standards in Support of Safe, Efficient and Economical Future UAS Airspace Integration

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F38 Unmanned Aircraft Systems

Why Standards?

CAA's

- Standards Link Research to Support Rulemaking
 - Technical Standard Orders
 - Advisory Circulars
 - Notice of Availability

Industry

- Ensure Safety, Reliability & Quality
- Facilitate Free & Fair Global Trade-acceptance
- Spur innovation / drive business growth
- Enable interoperability of products, processes, systems
- Lower research and development costs
- Promote quality and efficiency in supply chains
- Reduce liability and regulatory compliance risks





F38 Unmanned Aircraft Systems

Quick facts:

Formed: 2003, memorandum agreement with FAA
Current Membership: 230+ members (30 regulators)
Standards: **15** approved; **25+** in development

Subcommittees:

F38.01 Airworthiness

- Hardware/Software oriented
- Safe design, construction, test, modification, & inspection of the individual component, aircraft, or system

F38.02 Flight Operations

- Procedure oriented
- Safe employment of the system within the aviation environment among other aircraft & systems

F38.03 Personnel

- Individual, Crew and Organization Oriented
- Safe practices by the individuals and teams responsible for employing the system

Also Require Infrastructure capable of incorporating this technology safely in the NAS- ATM, UTM, LAANC

Global Representation

Argentina

Australia

Bahamas

Canada

China

France

Germany

Italy

Korea, Republic of

Netherlands

New Zealand

Norway

United Kingdom

United States

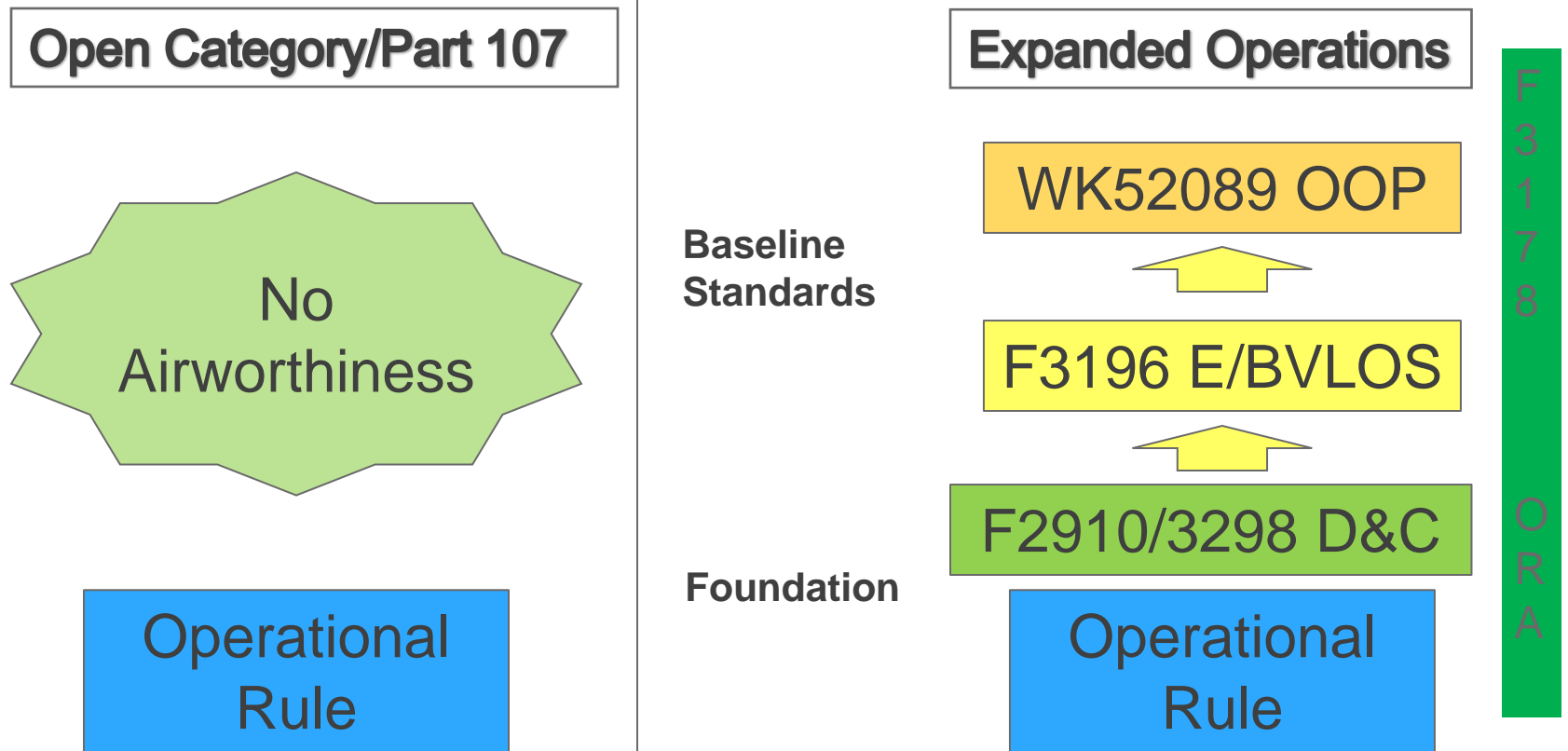
F38 Goal : Achieving Safe & Reliable UAS Operations in the NAS



