NFPA® 2400

Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations

2024 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA® 2400

Standard for

Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations

2024 Edition

This edition of NFPA 2400, *Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations*, was prepared by the Technical Committee on Unmanned Aircraft Systems and released by the Correlating Committee on Professional Qualifications. It was issued by the Standards Council on December 21, 2023, with an effective date of January 10, 2024, and supersedes all previous editions.

This edition of NFPA 2400 was approved as an American National Standard on January 10, 2024.

Origin and Development of NFPA 2400

NFPA 2400, *Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations*, 2019 edition, is the first NFPA standard supporting sUAS integration into the public safety community. Creation of the Technical Committee on Unmanned Aircraft Systems (UAS), the committee responsible for NFPA 2400, was approved at the August 3–5, 2016, Standards Council meeting. It was charged with developing a standard for the implementation, deployment, and operation of UAS in the public safety community, including the creation of the professional qualifications necessary for public safety operations. The committee included representatives from a variety of public safety departments that deal with UAS, including the fire service, law enforcement, and emergency medical services.

NFPA 2400 is an all-encompassing standard providing a foundation for sUAS integration into the public safety community. Based on a clear stakeholder need, the project was accelerated, and the committee produced a quality standard in approximately 2¼ years, completing every stage of the NFPA standards development process. Originally, the project encompassed all types of unmanned aircraft systems; however, because sUAS constitute the most pressing public safety need, the committee chose to focus on them, as defined by the FAA, for this first edition.

NFPA 2400 divides sUAS integration into three main elements within three core chapters. Chapter 4, Organizational Deployment and Considerations for sUAS, provides requirements for program development, program assessment, deployment, general operations, and multiple aircraft operations. A key element of Chapter 4 is the identification of the need for a risk assessment and consideration of mission objectives. Chapter 5, Professional Qualifications for sUAS Public Safety Personnel, identifies the minimum job performance requirements (JPRs) that a remote pilot in command (RPIC) and visual observer are required to perform. In essence, it covers essential job tasks that can be evaluated and tested. Finally, Chapter 6, Maintenance of sUAS, provides requirements aimed at identifying the maintenance needs within a sUAS program. It stipulates the need for core maintenance procedures that identify elements such as record-keeping, cleaning, and decontamination.

Combined, these three chapters form the core of NFPA 2400 and provide a road map for public safety departments to begin to develop and integrate sUAS into their incident response operations. NFPA 2400 is the foundation from which public safety departments can develop sUAS programs and can do so based on the most current industry knowledge and with the backing of an ANSI-accredited standard.

For the 2024 edition, the committee reviewed the entire document and updated the references and Annex B to reflect changes made by the Correlating Committee. While there were not many changes made for this edition of the standard, the committee did ensure that all of the requirements and JPRs were still relevant and applicable.

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Kissimmee, FL [M]
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Angus Maclean Duff, Consolidated Fire District 2, KS [U]

Alec Feldman, Fulcrum Consultants, Ireland [SE]
Rep. JOIFF-International Organisation for Industrial Hazard Management

Douglas P. Forsman, Fairfield Bay Fire Department, AR [L]

Richard Galtieri, Spokane Fire Department, WA [U]

Scott M. Gorgon, International Association of Fire Fighters (IAFF), DC [L]

R. Kirk Hankins, Fire Consulting & Case Review International, Inc., MO [U]
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Forest Herndon, Jr., MERE M-PACT Solutions, NJ [SE]

Bill Slosson, Washington State Patrol, WA [E]

Philip C. Stittleburg, La Farge Fire Department, WI [L]
Rep. National Volunteer Fire Council

Christopher A. Toten, US Department Of Navy, MS [E]

Charles "Randy" Watson, S-E-A, Ltd., GA [SE]

Alternates

Adam J. Goodman, S-E-A Limited, MD [SE]
(Alt. to Charles "Randy" Watson)

David W. Lewis, Odenton, MD [L]
(Alt. to Philip C. Stittleburg)

Robert W. Rand, Nat'l Board On Fire Service Prof. Qualifications, MA [E]
(Alt. to Brian R. Brauer)

Angela White, Wisconsin Technical College System, WI [E]
(Voting Alt.)

Nonvoting

Stephen P. Austin, Cumberland Valley Volunteer Firemen's Association, DE [L]
Rep. TC on Traffic Control Incident Management Professional Qualifications

Preet Bassi, Center For Public Safety Excellence, VA [C]
Rep. TC on Fire Service Analysts and Informational Technical Specialist

Alan W. Conkle, Ohio Association of Emergency Vehicle Technicians (OAEVT), OH [M]
Rep. TC on Emergency Vehicle Mechanic Technicians Professional Qualifications

John S. Cunningham, Nova Scotia Firefighters School, Canada [U]
Rep. TC on Fire Fighter Professional Qualifications

Jay Dornseif, III, Priority Dispatch Corporation, SC [M]
Rep. TC on Public Safety Telecommunicator Professional Qualifications

Richard A. Dunn, SC State Firefighters' Association, SC [E]
Rep. TC on Fire Officer Professional Qualifications

Richard C. Edinger, North Myrtle Beach, SC [SE]
Rep. TC on Hazardous Materials Response Personnel

Ronald R. Farr, Plainwell Fire Department, MI [C]
Rep. TC on Electrical Inspection Practices

Dave E. Hanneman, Self Employed, ID [SE]
Rep. TC on Incident Management Professional Qualifications

Ronald L. Hopkins, TRACE Fire Protection & Safety Consultant, Ltd., KY [SE]
Rep. TC on Fire Service Instructor Professional Qualifications

Robert J. James, Ione Rose Consulting, LLC, AZ [SE]
Rep. TC on Building Fire and Life Safety Director Professional Qualifications

Randy J. Krause, Port of Seattle Fire Department, WA [E]
Rep. TC on Fire Service Occupational Safety and Health

Peter J. Mulvihill, Reno, NV [SE]
Rep. TC on Fire Inspector Professional Qualifications

Randal E. Novak, Ames, IA [SE]
Rep. TC on Accreditation & Certification Professional Qualifications

Jim Stumpf, Organizational Quality Associates, ID [SE]
Rep. TC on Wildfire Suppression Professional Qualifications

Robert D. Taylor, PRB Coal Users Group, IN [U]
Rep. TC on Industrial Fire Brigades Professional Qualifications

Nancy J. Trench, Oklahoma City, OK [M]
Rep. TC on Public Fire Educator Professional Qualifications

Paul Valentine, Zurich Insurance North America, IL [M]
Rep. TC on Fire Marshal Professional Qualifications

Robert Fash, NFPA Staff Liaison

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Committee Scope: This Committee shall have primary responsibility for the management of the NFPA Professional Qualifications Project and documents related to professional qualifications for fire service, public safety, and related personnel.

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Spanish Fork, UT [SE]

Michael Baltrotsky, Montgomery County Fire & Rescue Service, MD [U]

Javier Caina, DJI, CA [M]

Kai-Dee Chu, Department of Homeland Security, DC [E]

Robby Cordobes, Los Angeles Fire Department, CA [L]
Rep. California State Firefighters Association

Adam Dershowitz, Exponent, NY [SE]

Bobby Eisele, Department of the Interior, ID [E]
Rep. National Wildfire Coordinating Group

Ritesh Ghimire, US Federal Aviation Administration, DC [E]

Robert W. Hill, City Of Stillwater, OK [M]
Rep. International Fire Service Training Association

John Hudgins, Boeing Fire Department, WA [U]

Adam Jacoff, National Institute of Standards & Technology (NIST), MD [RT]

James Allan Kidd, Oklahoma State University, OK [SE]

Michael Leo, Fire Department City of New York (FDNY), NY [U]

John Michael Looney, JML Engineering, MA [U]

Art Martynuska, Cambria County Emergency Services, PA [E]

Kevin P. Murphy, Great Oaks Public Safety Services, OH [U]

Robin Murphy, Texas A & M University, TX [SE]

Noah Ryder, Fire & Risk Alliance, MD [SE]

Christopher Wayne Sadler, Virginia Innovation Partnership Corporation, VA [U]
Rep. International Association of Fire Chiefs

Peter M. Schecter, Oakland Park, FL [SE]

Daniel Schwarzbach, Airborne Public Safety Association (APSA), MD [M]

Donald Shinnamon, Sr., Unmanned Safety Institute, Inc., FL [SE]

Matt Sloane, SkyFire Consulting, GA [M]

Doug Wiedman, Sacramento County Sheriff, CA [E]

Alternates

Ivanna Almanzar, JML Engineering, MA [U]
(Alt. to John Michael Looney)

Timothy P. Butters, VA Department Of Emergency Management, VA [E]
(Voting Alt.)

Brian Carlson, University Of Cincinnati, OH [SE]
(Voting Alt.)

David Collado, Fire Department City of New York (FDNY), NY [U]
(Alt. to Michael Leo)

Romeo Durscher, DJI, CA [M]
(Alt. to Javier Caina)

Philip Mattson, Department of Homeland Security, DC [E]
(Alt. to Kai-Dee Chu)

Kamel Saidi, National Institute of Standards & Technology (NIST), MD [RT]
(Alt. to Adam Jacoff)

Charles L. Werner, International Fire Chiefs Association (IAFC), VA [U]
(Alt. to Christopher Wayne Sadler)

Ken Holland, NFPA Staff Liaison

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents relating to the operation, deployment, and implementation of Unmanned Aircraft Systems (UAS) by public safety entities and public safety officials. This includes all documents that establish operational protocols for those who use and support UAS services and operator professional qualifications.

Contents

NFPA 2400

Standard for

Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations

2024 Edition

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A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex E.

Chapter 1 Administration

1.1 Scope. This standard shall cover the minimum requirements relating to the operation, deployment, and implementation of small unmanned aircraft systems (sUAS) for public safety operations.

1.1.1 This standard shall establish operational protocols for public safety entities who use and support sUAS.

1.1.2 This standard shall include minimum job performance requirements (JPRs) for public safety personnel who operate and support sUAS.

1.1.3 This standard shall include minimum requirements for the maintenance of sUAS when used by public safety entities.

1.1.4 This standard shall provide additional minimum requirements specific to public safety entities.

1.2 Purpose. This standard shall specify the minimum criteria necessary to support safe, effective, and efficient sUAS operations when utilized by public safety entities.

1.3 Application. This standard shall apply to all public safety entities operating sUAS.

1.3.1 This standard shall apply to non-public entities who conduct sUAS operations for public safety.

1.3.2* This standard shall apply to sUAS that weigh less than 55 lb (25 kg).