The Path to Full Integration



Standards Required for Expanded Operations



ASTM Aligns Priorities to Industry & CAA

Focus Areas-Key Standards: Design/Construct



F2910 Specification for Design and Construction of a Small Unmanned Aircraft System

- Going beyond Part 107 as foundation for basic integrity to allow expanded ops
- Will support AC 21.17B

F3298 (5/1/18) Specification for Design, Construction, and Verification of Fixed-Wing UAS

- **WK53964** Revision to include VTOL

WK62670 Specification for Large UAS Design and Construction

- Best practices/compliance specific to Large UAS (12,500-19,000 lbs).
 - Gap Fill Part 23 General Aircraft, F37 Light Sport Aircraft, and F44 General Aviation standards
 - STANAG 4671 (NATO UAV System Airworthiness)
 - JARUS CS-LUAS (750 k)

ASTM Aligns Priorities to Industry and CAA

Focus Areas-Key Standards: E/BVLOS



F3196 Practice for Seeking Approval for Extended/Beyond Visual Line of Sight Operations (under revision FAA Pathfinder Program + Canadian Best practices)

Applications:

- 1) Package Delivery- *in progress*
- 2) Critical Infrastructure
- 3) Agriculture
- 4) Linear Inspection
- 5) Search and Rescue
- 6) Disaster Response (Hurricane Preparedness-2019)

WK62344 (Appendix to F3196) Mitigation for Package Delivery sUAS BVLOS

- Defining minimum requirements for safe /efficient use of currently available technology/equipage
- Develop the minimum requirements ensuring compatibility/interoperability between delivery providers

ASTM Aligns Priorities to Industry & CAAs

Focus Area - Standards for Detect and Avoid



Standards Underway

- **WK62668** Specification for DAA Performance Requirements
 - *Defines minimum performance standards*
- **WK62669** Test Method for DAA
 - *Covering systems and sensors*

Scope of Work

- Applicable to smaller (<254 lbs)
- UAS BLVOS operations in lower altitudes (1200AGL)
- Protection of manned aircraft-UAS to manned aircraft encounters
- Defining well-clear and avoidance distances and/or times
- Regulatory constraints on ATC airspace and IFR ops
- Recommendations for DAA modifications to inform BVLOS standard practice

ASTM Aligns Priorities to Industry CAAs

Focus Areas-Key Standards-Ops Over People



WK52089 Specification for Operations over People

Design/Construction

- Quality assurance requirements
- Testing to verify the target reliability
- Software code control
- Redundant power supply, propulsion systems, communication and navigation
- Reliability

Risk Mitigation

- Operational Risk Assessment
- Parachute systems, airbags, human injury assessments, frangible design

Operations

- Pilot knowledge required for safe operations
- Route planning, risk minimization for ground and air hazards



ASTM Aligns Priorities to Industry and CAAs

Focus Areas- Key Standards-Ops Over People



WK59171 Parachute Recovery Systems for sUAS
(Summer 2018)

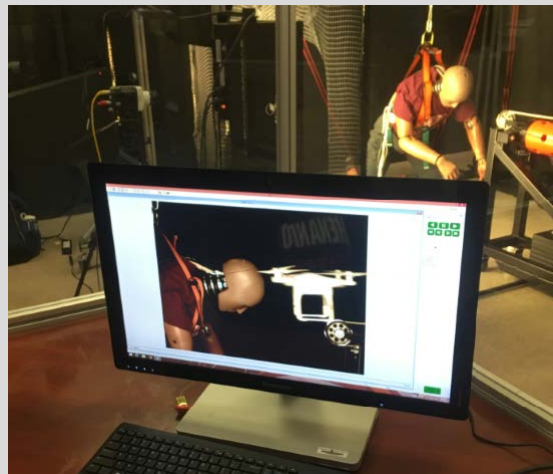
WK56338 Test Method for Assessing the Safety of Small Unmanned Aircraft Impacts

- Based on research and testing conducted by the ASSURE program for FAA
- Three methods for evaluating the potential for impact injury:

Method A: analytical method, suitable for lower weight, slower UAS with low impact energies

Method B: simplified low cost test using instrumented head-forms and flight test to demonstrate failure modes and impact

Method C: anthropomorphic test dummies to evaluate full human impacts for higher risk operations