1.4 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, devices, or technology of equivalent or superior quality, effectiveness, and performance over those prescribed by this standard.

1.4.1 The technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.4.2 The system, method, device, or aircraft shall be approved for the intended purpose by the authority having jurisdiction.

1.5* Enforcement. This standard shall be administered and enforced by the authority having jurisdiction.

1.6 Additional Administrative Information. This standard shall be divided based on the different types of minimum requirements for sUAS when used by public safety entities.

1.6.1 Chapter 4 shall include the minimum requirements relating to the organization, deployment, and selection of sUAS when used for operations supporting public safety entities.

1.6.2 Chapter 5 shall identify the minimum JPRs for remote pilot in command (RPIC) and visual observer for sUAS when used by public safety personnel.

1.6.3 Chapter 6 shall include minimum requirements for the maintenance of sUAS when used for public safety operations.

1.6.4 Chapters 4, 5, and 6 shall contain the following administrative sections in relation to the applicable type of requirements:

(1) Chapter(s) scope
(2) Chapter(s) purpose
(3) Chapter(s) application
(4) Chapter(s) definitions

1.6.5 Definitions found in Chapters 4, 5, and 6 shall be repeated in Chapter 3 in accordance with the *Manual of Style for NFPA Technical Committee Documents*.

1.6.6* Annexes shall provide explanatory information based on the applicable section number.

1.6.7 Annex B shall contain an explanation of professional qualification standards and the concepts of JPRs.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. (Reserved)

2.3 Other Publications.

2.3.1 US Government Publications. US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 14, Code of Federal Regulations, Part 107, "Small Unmanned Aircraft Systems," 2016.

FEMA — ICS Glossary, Incident Command System Training, 2008.

2.3.2 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020.

2.4 References for Extracts in Mandatory Sections. (Reserved)

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Shall. Indicates a mandatory requirement.

3.2.4 Should. Indicates a recommendation or that which is advised but not required.

3.2.5 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

3.3.1 Crew Readiness. The availability and readiness of the RPIC and visual observer to deploy for sUAS operations given their knowledge and completion of pre-flight duties. (PQU)

3.3.2 Data Acquisition. The collection of information from sUAS for the purpose of fulfilling the mission objectives and goals in accordance with the mission plan. (PQU)

3.3.3 Designated Operations Area. The operating area or location defining the volume of airspace to include altitude in Above Ground Level (AGL) or Mean Sea Level (MSL), and the defined geographical operational perimeter for a given public safety mission.

3.3.4 Digital Media Evidence (DME). The digital recording of images, sounds, and associated data with probative value stored or transmitted in binary form.

3.3.5 Incident Command System (ICS). A standardized on-scene emergency management construct specifically designed to provide for the adoption of an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. ICS is the combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure, designed to aid in the management of resources during incidents. It is used for all kinds of emergencies and is applicable to small as well as large and complex incidents. ICS is used by various jurisdictions and functional agencies, both public and private, to organize field-level incident management operations. [FEMA — ICS Glossary, 2008]

3.3.6 Incident Commander (IC). The individual responsible for all incident activities, including the development of strategies and tactics and the ordering and the release of resources. The IC has overall authority and responsibility for conducting incident operations and is responsible for the management of all incident operations at the incident site. [FEMA — ICS Glossary, 2008]

3.3.7 Maintenance Program. A maintenance program is a system or set of procedures for the continuous maintenance of the sUAS in order to ensure air-worthiness.

3.3.8 Payload Drop. The release of an item or package from sUAS for the purpose of fulfilling the mission objectives and goals in accordance with the mission plan. (PQU)

3.3.9 Positive Aircraft Control. Consistently maintaining appropriate control of the aircraft, regardless of the phase of flight or potential distraction of other required tasks. (PQU)

3.3.10 Public Safety Entity. Any entity involved with public safety that has a mission to protect life, property, or the environment or any combination of these.

3.3.11 Public Safety Personnel. Any individual involved with public safety that has a mission to protect life, property, or the environment or any combination of these. (PQU)

3.3.12 Remote Pilot in Command (RPIC). The person who has been found by the public safety entity to be properly qualified to exercise the privileges of remote pilot and has the final authority and responsibility for the operation and safety of sUAS operation as determined by the authority having jurisdiction (AHJ). (PQU)

3.3.13 Resources. The equipment, personnel, and facilities required for the sUAS operations provided by the public safety department. (PQU)

3.3.14 Risk Assessment. The evaluation of the relative danger of sUAS operations when taking into consideration mission objectives and goals, sUAS, professional qualifications of the RPIC and visual observer, operational readiness of the crew, weather conditions, environmental conditions, regulatory requirements, potential hazards, and operating conditions. (PQU)

3.3.15 Small Unmanned Aircraft. An unmanned aircraft weighing less than 55 lb (25 kg) including everything that is on board the aircraft. [14 CFR Part 107, 2016]

3.3.16 Small Unmanned Aircraft Systems (sUAS). A small unmanned aircraft and its associated elements (including communication links and the components that control the small unmanned aircraft) that are required for the safe and efficient operation of the small unmanned aircraft in the national airspace system. [14 CFR Part 107, 2016]

3.3.17 sUAS Operations. The use of any sUAS for the purpose of protecting life, property, or the environment or any combination of these.

3.3.18 sUAS Program. The elements (administrative, operational, qualifications and training, safety, and maintenance) that are required within the structure of a public safety entity in order to support sUAS operations that are safe, efficient, and feasible.

3.3.19 Sustainable Life Cycle. A determination made by a public safety entity in relation to the ability of sUAS manufacturer, system provider, or both to supply replacement parts, critical maintenance, system updates, upgrades, and other applicable components critical to ensuring continuous sUAS operations.

3.3.20 UAS Coordinator. A public safety person responsible for mission coordination and local deconfliction of multiple aircraft. (PQU)

3.3.21 Unmanned Aircraft. An aircraft operated without the possibility of direct human intervention from within or on the aircraft. [14 CFR Part 107, 2016]

3.3.22 Visual Observer. A person who assists the RPIC and the person manipulating the flight controls of the small UAS (if that person is not the RPIC) to see and avoid other air traffic or objects aloft or on the ground. [14 CFR Part 107, 2016] (PQU)

Chapter 4 Organizational Deployment and Considerations for sUAS

4.1 Administration.

4.1.1 Scope. The chapter shall identify the minimum requirements relating to the organization, deployment, and selection of sUAS when used for operations supporting public safety entities *(see 1.6.1)*.

4.1.2 Purpose. The purpose of this chapter shall be to provide minimum requirements that address the criteria a public safety entity is required to consider for sUAS operations.

4.1.3 Application. This chapter shall apply to all elements of sUAS when utilized by public safety entities, such as sUAS program criteria, sUAS mission objectives and goals, sUAS selection, concepts of operations (ConOps), and operational applications.

4.1.4 Definitions.

4.1.4.1 Designated Operations Area (DOA). The operating area or location defining the volume of airspace to include altitude in Above Ground Level (AGL) or Mean Sea Level (MSL), and the defined geographical operational perimeter for a given public safety mission.

4.1.4.2* Digital Media Evidence (DME). The digital recording of images, sounds, and associated data with probative value stored or transmitted in binary form.

4.1.4.3 Incident Commander (IC). The individual responsible for all incident activities, including the development of strategies and tactics and the ordering and the release of resources. The IC has overall authority and responsibility for conducting incident operations and is responsible for the management of all incident operations at the incident site. [FEMA — ICS Glossary, 2008]

4.1.4.4 Incident Command System (ICS). A standardized on-scene emergency management construct specifically designed to provide for the adoption of an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. ICS is the combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure, designed to aid in the management of resources during incidents. It is used for all kinds of emergencies and is applicable to small as well as large and complex incidents. ICS is used by various jurisdictions and functional agencies, both public and private, to organize field-level incident management operations. [FEMA — ICS Glossary, 2008]

4.1.4.5* Public Safety Entity. Any entity involved with public safety that has a mission to protect life, property, or the environment or any combination of these.

4.1.4.6 Remote Pilot in Command (RPIC). The person who has been found by the public safety entity to be properly qualified to exercise the privileges of remote pilot and has the final authority and responsibility for the operation and safety of sUAS operation as determined by the AHJ. (PQU)

4.1.4.7 Risk Assessment. The evaluation of the relative danger of sUAS operations when taking into consideration mission objectives and goals, sUAS, professional qualifications of the RPIC and visual observer, operational readiness of the crew, weather conditions, environmental conditions, regulatory requirements, potential hazards, and operating conditions. (PQU)

4.1.4.8 Small Unmanned Aircraft. Small unmanned aircraft means an unmanned aircraft weighing less than 55 lb (25 kg) including everything that is on board the aircraft. [14 CFR Part 107, 2016]

4.1.4.9 Small Unmanned Aircraft Systems (sUAS). Small unmanned aircraft system (sUAS) means a small unmanned aircraft and its associated elements (including communication links and the components that control the small unmanned aircraft) that are required for the safe and efficient operation of the small unmanned aircraft in the national airspace system. [14 CFR Part 107, 2016]

4.1.4.10 sUAS Operations. The use of any sUAS for the purpose of protecting life, property, the environment or any or all of the above.

4.1.4.11 sUAS Program. The elements (administrative, operational, qualifications and training, safety and maintenance) that are required within the structure of a public safety entity in order to support sUAS operations that are safe, efficient and feasible.

4.1.4.12 Sustainable Life Cycle. A determination made by a public safety entity in relation to the ability of sUAS manufacturers, system provider, or both to supply replacement parts, critical maintenance, system updates, upgrades and other applicable components critical to ensuring continuous sUAS operations.

4.1.4.13 Unmanned Aircraft. Unmanned aircraft means an aircraft operated without the possibility of direct human intervention from within or on the aircraft. [14 CFR Part 107, 2016]

4.1.4.14 Visual Observer. A person who assists the RPIC and the person manipulating the flight controls of the small UAS (if that person is not the RPIC) to see and avoid other air traffic or objects aloft or on the ground. [14 CFR Part 107, 2016] (PQU)

4.2 General Requirements. Public safety entities that perform sUAS operations shall comply with Sections 4.3 through 4.7.

4.3 sUAS Program Criteria.

4.3.1 Public safety entities shall develop policies and procedures for sUAS programs.

4.3.2 Prior to implementing an sUAS program, public safety entities shall adopt policies and procedures that address the following:

(1) Overall program management
(2) Operational procedures
(3) Personnel qualifications, training, and certifications
(4) Safety
(5) Care and maintenance of the aircraft, systems, and equipment

4.3.3 The decision to develop an sUAS program shall be assessed based on the following:

(1) Mission objectives
(2) Environmental conditions
(3) Resources
(4) Cost-benefit analysis

4.3.4 Public safety entities shall establish a policy that addresses data captured by the sUAS.

4.3.5 Public safety entities shall handle data collected by the sUAS for evidentiary purposes in accordance with the regulatory requirements as determined by the AHJ and policies governing DME.