ASTM Aligns Priorities to Industry & CAA

Focus Area – Key standards ORA



F3178 Operational Risk Assessment (sUAS)

- Will Support AC 21.17b Rewrite as AMOC
- <25 kg
- Documents CONOPS
- Identify , Quantify and Qualify operational hazards/harm
- Analyze the outputs of assessment
- Apply mitigations to satisfy safety of flight
- For access to airspace as regulated by respective CAA(s) either for *a: vehicle design (airworthiness), or a vehicle's use (operational approval)*

ORA/JARUS Specific Operations Risk Assessment (SORA):

- Different pathways – similar results
- SORA - Step by step approach for applicant
 - Standard scenarios will simplify process
- ORA – Traditional safety risk management process
- Both systems are acceptable means of compliance and should be used as appropriate for applicant

F38 UAS Standards

F2911 Practice for Production Acceptance of sUAS

F3002 Specification for Design of the Command and Control System for sUAS

F3003 Specification for Quality Assurance of a sUAS

F3005 Specification for Batteries for Use in sUAS

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

F3269 Practice for Methods to Safely Bound Flight Behavior of Unmanned Aircraft Systems Containing Complex Functions

F2909 Practice for Maintenance and Continued Airworthiness of sUAS

F2908 Specification for sUAS Flight Manual (AFM)

F3266 Training for Remote Pilot Instructor (RPI) of Unmanned Aircraft Systems (UAS)

F2851 Standard Practice for UAS Registration and Marking (



F38 Standards Under Development



WK27055 Practice for UAS Remote ID and Tracking

WK60937 Design of Fuel Cells for Use in UAS

WK59317 Vertiport Design

WK61764 Training for Public Safety Remote Pilot of UAS Endorsement

WK60659 UAS Maintenance Technician Qualification

ASTM F38.03 Operator Standards



WK62744 General Operations Manual for Professional Operator of Light Unmanned Aircraft Systems (UAS)

- Best practices to support professional entities receiving operator certification by a CAA, and provide practice for self- or third-party audit of operators of UAS.

WK62730 UAS Operator Audit Programs

- Minimum requirements, responsibilities, qualifications for entities conducting internal audits against ASTM standards on Unmanned Aircraft Systems

WK62731 UAS Operator Compliance Audits

- How to conduct a third party audit program for those who execute audits to meet the consensus set of minimum requirements and qualifications.

WK62733 Development of Training Manuals for the UAS Operator

Mission: Coordinate/accelerate standard development and conformity assessment programs with international coordination and adaptability

Deliverable: roadmap describing the current and desired standardization landscape for UAS, to be completed in 2018. UASSC is not developing standards

- Foster coordination and collaboration on UAS standardization issues among stakeholders
- Clarify current and future UAS standardization landscape
- Help stakeholders focus standards participation resources
- Inform U.S. policy and technical input to regional and international audiences
- Support growth of the UAS market with emphasis on civil, commercial, and public safety applications

UAS Public Safety JWG



Overview

- Formed 2017, MOU with ASTM & NFPA
- 30 experts
- Identify key public safety UAS operations
- Prioritize operations for industry need
- Develop Standard Use-case scenarios

Scenarios underway

- Accident Reconstruction
- Search and Rescue (SAR)
- Hazardous Chemicals
- Fire Response



ASTM	F38 <i>Unmanned Aircraft Systems</i> <ul style="list-style-type: none"> - Platforms / Systems - Operational - Personnel 	E54.09 <i>Response Robots</i> <ul style="list-style-type: none"> - Performance & Operator Evaluations 	F32 <i>Search & Rescue</i> <ul style="list-style-type: none"> - Wilderness focus - Not urban
NFPA	2400 UAS <i>Selection, Care, & Maintenance for Emergency Response</i> <ul style="list-style-type: none"> - Fire - EMS - Law Enforcement 	Incidents <i>Response, Assessments</i> <ul style="list-style-type: none"> - 422 Aircraft - 1670 SAR - 403 Airport fire - 551 Fire Risk - more... 	Hazardous Materials <ul style="list-style-type: none"> - 471 Practice for response - 472 Responder Competencies - 473 EMS Competencies

AUVSI and the Remote Pilot Council Trusted Operator Program - TOP



TOP OBJECTIVES :

1. Ensure an operation-centric, proportionate, risk- and performance-based framework;
2. Develop community agreed unified safety training protocols and best practice for remote pilots;
3. Advance and support the development of remote pilots and further enhance trust in the UAS market; and
4. Contribute to enhancing privacy, data protection, and security through best practice training.
5. Adaptable for any regulatory environment

MEANS:

1. Compliance with ANSI-accredited standards and based on ASTM Training of Pilots and Visual Observers (F3266) Training Standard
2. Adopt Best Practice methods.
3. Utilize existing and established best practices



Task Group Objectives:

- Develop a short and long term strategy towards autonomy standards in ASTM
- Cross Cutting Task group
- Developing terminology, certification guidance & levels

Technical Committees:

- F37 - Light Sport Aircraft
- F38 - Unmanned Aircraft Systems
- F39 - Aircraft Systems
- F44 - General Aviation Aircraft

Integration of Automation Across Aviation

Swarms, cargo delivery, leading eventually to passenger service

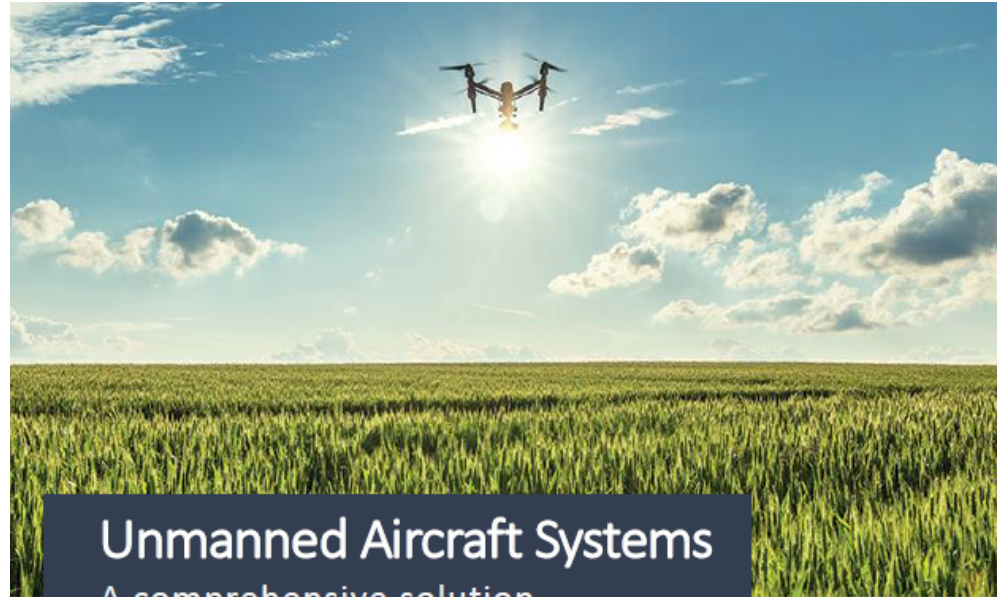
ASTM Autonomy Task Group



ASTM UAS Roadmap

**Available and updated on ASTM website URL:*

<https://www.astm.org/COMMIT/ASTM%20UAS%20Roadmap-1.pdf>



Unmanned Aircraft Systems A comprehensive solution

ASTM International is a globally recognized leader in the development of voluntary consensus standards. Today, **over 12,000 ASTM standards** are used around the world to improve product quality, enhance safety, strengthen market access and trade, and build consumer confidence. We **welcome and encourage participation** from around the world.

Our leadership in international standards development is driven by the contributions of our members: more than 30,000 of the world's top technical experts and business professionals representing 140 countries. Working in an open and transparent process and using ASTM's advanced IT infrastructure, our members create the tools that support industries and governments worldwide.

Through our **150 technical standards-writing committees**, we serve a broad range of industries: aerospace, infrastructure, public safety personnel, consumer products and many more. When new industries — like nanotechnology, additive manufacturing and robotics — look to advance the growth of cutting-edge technologies through standardization, many of them come to ASTM International.

Beyond standards development, ASTM offers **certification and declaration through our subsidiary, the Safety Equipment Institute**, as well as **technical training programs** and **proficiency testing**. All our programs complement our standards development activities and provide enterprise solutions for companies, government agencies, researchers and laboratories worldwide.

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** This material represents the views and positions of the presenter and not those of ASTM International and/or the entire ASTM F38 Committee*

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E54.09 Response Robots Subcommittee

Aerial Response Robots – Test Methods Under Development



- **Safety:** Lost power behaviors; lost communication behaviors; lost GPS behaviors
- **Operation:** Pre-flight Readiness Assessment & Launch & Recovery Procedures
- **Sensing:**
 - Visual: Image Acuity; Dynamic Range, Color Acuity
 - Thermal: Image Acuity; Dynamic Range
 - Latency of Video, Audio and Control
 - Audio Speech Acuity
- **Radio Communications:** Line of Sight, Non-Line of Sight, Attenuated Range; Interference Range
- **Navigation:** Follow Lines While in Up & Down Range Orientation; Orbit a Point; Precision Landing; Negotiate through Wires, Pass through Windows and Slalom Obstacles
- **Logistics:** Configuration Identification; Packaging for Urban Search & Rescue Equipment
- **Guides:** Aerial Response Robot Purchasing; Response Robot Training; Response Robot test apparatuses