4.3.6 Public safety entities shall handle data collected by the sUAS not of evidentiary value in accordance with the regulatory requirements as determined by AHJ.

4.3.7 Public safety entities shall have a policy that restricts data collection to what is necessary to accomplish the sUAS operation.

4.4 sUAS Mission Objectives and Goals — Operational Needs Assessment.

4.4.1 The deployment of sUAS operations shall be considered an additional segment of an operation or an operation of its own.

4.4.2 The deployment of sUAS operations shall be assessed based on the following:

(1) Mission objectives
(2) Risk assessment
(3) Availability and capability of resources

4.5 sUAS Selection — Needs of the Public Safety Entity.

4.5.1 A purchase specification for the sUAS shall be completed by the public safety entity prior to commencing the acquisition process.

4.5.2 The purchase specifications shall be based on the specific uses and applications as determined by the operational needs assessment.

4.5.3* Any purchase specification shall consider the following:

(1) Operational requirements
(2) Minimum system configuration and specifications
(3) Quantitative data demonstrating sUAS capabilities
(4) Sustainable life cycle

4.6 Concepts of Operations (ConOps).

4.6.1 General Operations.

4.6.1.1 The RPIC of sUAS shall be directly responsible for, and is the final authority on, the operation of that aircraft.

4.6.1.2 sUAS operations shall only be conducted following a risk assessment that is performed by the RPIC.

4.6.1.3* The risk assessment shall address the operational risks severity and the operational risks probability.

4.6.1.4 Prior to sUAS operations, the RPIC shall develop mitigations to reduce the risks identified.

4.6.1.5 The RPIC shall verify mitigations do not create new hazards to the operation.

4.6.1.6* sUAS operations shall comply with all regulatory requirements as determined by the AHJ based on their type of operation.

4.6.1.7 sUAS operations shall only be conducted for authorized missions in accordance with the public safety entities policies and procedures.

4.6.1.8 sUAS operations shall be incorporated within ICS, when established.

4.6.1.9 sUAS operations shall be performed by individuals meeting the requirements of Chapter 5.

4.6.1.10 Deployment of sUAS operations shall include the establishment of take-off, landing, and drop zones to allow for safe operations.

4.6.1.11* Contaminated sUAS shall be decontaminated in accordance with the policies and procedures established by the public safety entity.

4.6.2 Multiple Aircraft Operations.

4.6.2.1 A UAS Coordinator shall oversee multiple RPICs during active multiple aircraft operations.

4.6.2.2 The public safety entity shall conduct and document multiple sUAS training at a specific training site that will remain well clear of housing areas, roads, people, and watercraft.

4.6.2.3 Each aircraft and ground control station (GCS) shall have visible markings to individually identify the aircraft as a means to distinguish aircraft and GCS among others at the incident scene.

4.6.2.4 Lights of an individual color shall be used to identify the individual aircraft being controlled by the RPICs and observed by the visual observer.

4.6.2.5 Lights of an individual color used for day or night operations shall be designed to be visible from a distance of no less than 3 statute miles (4.8 km) at night.

4.6.2.6 A separate RPIC and visual observer shall be used for each aircraft operating in the DOA.

4.6.2.7 A protocol shall be established to minimize the risk of an in-flight conflict between multiple aircrafts during all of the following:

(1) Launch
(2) Flight and recovery
(3) Lost communication link event
(4) Loss of GPS signal

4.6.2.8 The UAS Coordinator shall conduct a pre-mission briefing with all RPICs and visual observers.

4.6.2.9 The pre-mission briefing shall include the following:

(1) Airspace authorization
(2) Altitudes to be flown
(3) Mission overview, including handoff procedures
(4) Frequencies to be used
(5) Flight time, including reserve fuel or battery requirements
(6) Contingency procedures, including lost link, divert, and flight termination
(7) Hazards unique to the flight being flown
(8) Protocol to prevent in-flight conflict

4.7 Operational Applications.

4.7.1* Firefighting. Public safety entities that utilize sUAS for firefighting applications shall identify what tactics and functions associated with firefighting are supported by sUAS operations.

4.7.2* Search and Rescue. Public safety entities that utilize sUAS for search and rescue applications shall identify what tactics and functions associated with search and rescue are supported by sUAS operations.

4.7.3* Hazardous Materials Response. Public safety entities that utilize sUAS in hazardous materials response shall identify what tactics and functions associated with hazardous materials response are supported by sUAS operations.

4.7.4* Emergency Medical Services (EMS) Operations.

4.7.4.1 Public safety entities that utilize sUAS in emergency medical intervention shall identify what functions associated with EMS intervention are supported by sUAS operations.

4.7.4.2 EMS providers shall ensure all sUAS used in emergency medical intervention are in accordance with the local medical control authority.

4.7.4.3* Public safety entities shall comply with patient privacy regulations as relating to the data captured during sUAS operations.

4.7.5* Law Enforcement Operations.

4.7.5.1 Public safety entities that utilize sUAS for law enforcement applications shall identify what tactics and functions associated with law enforcement are supported by sUAS operations.

4.7.5.2 Law enforcement agencies shall have written policies that strictly comply with existing laws and statutes to ensure sUAS operations are conducted in a lawful manner.

4.7.6* Other Operational Applications. Public safety entities that perform sUAS operations for other ancillary public safety services shall identify what functions are supported by sUAS operations.

Chapter 5 Professional Qualifications for sUAS Public Safety Personnel

5.1 Administration.

5.1.1 Scope. This chapter shall identify the minimum JPRs for RPIC and visual observer for sUAS when used by public safety personnel *(see 1.6.2)*.

5.1.2 Purpose. This chapter shall specify the minimum JPRs when serving as an RPIC and visual observer for sUAS operations by public safety entities.

5.1.2.1 This chapter shall define RPIC and visual observer positions for public safety entities.

5.1.2.2* The purpose of this chapter shall be to ensure that individuals serving as RPICs and visual observers of sUAS operations by public safety entities are qualified to do so.

5.1.2.3 This chapter shall not address organization or management responsibility.

5.1.2.4 It shall not be the purpose of this chapter to restrict any jurisdiction from exceeding or combining these minimum requirements.

5.1.2.5 JPRs for each level and position are the tasks personnel shall be able to perform to carry out the job duties.

5.1.2.6 Public safety personnel who operate or support sUAS operations shall remain current with the general knowledge, skills, and JPRs addressed for each level or position of qualification.

5.1.2.7 Public safety personnel who operate or support sUAS operations shall remain current with practices and applicable standards.

5.1.2.8 sUAS shall be operated within the design limitations and manufacturer's specifications.

5.1.3 Application. The application of this chapter is to specify which requirements within the standard shall apply to specific personnel who operate and support sUAS operations by public safety entities.

5.1.3.1 The JPRs shall be accomplished in accordance with the requirements of the AHJ and all applicable NFPA and other standards development organization (SDO) standards.

5.1.3.2 Priority.

5.1.3.2.1 It shall not be required that the JPRs be mastered in the order in which they appear.

5.1.3.2.2 The public safety entity shall establish instructional priority and training program content to prepare personnel to meet the JPRs of this standard.

5.1.3.3 The performance of each requirement of this chapter shall be evaluated by personnel approved by the AHJ.

5.1.3.4 The JPRs for each level or position shall be completed in accordance with recognized practices and procedures or as defined by law or by the AHJ.

5.1.3.5 Public safety personnel who operate or support sUAS operations shall meet the requirements of this chapter for each make and model of small unmanned aircraft in operation.

5.1.3.6 The public safety entity shall ensure the applicable equipment, personal protective equipment (PPE), force protection, and clothing are utilized to safely conduct operations.

5.1.3.7 JPRs involving exposure to products of combustion shall be performed in approved PPE.

5.1.3.8 Prior to training to meet the requirements of this chapter, personnel shall meet the following requirements:

(1) Educational requirements established by the AHJ
(2) Age requirements established by the AHJ
(3) Medical evaluation, as required by occupational safety and health standards
(4) Job-related physical performance requirements established by the AHJ

5.1.3.9 Wherever in this chapter the terms rules, regulations, regulatory requirements, policies, procedures, or legislative requirements are referred to, it is implied that they are those of the AHJ.

5.1.4 Definitions.

5.1.4.1 Crew Readiness. The availability and readiness of the RPIC and visual observer to deploy for sUAS operations given their knowledge and completion of pre-flight duties. (PQU)

5.1.4.2 Data Acquisition. The collection of information from sUAS for the purpose of fulfilling the mission objectives and goals in accordance with the mission plan. (PQU)

5.1.4.3 Payload Drop. The release of an item or package from sUAS for the purpose of fulfilling the mission objectives and goals in accordance with the mission plan. (PQU)

5.1.4.4 Positive Aircraft Control. Consistently maintaining appropriate control of the aircraft, regardless of the phase of flight or potential distraction of other required tasks. (PQU)

5.1.4.5 Public Safety Personnel. Any individual involved with public safety that has a mission to protect life, property, or the environment or any combination of these. (PQU)

5.1.4.6* Remote Pilot in Command (RPIC). The person who has been found by the public safety entity to be properly qualified to exercise the privileges of remote pilot and has the final authority and responsibility for the operation and safety of sUAS operation as determined by the authority having jurisdiction (AHJ). (PQU)

5.1.4.7 Resources. The equipment, personnel, and facilities required for the sUAS operations provided by the public safety department. (PQU)

5.1.4.8 Risk Assessment. The evaluation of the relative danger of sUAS operations when taking into consideration mission objectives and goals, sUAS, professional qualifications of the RPIC and visual observer, operational readiness of the crew, weather conditions, environmental conditions, regulatory requirements, potential hazards, and operating conditions. (PQU)

5.1.4.9* UAS Coordinator. A public safety person responsible for mission coordination and local deconfliction of multiple aircraft. (PQU)

5.1.4.10 Visual Observer. A person who assists the RPIC and the person manipulating the flight controls of the small UAS (if that person is not the remote pilot in command) to see and avoid other air traffic or objects aloft or on the ground. [14 CFR Part 107, 2016] (PQU)

5.2 General Requirements.

5.2.1 RPIC, Visual Observers, and Other Supervisory Personnel.

5.2.1.1 Public safety personnel engaged in sUAS operations shall comply with all regulations as required by the authority having jurisdiction.

5.2.1.2 Public safety personnel utilizing more than one aircraft for any type of operation shall have a UAS coordinator.

5.2.2 RPIC.

5.2.2.1 The RPIC shall meet the job performance requirements defined in Section 5.3.

5.2.2.2 The job performance requirements defined in Section 5.3 shall apply to the following:

(1) Normal conditions for sUAS operations
(2) Extreme or emergency conditions for sUAS operations

5.2.3 Visual Observer.

5.2.3.1 Visual observers shall meet the job performance requirements defined in Section 5.4.

5.2.3.2 During flight visual observers shall not perform other roles.

5.2.3.3 The visual observer shall be trained prior to deployment in pre-flight, flight, and post-flight duties in accordance with the public safety entities operating procedures.

5.3 RPIC. Duties shall include performing pre-flight, flight, and post-flight functions for sUAS operations.

5.3.1 Pre-Flight.

5.3.1.1 Plan sUAS operations given mission objectives and goals, resources, environmental conditions, and scenarios, so that a mission plan is completed that aligns with the mission objectives and goals, identifies the resources required, assesses the risks associated with the mission, and identifies the operational tasks necessary to complete the mission.

(A) Requisite Knowledge. Knowledge of airspace requirements, weather conditions, crew readiness, resource capabilities, ICS, risk assessments, and regulatory requirements.

(B) Requisite Skills. The ability to produce and communicate a mission plan.

5.3.1.2 Prepare the sUAS operation given a mission plan and resources, so that the sUAS is operated by confirming a state of readiness that demonstrates possession, configuration, and operational functions are checked and verified as operational.

(A) Requisite Knowledge. Knowledge of procedures and information needed to identify, configure, and check systems.

(B) Requisite Skills. The ability to identify, assemble, configure, and verify the operational functionality of sUAS.

5.3.2 Flight.

5.3.2.1 Perform take-off under the regulatory requirements as determined by the AHJ given a specific sUAS and confirmed state of readiness, so that the sUAS takes off after having completed system checks and flight is initiated and maintained in a manner compliant with regulatory requirements.

(A) Requisite Knowledge. Knowledge of aircraft, systems, payload, and changes in environmental conditions, weather, and regulatory requirements relating to the use and operation of sUAS.

(B) Requisite Skills. The ability to operate the specific sUAS and maintain control in a safe manner during this phase of flight.

5.3.2.2 Maintain visual line of sight given an sUAS in flight along a designated flight path under the regulatory requirements as determined by the AHJ, so that the sUAS is maneuvered in a manner that avoids obstacles and reaches targeted locations and altitudes without losing line of sight of the sUAS in accordance with the approved operational flight plan.

(A) Requisite Knowledge. Knowledge of regulatory requirements, capabilities, and operational controls of the specific sUAS.

(B) Requisite Skills. The ability to operate the specific sUAS and maintain control in a safe manner during this phase of flight.

5.3.2.3* Perform aerial maneuvers given an sUAS in flight within a designated airspace under the regulatory requirements as determined by the AHJ, so that the operator demonstrates positive aircraft control in accordance with the approved operational flight plan.

(A) Requisite Knowledge. Knowledge of regulatory requirements, capabilities, and operational controls of the specific sUAS.

(B) Requisite Skills. The ability to operate the specific sUAS, activate different sUAS functions, and maintain control in a safe manner during this phase of flight.

5.3.2.4* Perform payload functionality given an sUAS in flight within a designated airspace under the regulatory requirements as determined by the AHJ, so that the sUAS is maneuvered in a manner that avoids obstacles and demonstrates payload drop, payload application, or data acquisition at targeted locations in accordance with the mission plan.

(A) Requisite Knowledge. Knowledge of mission plan, objectives, regulatory requirements, capabilities, operation of payload functions, and operational controls of the specific sUAS.

(B) Requisite Skills. The ability to operate the specific sUAS, activate different payload functions, and maintain control in a safe manner during this phase of flight.

5.3.2.5 Perform pre-landing procedures given an sUAS in flight within a designated airspace under the regulatory requirements as determined by the AHJ, so that the sUAS is maneuvered in a manner that avoids obstacles while reaching a clear landing area, establishes a configuration for landing, and confirms a decent path free of obstructions.

(A) Requisite Knowledge. Knowledge of aircraft, systems, payload, and the effects of changes in environmental conditions, weather, and airspace requirements for the specific sUAS.

(B) Requisite Skills. The ability to operate the specific sUAS and maintain control in a safe manner during this phase of flight.

5.3.2.6 Perform a landing given an sUAS in flight within a designated airspace under the regulatory requirements as determined by the AHJ and having completed pre-landing procedures, so that the sUAS is maneuvered in a manner that avoids obstacles and is able to touch down at a clear landing area and ceases operational functions without any damage to the sUAS.

(A) Requisite Knowledge. Knowledge of small unmanned aircraft, systems, payload, and the effects of changes in environmental conditions, weather, and regulatory requirements for the specific sUAS.

(B) Requisite Skills. The ability to operate the specific sUAS and maintain control in a safe manner during this phase of flight.

5.3.3 Post-Flight.

5.3.3.1 Complete post-flight procedures given an sUAS that has performed a successful landing, so that the sUAS is visually inspected for damage, configured for transport and storage, confirmed ready for service through immediate maintenance, or out of service for scheduled maintenance.

(A) Requisite Knowledge. Knowledge of small unmanned aircraft, systems, payload, transport mechanisms, and storage procedures for the specific sUAS.

(B) Requisite Skills. The ability to complete log books, forms, records, and any digital programs for information from sUAS operations.

5.3.3.2 Conduct a mission debrief given a mission plan and ended sUAS operation, so that the operational tasks necessary to complete the mission are identified as complete, incomplete, or deviated from the designated mission plan for specific reasons.

(A) Requisite Knowledge. Knowledge of mission plan elements, contents, and the potential impact of changes in environmental conditions, weather, and regulatory requirements on the specific sUAS.

(B) Requisite Skills. The ability to communicate and present information obtained from sUAS operations.

5.4 Flight. Duties shall include performing pre-flight and in-flight functions for sUAS operations.

5.4.1 Pre-Flight.

5.4.1.1 Evaluate operational role given a mission plan, RPIC, and sUAS operation, so that operational tasks necessary to support the mission are identified, listed, and communicated to the RPIC.

(A) Requisite Knowledge. Knowledge of airspace requirements, weather conditions, and regulatory requirements.

(B) Requisite Skills. The ability to review, understand, and support a mission plan.

5.4.2 Flight.

5.4.2.1 Maintain visual line of sight of the sUAS given an RPIC and an sUAS in flight along a designated flight path under the regulatory requirements as determined by the AHJ, so that obstacles are identified and communicated to the RPIC prior to a potential collision and in a time that allows for corrective action.

(A) Requisite Knowledge. Knowledge of regulatory requirements and operational and flight capabilities of the specific sUAS.

(B) Requisite Skills. The ability to communicate verbally to the RPIC.

Chapter 6 Maintenance of sUAS

6.1 Administration.

6.1.1 Scope. This chapter shall identify minimum requirements for the maintenance of sUAS when used for public safety operations. *(See 1.6.3.)*

6.1.2 Purpose. The chapter shall establish procedures as part of a program to provide maintenance for sUAS when used by public safety entities in order to reduce risks associated with poorly maintained, contaminated, or damaged sUAS and ensure airworthiness.

6.1.3 Application. The chapter shall apply to new and existing sUAS used by public safety entities.

6.1.4 Definitions.

6.1.4.1 Maintenance Program. A maintenance program is a system or set of procedures for the continuous maintenance of the sUAS in order to ensure airworthiness.

6.2 General Requirements.

6.2.1 Public safety entities that utilize sUAS shall establish a maintenance program in accordance with this chapter.

Δ **6.2.2** The maintenance program shall be documented and address all components of the system, maintenance personnel, and training.

Δ **6.2.3** The maintenance program shall comply with the system manufacturer's recommendations, if provided.

N **6.2.3.1** If the system manufacturer's recommendations are not provided, the public safety entity shall develop its own program.

Δ **6.2.4** Maintenance programs shall include scheduled and unscheduled maintenance requirements.

6.2.5 As part of the maintenance program, the public safety entity shall have procedures for service for the following:

(1) Routine cleaning
(2) Decontamination
(3) Maintenance necessary due to operational applications
(4) Maintenance necessary due to operating environment
(5) Storage requirements

6.2.6 Maintenance programs shall identify the following:

(1) List of personnel authorized to perform each type of maintenance
(2) Necessary qualifications of personnel authorized to perform maintenance
(3) Maintenance only performed by the manufacturer

6.2.7 Discrepancy Reporting.

6.2.7.1 Maintenance programs shall have a documented discrepancy reporting procedure for unscheduled maintenance.

6.2.7.2 Discrepancy reporting shall include procedures for removing the sUAS from service, including procedures for identifying those systems determined to be out of service.

6.2.8 Maintenance programs shall require post-maintenance systems checks appropriate to the level of maintenance performed, including firmware and software updates, prior to returning the sUAS to service.

6.2.9 Maintenance programs shall have a documented battery storage, charging, disposal, and emergency procedures policy in accordance with the manufacturer's recommendations or agency instructions.

6.2.10 Maintenance programs shall have a documented parts storage policy in accordance with the manufacturer's instructions.

6.2.11 Recordkeeping.

6.2.11.1 Maintenance programs shall require documentation of all maintenance activities in a logbook.

6.2.11.2 Unless in conflict with any retention policies or laws as determined by the AHJ, maintenance records shall be retained by the public safety department for the life of the sUAS.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.3.2 Small unmanned aircraft means an unmanned aircraft weighing less than 55 lb on takeoff, including everything that is on board or otherwise attached to the aircraft. The weight limit defining a small unmanned aircraft will vary from country to country and quite often will be determined by the applicable aviation authority. The current definition is based on regulations in the United States developed by the Federal Aviation Administration (FAA). 14 CFR Part 107, often referred to as "the Small Unmanned Aircraft Rule — Part 107" establishes the less than 55 lb (25 kg) weight limit used in this standard for small unmanned aircraft. Public safety entities will need to apply the applicable weight limit, if any, based on the AHJ.

A.1.5 For example, the AHJ includes the aviation regulatory authority having jurisdiction. In the United States, this is the FAA. Internationally, this is the applicable national civil aviation authority.

A.1.6.6 For example, the corresponding annex to 4.1.1 will be A.4.1.1, for 5.1.1 it will be A.5.1.1, and for 6.1.1 it will be A.6.1.1.

Δ **A.3.2.1 Approved.** The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment, or materials, the "authority having jurisdiction" may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The "authority having jurisdiction" may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA standards in a broad manner because jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.4.1.4.2 Digital Media Evidence (DME). The term DME used in this standard refers specifically to data associated with that form of DME.

A.4.1.4.5 Public Safety Entity. The following is a nonexhaustive list of different types of public safety entities:

(1) Fire Service
(2) Law Enforcement
(3) Emergency Medical Services (EMS)
(4) Emergency Management
(5) Search and Rescue
(6) Hazardous Materials Response

Δ **A.4.5.3** Within the purchase specification there are many additional elements a public safety entity needs to consider. This annex providences further guidance on topics such as life cycle sustainability, the evaluation of system capabilities, minimum system considerations, and data link security.

Public safety departments will need to consider the life cycle sustainability of any sUAS they intend to purchase. The ability of a manufacturer to supply replacement parts, critical maintenance, system updates (firmware/software), upgrades, and other applicable components is essential to ensuring continuous sUAS operations. Manufacturer considerations can include, but are not limited to, the following:

(1) Length of time the manufacturer built or sold sUAS
(2) Mean time between failures
(3) Availability — the mean time (how long one can expect to wait) to repair
(4) Total number of systems delivered
(5) Total number of systems in use by public safety departments
(6) Feedback from existing customers
(7) Recorded performance data

In order to evaluate system capabilities, the public safety entity should consider conducting the following procedure based on the purchase specification:

(1) Define and prioritize a list of mission objectives for the sUAS as determined by the operational needs assessment. An example of a mission objective might be to visually identify an object of interest from a given altitude and distance, then deliver a payload to a target location.
(2) Decompose the envisioned mission objectives into their essential mission capabilities. Following the same examples, the system should have a certain level of visual acuity, and potentially also a level of thermal acuity, from the expected altitude. It should have an expected endurance range and time given the payload weight, plus a number of other essential capabilities and safeguards for such a mission to be successful.
(3) Identify the list of applicable standard test methods (with or without acceptance criteria) representing those essential mission capabilities. Examples of test method categories include safety, maneuvering, sensing, situational awareness, energy, communications, durability, and logistics. Annex D provides a list of potential test methods currently in development that could provide such information.
(4) Review the quantitative capabilities data captured within the test methods for the class of sUAS being considered. If particular systems have not yet been tested, ask the manufacturer to provide the results of such testing.
(5) Assess existing combinations of capabilities for available systems to align with envisioned missions.
(6) Consider the value of these systems by comparing system costs vs. their capabilities relative to the "best-in-class" identified in the quantitative data. It is sometimes easiest for comparison purposes to ask each manufacturer to quote a system and related components adding up to a fixed (arbitrary) cost to directly compare value.

(7) Specify your chosen sUAS capabilities for procurement using all applicable test methods with related acceptance criteria as referenced from the quantitative data.
(8) If possible, perform acceptance testing using selected high priority test methods to ensure the delivered system meets the acceptance criteria.

Public safety entities acquiring sUAS should consider the following minimum system considerations for that purchase. These specifications ensure the system has the ability to perform the identified mission safely and effectively.

(1) The small unmanned aircraft should be capable of autonomously executing emergency procedures without the need for inputs by the RPIC for the following situations:
    (a) Loss of the command and control communications link
    (b) Loss of global positioning system signal
(2) sUAS being considered should have the sensors required to perform the identified missions available to meet the identified mission objectives.
(3) The sUAS should be capable of streaming video live to the incident command post or other locations if that requirement is needed to satisfy the identified mission set.
(4) sUAS should be able to record flight telemetry including the following: date, time, altitude, and GPS coordinates. This recorded information allows the agency to document the location of the aircraft for evidentiary value or complaint investigations.
(5) The sUAS control station (the interface used by the RPIC to control the sUAS) should have the ability to monitor the strength of the command and control communications signal between the control station and air vehicle to present loss of that signal and thus control of the air vehicle.
(6) The sUAS control station should have the capability to monitor battery or fuel load of the air vehicle at the control station. This information will be crucial in order to ensure sufficient power or fuel exists to complete the mission objectives and allow for safe return and recovery.
(7) sUAS should have the ability to monitor altitude above ground level at the ground control station (GSC).
(8) sUAS should have a tamper-proof flight time calculator. The ability to account for all flight time to assure that all flights are approved and documented is essential to assure appropriate use of the system. A tamper-proof system tabulates flight time and allows only authorized personnel to reset that calculator.
(9) sUAS intended for use at night or during civil twilight time should have lighted anticollision lighting visible for at least 3 statute miles (required by 14 CFR Part 107). In addition to anti-collision lighting, the air vehicle can be equipped with standard aircraft position lights and painted in high-visibility colors to aid in maintaining visual sight of the air vehicle.
(10) The manufacturer should be able to provide the following based on the specific sUAS purchased by the public safety department:
    (a) System operating manual
    (b) Maintenance manual or maintenance procedures
(11) The manufacturer should provide the following standardized programs for any sUAS purchased by the public safety department:
    (a) Training program for RPICs
    (b) System maintenance program
(12) The manufacturer should provide the following standardized checklists based on the specific sUAS purchased by the public safety department:
    (a) Pre-flight
    (b) Launch
    (c) Pre-landing
    (d) Recovery/landing
    (e) Post-flight

Note that the US National Institute of Justice publication, *"Considerations and Recommendations for Implementing an Unmanned Aircraft Systems (UAS) Program,"* lists additional recommendations for public safety sUAS specifications.

Public safety entities should consider the need for data link security in relation to the sUAS they intend to purchase. All unmanned aircraft systems use wireless communications links to control the aircraft and to downlink data from its airborne sensors. Many sUAS use minimal, if any, encryption to protect those signals from being compromised. Should this happen, the command and control signal is blocked and either someone else can take control of the aircraft or the aircraft will "fly away" uncontrolled. For data being downlinked, it could allow others to view the data being collected. Many systems use "open source" autopilots, essentially a commercially available autopilot that can be obtained by literally anyone. By definition, any system using an open source autopilot is compromised from a security perspective as it can be obtained and used by anyone to control any system using the same autopilot.

Using multiple levels of security provides the highest level of protection. This is accomplished by manufacturers not using open source components. Next, digital data links can be secured with Advanced Encryption Standard (AES), 256-bit encryption. AES encryption is a specification for the encryption of electronic data established by the US National Institute for Standards and Technology (NIST). AES is the standard for the US federal government and is the only publicly accessible cipher approved by the National Security Agency for top-secret information.

The sUAS being acquired by the public safety entity should have an appropriate level of security, commensurate with the mission, to protect the wireless communications links used to control the aircraft and to downlink data from its airborne sensors.

A.4.6.1.3 In the United States, the FAA provides risk assessment tools which can be found in the Advisory Circular 107-2. This guidance will change based on the country you are operating from and what applicable guidance your national aviation authority uses.

A.4.6.1.6 In addition to regulatory requirements as determined by the applicable national aviation authority, there can exist additional regulations at an operational level. These can also vary based on the type of public safety entity and the type of sUAS operations provided. For example, a fire department operating sUAS for responding to incidents can be subject to different regulatory requirements than a law enforcement agency operating sUAS for reconnaissance, even if operating in the same location.

A.4.6.1.11 Public safety entities should be aware of the potential for contaminated sUAS to cross-contaminate other areas if it is allowed to leave the warm zone prior to decontamination or the sUAS returns home due to the loss of communications link.

A.4.7.1 Uses of sUAS in a firefighting environment can include, but are not limited to, the following:

(1) Assessing thermal conditions
(2) Hazard identification
(3) Personnel tracking
(4) Victim location
(5) Atmospheric condition monitoring
(6) Providing temporary illumination
(7) Assessing structural status
(8) Identification of urban interface
(9) Identification of fuel types
(10) Identification of shelter locations
(11) Identification of evacuation or escape routes
(12) Identification of fuel load

A.4.7.2 Uses of sUAS in a search and rescue environment can include, but are not limited to, the following:

(1) Missing person search
(2) Confirming victim locations
(3) Delivery of supplies
(4) Monitoring condition of victim(s)
(5) As a visual beacon
(6) Radio direction finding
(7) To help locate access routes for ground teams
(8) 3D imaging a search area or incident site
(9) Assessing structural integrity
(10) Providing temporary illumination

A.4.7.3 Uses of sUAS in hazardous materials response can include, but are not limited to, the following:

(1) Site survey
(2) Material identification
(3) Container identification and condition
(4) Monitoring hazardous product migration
(5) Delivery of supplies or equipment
(6) Help to identify safe ingress and egress routes
(7) Providing temporary illumination
(8) Monitoring personnel accountability
(9) Monitoring mass decontamination operations
(10) Atmospheric monitoring, if properly equipped

A.4.7.4 Uses of sUAS in emergency medical intervention are primarily for the delivery of supplies (including pharmaceuticals) and samples. Other uses include, but are not limited to, the following:

(1) Telemedicine
(2) Intervention delivery
(3) Equipment or recovery support
(4) Remote consultation of treatment and management

A.4.7.4.3 In the United States, the applicable patient privacy regulations are referred to as the Health Insurance Portability and Accountability Act (HIPAA) of 1996. It provides data privacy and security provisions for safeguarding medical information. This will change based on the country you are operating from and what the applicable patient privacy regulations are.

A.4.7.5 Uses of sUAS for law enforcement can include, but are not limited to, the following:

(1) Crime scene investigation
(2) Traffic control
(3) Gathering incident information
(4) Clear or maintain perimeters
(5) Reconstructions
(6) Assist with locating victim(s) or suspect(s)
(7) Documentation
(8) Identify presence and/or location of hazards
(9) Evidence collection

A.4.7.6 Uses of sUAS for other ancillary public safety operations (non-emergency) can include, but are not limited to, the following:

(1) Training/exercises
(2) Flight demonstrations
(3) Survey
(4) Pre-incident planning
(5) Visual screening
(6) Risk/vulnerability assessments
(7) Cartography
(8) Investigations
(9) Recovery operations
(10) Safety assessments
(11) Damage assessments
(12) Test flights
(13) Documentation
(14) Communications
(15) Critical Infrastructure Inspection

N **A.5.1.2.2** End users can visit https://www.nist.gov/el/intelligent-systems-division-73500/standard-test-methods-response-robots/aerial-systems for further information pertaining to the evaluation of the remote pilots proficiency.

A.5.1.4.6 Remote Pilot In Command (RPIC). Remote pilot certification can be achieved through certification of the national governing authority — that is, FAA 14 CFR Part 107, or Remote Pilot Aircraft System (RPAS) Certificate (International).

A.5.1.4.9 UAS Coordinator. The UAS coordinator ensures that multiple sUAS are separated by vertical or horizontal distance, and that each aircraft does not interfere with any other. The UAS coordinator is responsible for coordinating all UAS operations with manned aviation if these are operating on the incident. The role of the UAS coordinator can be taken on by a qualified member of the ICS air operations branch at the discretion of the IC or air operations branch director.

A.5.3.2.3 The type of sUAS (e.g., fixed wing, untethered quadcopter, or tethered quadcopter) will greatly affect the type of maneuvers the RPIC can perform. Also, the capabilities and limitations of the individual product may influence the maneuvers an RPIC can demonstrate. Any training or curriculum based on the JPR should take these factors into consideration.

The following test methods developed by the National Institute of Standards and Technology (NIST) can be applied to the JPR to demonstrate RPIC proficiency when performing aerial maneuvers:

(1) *Maintain position and rotate.* This test method evaluates the system capability to maintain position while rotating. The system performs a series of basic maneuvers using an onboard camera to align with four surrounding recessed targets angled inward toward a defined center hover position and altitude. *[See Figure A.5.3.2.3(a).]*

(2) *Orbit a point (move and rotate).* This test method evaluates the system capability to move and rotate around a point. The system performs a series of basic maneuvers using an onboard camera to align with centrally located bucket targets from a defined radius and altitude. Surrounding bucket targets are used to define the intended radius and altitude. This test method can be conducted manually using discrete move and rotate maneuvers or automatically using orbit features of the system. *[See Figure A.5.3.2.3(b).]*

(3) *Land accurately.* This test method evaluates the system capability to land accurately from vertical and downward 45-degree descending approaches. The system performs a series of landings on a metered platform from a defined range, altitude, and four different approach directions. When performing the angled approaches, the recessed targets are used to guide the descent. [*See Figure A.5.3.2.3(c).]*

(4) *Avoid obstacles (figure-8s).* This test method evaluates the system capability to maneuver around vertical obstacles (shown as yellow posts) and horizontal obstacles (shown as red bars). The system performs a series of figure-8 paths in various orientations, including nose-forward, nose-left, and nose-right. *[See Figure A.5.3.2.3(d).]*

(5) *Fly straight and level.* This test method evaluates the capability to fly straight and level using a visual target as a guide. The system performs a series of flights toward such targets either from multiple directions or in a back and forth manner between two targets using the recessed bucket target to assess deviations from the linear trajectory. *[See Figure A.5.3.2.3(e).]*

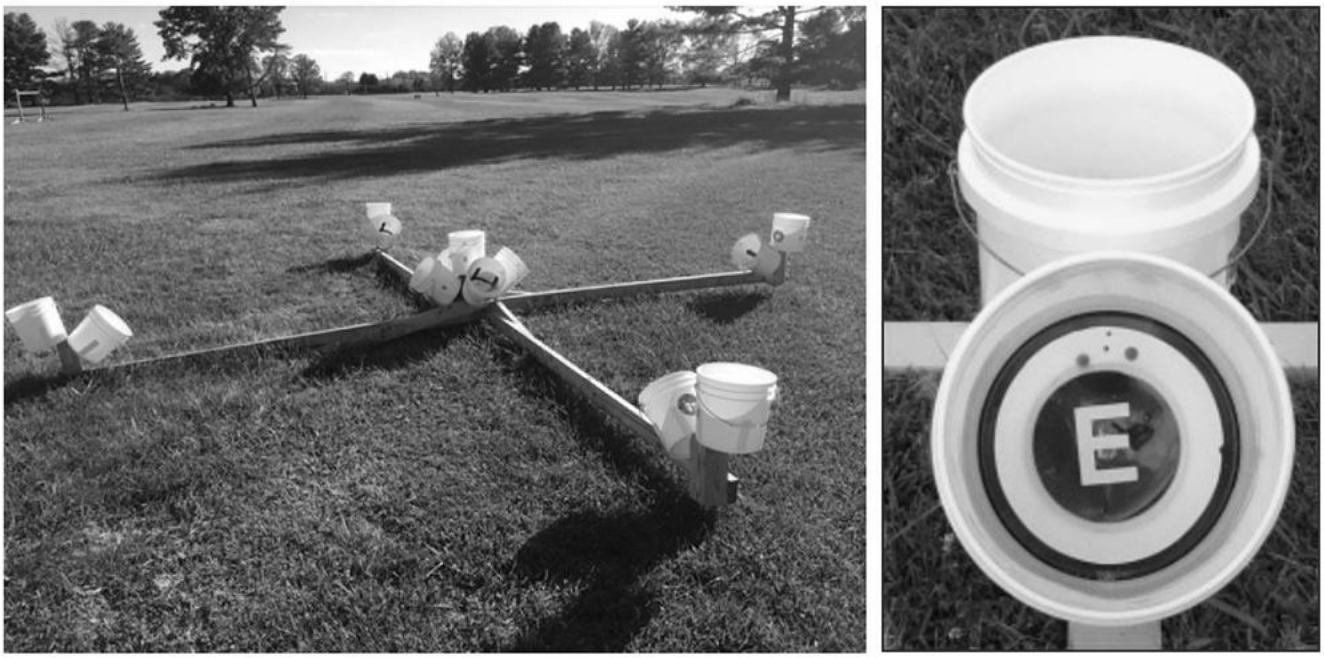


FIGURE A.5.3.2.3(a) Maintain Position and Rotate.

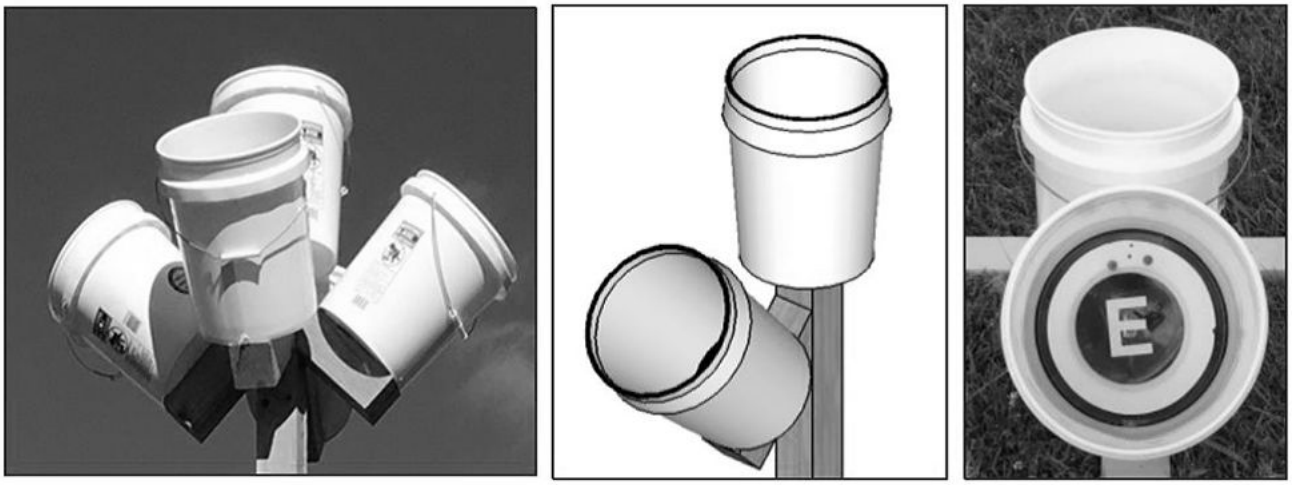


FIGURE A.5.3.2.3(b) Orbit a Point (Move and Rotate).

FIGURE A.5.3.2.3(c) Land Accurately.

FIGURE A.5.3.2.3(d) Avoid Obstacles (Figure-8s).

FIGURE A.5.3.2.3(e) Fly Straight and Level.

A.5.3.2.4 The type of sUAS (e.g., fixed wing, untethered quadcopter, or tethered quadcopter) will greatly affect the type of payload functions the RPIC can perform. Also, the capabilities and limitations of the individual product may influence the payload functions an RPIC can demonstrate. Any training or curriculum based on the JPR should take these factors into consideration.

The following test methods developed by the NIST can be applied to the JPR to demonstrate RPIC proficiency when performing payload functions:

(1) *Point and zoom cameras.* This test method evaluates the capability to point and zoom cameras at near-field and far-field visual acuity targets from a specified hover position. The system performs a series of target identifications alternating between near-field and far-field visual acuity targets separated by a 180-degree rotation. *[See Figure A.5.3.2.4(a).]*

(2) *Identify objects.* This test method evaluates the capability to move and rotate around an object of interest to identify key features. The system performs a series of basic maneuvers using an onboard camera to align with centrally located bucket targets from a defined radius and altitude. Surrounding bucket targets are used to define the intended radius and altitude. This test method can be conducted manually using discrete move and rotate maneuvers or automatically using orbit features of the system. *[See Figure A.5.3.2.4(b).]*

(3) *Inspect objects.* This test method evaluates the capability to move around an object of interest to inspect key details from close proximity. The system performs a series of basic maneuvers using an onboard camera to align with bucket targets to inspect downward, forward, omnidirectional, and upward objects. *[See Figure A.5.3.2.4(c).]*

(4) *Map wide areas.* This test method evaluates the capability to localize and map a variety of known and unknown objects across a wide area. The system performs its mapping function from a prescribed altitude intended to force extensive stitching of images. Ground targets are placed at known locations throughout a scenario. The embedded ground objects are made of standard test apparatuses used in other test methods and operationally significant items. *[See Figure A.5.3.2.4(d).]*

(5) *Drop accuracy.* This test method evaluates the capability to drop a payload accurately from a defined altitude. The system performs a series of drops on a metered platform from different altitudes. The payloads can be weighted surrogates or operationally significant delivery items. *[See Figure A.5.3.2.4(e).]*

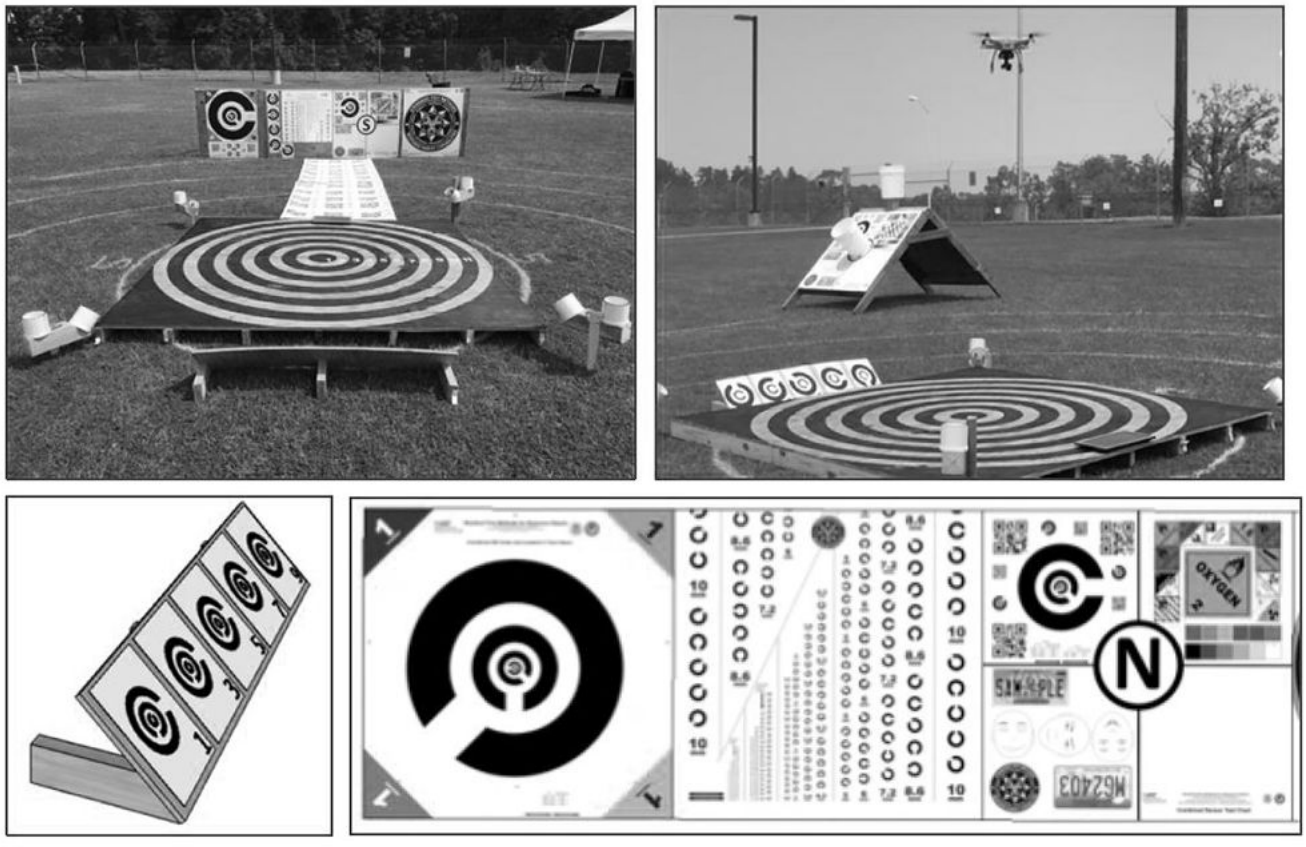


FIGURE A.5.3.2.4(a) Point and Zoom Cameras.

FIGURE A.5.3.2.4(b) Identify Objects.

FIGURE A.5.3.2.4(c) Inspect Objects.

FIGURE A.5.3.2.4(d) Map Wide Areas.

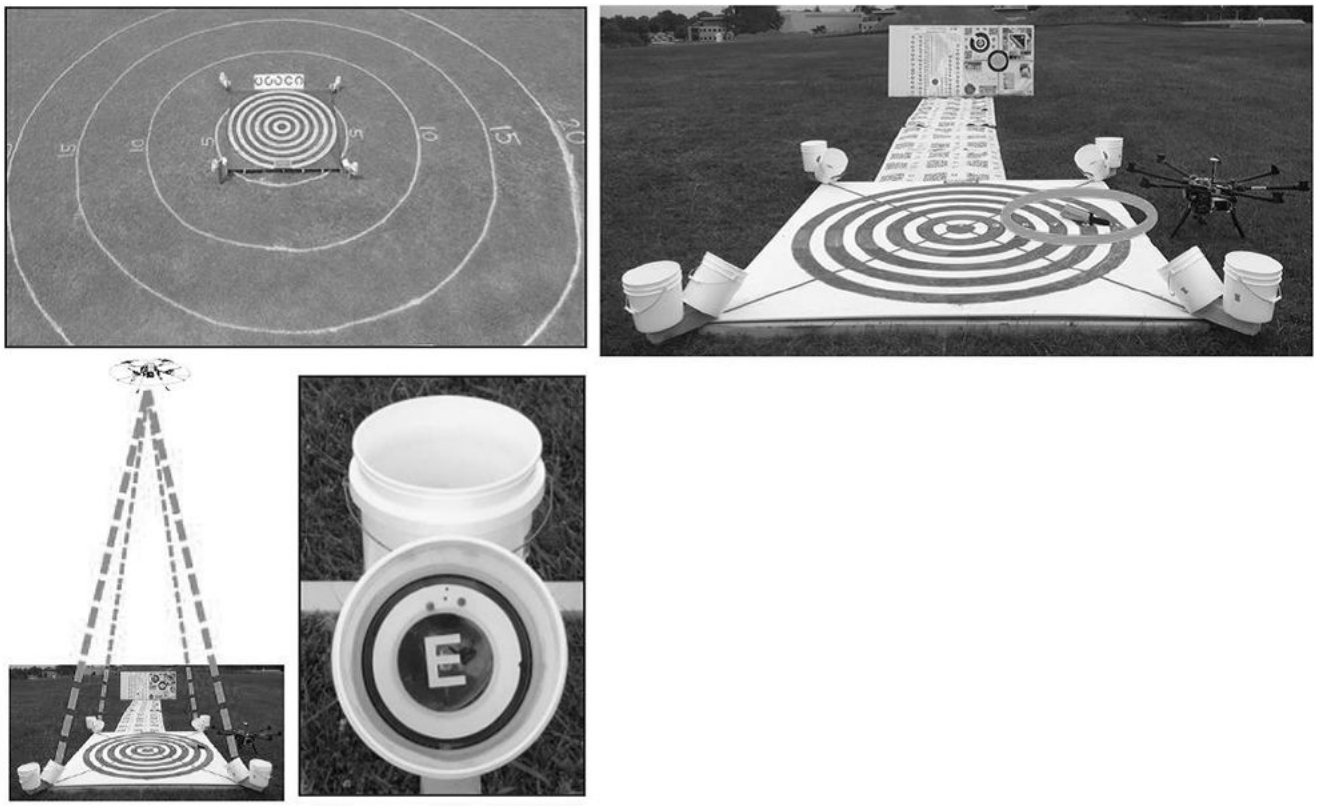


FIGURE A.5.3.2.4(e) Drop Accuracy.

Δ Annex B Explanation of the Professional Qualifications Standards and Concepts of JPRs

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

Δ B.1 Explanation of the Professional Qualifications Standards and Concepts of Job Performance Requirements (JPRs). The primary benefit of establishing national professional qualifications standards is to provide both public and private sectors with a framework of the job requirements for emergency services personnel. Other benefits include enhancement of the profession, individual as well as organizational growth and development, and standardization of practices.

NFPA professional qualifications standards identify the minimum job performance requirements (JPRs) for specific emergency services levels and positions. The standards can be used for training design and evaluation, certification, measuring and critiquing on-the-job performance, defining hiring practices, job descriptions, and setting organizational policies, procedures, and goals.

Professional qualifications standards for specific jobs are organized by major areas of responsibility defined as *duties*. For example, the firefighter's duties might include fire department communications, fireground operations, and preparedness and maintenance, whereas the fire and life safety educator's duties might include education and implementation, planning and development, and evaluation. Duties are major functional areas of responsibility within a specific job.

The professional qualifications standards are written as JPRs. JPRs describe the performance required for a specific job and are grouped according to the duties of the job. The complete list of JPRs for each duty defines what an individual must be able to do in order to perform and achieve that duty.

B.2 The Parts of a JPR.

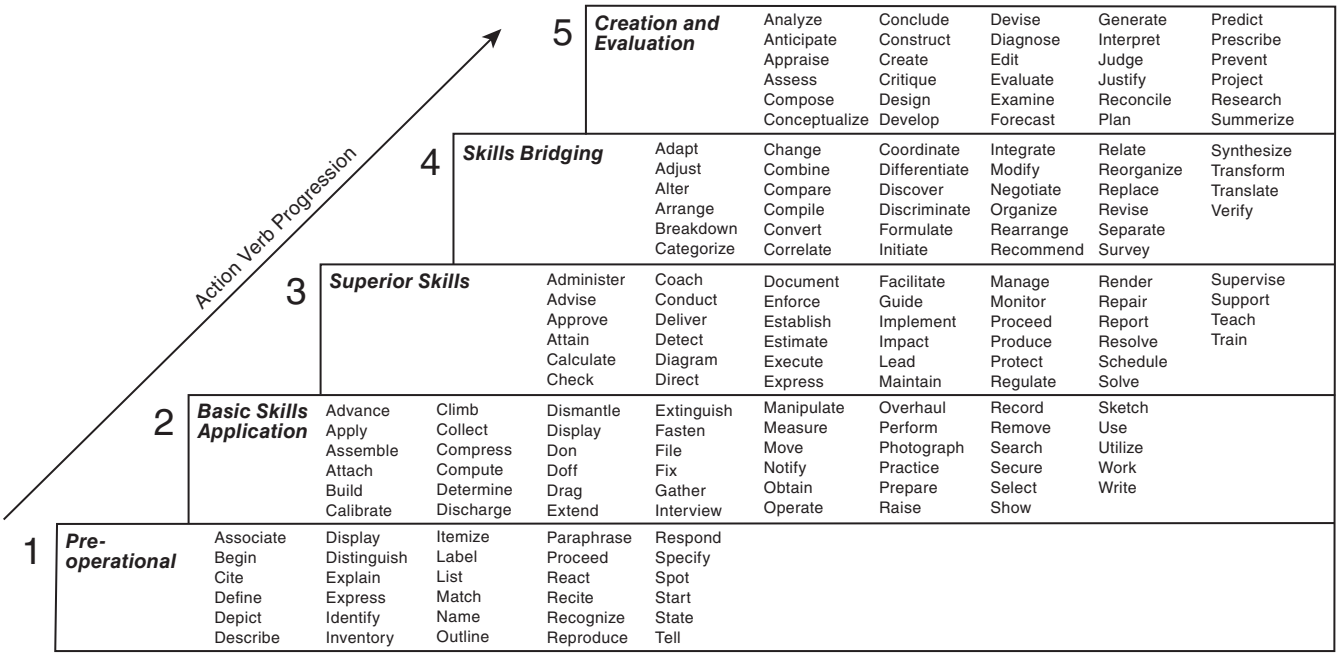
B.2.1 Critical Components. The JPR comprises three critical components, which are as follows:

(1) Task to be performed, partial description using an action verb *(See Figure B.2.1 for examples of action verbs used in the creation of JPRs.)*
(2) Tools, equipment, or materials that are to be provided to complete the task
(3) Evaluation parameters and performance outcomes

Table B.2.1 gives an example of the critical components of a JPR.

Δ Table B.2.1 Example of a JPR

(1) Task to be performed	(1) Overhaul a fire scene,
(2) Tools, equipment, or materials	(2) given PPE, attack line, hand tools, flashlight, and an assignment,
(3) Evaluation parameters and performance outcomes	(3) so that structural integrity is not compromised, all hidden fires are discovered, fire cause evidence is preserved, and the fire is extinguished.



N FIGURE B.2.1 Examples of Action Verbs.

B.2.1.1 The Task to Be Performed. The first component is a concise statement of what the person is required to do. A significant aspect of that phrase is the use of an action verb, which sets the expectation for what is to be accomplished.

B.2.1.2 Tools, Equipment, or Materials That Should Be Provided for Successful Completion of the Task. This component ensures that all the individuals completing the task are given the same tools, equipment, or materials when they are being evaluated. Both the individual and the evaluator will know what should be provided in order for the individual to complete the task.

B.2.1.3 Evaluation Parameters and Performance Outcomes. This component defines — for both the performer and the evaluator — how well the individual should perform each task. The JPR guides performance toward successful completion by identifying evaluation parameters and performance outcomes. This portion of the JPR promotes consistency in evaluation by reducing the variables used to gauge performance.

B.2.2 Requisite Knowledge and Skills. In addition to these three components, a JPR describes requisite knowledge and skills. As the term *requisite* suggests, these are the necessary knowledge and skills the individual should have prior to being able to perform the task. Requisite knowledge and skills are the foundation for task performance.

Δ **B.2.3 Examples.** With the components and requisites combined, a JPR might be similar to the two examples in B.2.3.1 and B.2.3.2.

Δ **B.2.3.1 Example: Firefighter I.** Overhaul a fire scene, given PPE, attack line, hand tools, flashlight, and an assignment, so that structural integrity is not compromised, all hidden fires are discovered, fire cause evidence is preserved, and the fire is extinguished.

(A) Requisite Knowledge. Types of fire attack lines and water application devices for overhaul, water application methods for extinguishment that limit water damage, types of tools and methods used to expose hidden fire, dangers associated with overhaul, signs of area of origin or signs of arson, and reasons for protection of fire scene.

(B) Requisite Skills. The ability to deploy and operate an attack line; remove flooring, ceiling, and wall components to expose void spaces without compromising structural integrity; apply water for maximum effectiveness; expose and extinguish hidden fires in walls, ceilings, and subfloor spaces; recognize and preserve signs of area of origin and arson; and evaluate for complete extinguishment.

B.2.3.2 Example: Fire and Life Safety Educator II. Prepare a written budget proposal for a specific program or activity, given budgetary guidelines, program needs, and delivery expense projections, so that all guidelines are followed and the budget identifies all program needs.

(A) Requisite Knowledge. Budgetary process; governmental accounting procedures; federal, tribal, state, and local laws; organizational bidding process; and organization purchase requests.

(B) Requisite Skills. Estimate project costs; complete budget forms; requisition/purchase orders; collect, organize, and format budgetary information; complete program budget proposal; and complete purchase requests.

B.3 Potential Uses for JPRs.

Δ **B.3.1 Certification.** JPRs can be used to establish the evaluation criteria for certification at a specific job level. When used for certification, evaluation should be based on the successful completion of JPRs.

The evaluator would verify the attainment of requisite knowledge and skills prior to JPRs evaluation. Verification could be through documentation review or testing.

The individual seeking certification should be evaluated on the completion of the JPRs. The individual should perform the task and be evaluated based on the evaluation parameters and performance outcomes. This performance-based evaluation is based on practical exercises for psychomotor skills and written examinations for cognitive skills.

Psychomotor skills are those physical skills that can be demonstrated or observed. Cognitive skills cannot be observed but rather are evaluated on how an individual completes a task (process-oriented) or a task's outcome (product-oriented).

Performance evaluation requires that individuals be given the tools, equipment, or materials listed in the JPRs in order to complete the task.

Table B.3.1 provides examples of how assessment methodologies can be utilized by a certifying body.

B.3.2 Curriculum Development and Training Design and Evaluation. The statements contained in this document that refer to job performance were designed and written as JPRs. Although a resemblance to instructional objectives might be present, these statements should not be used in a teaching situation until after they have been modified for instructional use.

JPRs state the behaviors required to perform specific skills on the job, as opposed to a learning situation. These statements should be converted into instructional objectives with behaviors, conditions, and the degree to be measured within the educational environment.

While the differences between JPRs and instructional objectives are subtle in appearance, their purposes differ. JPRs state what is necessary to perform the job in practical and actual experience. Instructional objectives, on the other hand, are used to identify what students should do at the end of a training session and are stated in behavioral terms that are measurable in the training environment.

By converting JPRs into instructional objectives, instructors would be able to clarify performance expectations and avoid confusion caused by using statements designed for purposes other than teaching. Instructors would be also able to add jurisdictional elements of performance into the learning objectives as intended by the developers.

Requisite skills and knowledge could be converted into enabling objectives, which would help to define the course content. The course content would include each item of the requisite knowledge and skills ensuring that the course content supports the terminal objective.

N **Table B.3.1 Assessment Methodology Sample Utilization**

Assessment of…	How Assessed?	How Scored?	Methodology Is Likely…
Knowledge/facts *Action verb examples:* identify, define, list, cite, state, choose, name	A written test in which the candidate is required to provide specific answers to specific questions related to the JPRs *Examples:* multiple choice, sequencing, true/false, fill-in-the-blank	Responses are scored in relation to the answer that has been determined to be correct.	Cognitive
A manipulative skill in real time *Action verb examples*: climb, build, perform, raise, haul, don	A skills test to evaluate a candidate's ability to perform physical tasks in real time *Examples:* donning SCBA, raising ladders, tying rescue knots	The directly observed performance with the correct performance outcome of the skill is normally indicated as part of the yes/no or pass/fail scoring checklist.	Psychomotor (skills)
A cognitive skill that cannot be directly observed; the application of knowledge to yield a product *Action verb examples:* develop, create, write	A work product created by the candidate usually outside of the classroom setting *Examples*: creating a budget, report, proposal, lesson plan, incident action plan	Scoring rubric for expected responses evaluating how a candidate completes the task outcome after submission. Used to differentiate consistently between different degrees of candidate performance.	Product
A mental activity to perform a cognitive skill in real time that cannot be directly observed *Action verb examples:* inspect, investigate	Candidate performs the activity in the presence of the evaluator; the verbalization of mental thought "First, I…, then I…," etc. *Examples:* performing an inspection, conducting an investigation	Scoring rubric with questions and expected verbal responses. Used to differentiate consistently between different degrees of candidate performance.	Process
Documentation of the candidate's experience, training, and education against all JPRs *Action verb examples*: attend, participate, testify	A list of acceptable documents or items for each and every JPR *Examples:* coursework at training or college, participation in a certain number of investigations, testifying at court	This portfolio is evaluated using criteria that have been identified by the agency.	Portfolio

Δ **B.3.2.1 Example: Converting a Firefighter I JPR into an Instructional Objective.** The instructional objectives are just two of several instructional objectives that would be written to support the terminal objective based on the JPR.

JPR: Perform overhaul at a fire scene, given PPE, attack line, hand tools, flashlight, and an assignment, so that structural integrity is not compromised, all hidden fires are discovered, fire cause evidence is preserved, and the fire is extinguished.

Instructional Objective (Cognitive): The Firefighter I will identify and describe five safety considerations associated with structural integrity compromise during overhaul as part of a written examination.

Instructional Objective (Psychomotor): The Firefighter I will demonstrate the designed use of tools and equipment during overhaul to locate and extinguish hidden fires without compromising structural integrity.

B.3.2.2 Example: Converting a Fire and Life Safety Educator II JPR into an Instructional Objective. This instructional objective is just one of several instructional objectives that could be written to support the terminal objective based on the JPR.

JPR: Prepare a written budget proposal for a specific program or activity, given budgetary guidelines, program needs, and delivery expense projections, so that all guidelines are followed and the budget identifies all program needs.

Instructional Objective (Cognitive): The Fire and Life Safety Educator II will list and describe the bidding process for the purchase of a published program using budgetary guidelines, program needs, and the guidelines established by local organizational procedures as part of a written examination.

Instructional Objective (Psychomotor): The Fire and Life Safety Educator II will lead in the purchase of a specific fire and life safety educational program by following the bidding process to completion, using local organizational guidelines, including budgetary procedures, program needs, and delivery expense projections.

Δ **B.4 Other Uses for JPRs.** While the professional qualifications standards are used to establish minimum JPRs for qualification, they have been recognized as guides for the development of training and certification programs, as well as a number of other potential uses.

These areas might include the following:

(1) *Employee Evaluation/Performance Critiquing.* The professional qualifications standards can be used as a guide by both the supervisor and the employee during an evaluation. The JPRs for a specific job define tasks that are essential to perform on the job as well as the evaluation criteria to measure completion of the tasks.

(2) *Establishing Hiring Criteria.* The professional qualifications standards can be helpful in a number of ways to further the establishment of hiring criteria. The authority having jurisdiction (AHJ) could simply require certification at a specific level — for example, Firefighter I. The JPRs could also be used as the basis for pre-employment screening to establish essential minimal tasks and the related evaluation criteria. An added benefit is that individuals interested in employment can work toward the minimal hiring criteria at local colleges.

(3) *Employee Development.* The professional qualifications standards can be practical for both the employee and the employer in developing a plan for the employee's growth within the organization. The JPRs and the associated requisite knowledge and skills can be used as a guide to determine the additional training and education required for the employee to master the job or profession.

(4) *Succession Planning.* Succession planning addresses the efficient placement of individuals into jobs in response to current needs and anticipated future needs. A career development path can be established for targeted employees to prepare them for growth within the organization. The JPRs and requisite knowledge and skills could then be used to develop an educational path to aid in the employee's advancement within the organization or profession.

(5) *Establishing Organizational Policies, Procedures, and Goals.* The professional qualifications standards can be functional for incorporating policies, procedures, and goals into the organization or agency.

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